Fracking Our Farmland, Our Families and Our Future: A New Toxic Legacy

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***"It shocks me that we pride ourselves on being a national leader on environmental protection, yet we have allowed this activity to occur largely unregulated. California regulates massage therapists more than hydraulic fracturing." Assemblymember Richard Bloom* (37)**

A large bus rolls by with a sign on the side that says in big bold letters "This bus is running on clean natural gas". We don't see a trail of smoke or detect an acrid smell from the tailpipe and we think to ourselves what a wonderful alternative to gasoline with its lung damaging sulfur oxides, nitrous oxides and particulate matter that waft into the air. No pollution necessary to turn those wheels. Right? Natural gas is important for a healthy clean environment. Right? Unfortunately scientists who have carefully reviewed this issue contend nothing could be farther from the truth. Yes **natural gas is largely methane and burns somewhat cleaner than oil but it is actually dirtier than coal and much worse for the environment** when you look at the entire life cycle of natural gas extraction with its air pollution, water contamination, hazardous waste disposal, seismic activity, total emissions and potent global warming gases released. (90) (91)(92)(93)(178) Rapid removal and use of natural gas and oil will contribute to a more rapid shift in the earth's climate and limit our ability to prevent catastrophic global warming. (87) An analysis of 36 climate change indicators was recently detailed in a 240 page report by California's Environmental Protection Agency. (298) It shows that "The science is clear that we are already seeing significant changes in every part of the state."
(87)(93)(99)(128)(130)(133)(134)(165)(178)(204)(205)(206)(213) See below.

Oil and natural gas are extracted by similar methods and both have serious environmental and public health consequences. Modern fracking just carries more risk and more rapidly damages the environment.

Hydraulic fracking is a method to increase oil and gas extraction by drilling into the earth then injecting fracking chemicals and water under high pressure to break apart rock formations and release trapped gas and oil, forcing them to the surface. After the fractures are created a "propping" agent such as sand is pumped into the fractured rock to keep the fracture open and keep the gas and oil flowing out. Fracking has been used for decades however advancements in technology in the last 10 years now allow deeper drilling especially in deep "unconventional" oil deposits such as shale and tar sands where the gas and oil is found in small pockets within the geologic formation.

Oil and gas companies now use horizontal drilling with **wells more than 7 empire state buildings deep. (3)** Horizontal drilling also uses explosives to open the pipes and create fissures in the rock to allow gas to flow easily. (259)(260)(261) Much of the gas and oil is extracted by perforated pipes. The pipes

however are not leak proof. Rock layers have been shown to be permeable and the fractured rocks can interlink in unexpected ways connecting gas deposits to aquifers. Fracked methane seeps into the water and leaks into the atmosphere. (3)

Extending Peak Oil

These newer extraction methods along with a relaxation of federal environmental laws have enabled access to vast quantities of previously unrecoverable deep shale natural gas under farms as well as remote and fragile areas where our drinking water and wildlife are at risk. (3) Oil and gas leases in many states are getting closer to populated areas. Natural gas drilling has mushroomed across the United States in the last decade. In 2007, there were 449,000 gas wells in 32 states, thirty percent more than in 2000. (221) According to the American Petroleum Industry the number of estimated shale wells drilled in 2011 is 43.8 percent more than 2010. (135)(238)

California has over 50,000 oil and gas wells many of which are “conventional” superficially drilled wells. Increasingly deeper hydraulic “unconventional” fracking methods were used in 25%-50% of the drilling operations in the last decade in California. Although exact numbers are not known it is estimated that there were over 750 wells in California using hydrauic fracking in 2009, most in Southern California. (106) (136)(137) (138) It is estimated that there are 15 billion barrels of oil and gas under the Monterey Shale that potentially could be extracted. California Counties that have documented hydraulic fracking for oil and gas are home to more than 100 rare and endangered species that are now threatened by this practice. (6) Oil and gas companies are preparing to frack California even more.

Deep horizontal fracking has more than one serious downside. It uses massive amounts of clean water which becomes permanently contaminated with toxic chemicals and is then disposed of as wastewater. These chemicals permeate and contaminate groundwater and local streams leaving lifeless polluted waterways. Toxic air contaminants are released during fracking that have caused grave illness in nearby residents. (10)(20)(233) Radioactive elements from the earth’s deep core are brought to the surface and become part of the air, soil and water contamination. Plugs in old wells may burst allowing for even more massive contamination of private wells and aquifers similar to what has happened in Montana. (3)

Fracking has been shown to induce earthquakes in a variety of states. (12) (13)(14)(15)(16) (52)(53)(54)(55)(115)(166)(167)

To make matters worse as the U.S. focuses our attention on high pressure horizontal fracking an older unregulated but no less toxic method of oil and gas extraction is being used called “acid” extraction. “Acid jobs” are an old well completion method that involves pumping chemicals such as hydrofluoric acid into wells to melt rocks to allow more of the oil to flow. Companies are not required to report when they do it. (173)

Oil and gas extraction are exempted from provisions of seven major federal environmental protections: The Clean Air Act, The Clean Water Act, The Safe Drinking Water Act, The Superfund Law (regulation of hazardous spills), The Resource Conservation and Recovery Act (regulation of hazardous waste), The National Environmental Policy Act and The Toxic Release Inventory. (100)(101)(102)(125)(239)

With little federal oversight of the oil and gas industry scientists and public health experts feel regulations and enforcement in California and the rest of the nation are insufficient to handle the expected increase in oil and gas extraction and protect the environment, the public or our global climate.

"We're just seeing the tip of the iceberg of what's coming," he said of the drilling for Monterey Shale oil here. "It could enrich the state beyond belief, but it could also destroy it." Rex Parris, Attorney and mayor of Lancaster, California (58)

Frack to Tap

The tragic aftermath of fracking is visible in Montana, Texas, Wyoming, Utah, Colorado and North Dakota but especially in Pennsylvania where Dimock residents don't have to worry about a steady supply of natural gas in their homes because it comes right out of their faucets. In fact residents have fully documented the unique ability to light their kitchen tap water on fire. Other states have documented the same. (1)(2)(147)(156)(157).

Boom and Bust

Some predict we will have a gas and oil boom here in California like the 1949 gold rush especially in the Monterey Shale territory where "unconventional" deeper drilling is necessary for extraction. What will happen to our Golden State if this continues? Will it be transformed overnight like North Dakota into a polluted industrial wasteland where NASA can see the wasted flared natural gas from outer space (301(302) or as in Dimock Pennsylvania where they have to truck in drinking water to farms? Quick cash but with larger long term problems that threaten not only our economy but our health and way of life.

California Dreaming

In California we have three unique features that make the possibility of increased deep fracking much more frightening.

Food: We have produced the majority of the country's fruits and vegetables for over 50 years due to California's year round temperate climate and rich soil. We are the number one dairy state.(140) (141) (276)

Water: We have an increasing scarcity of water with nature and farms already competing. Government agencies agree we have a water crisis in California. **(169)**

Earthquakes: the Monterey Shale is very close to the San Andreas fault. (169)

Do we really need a flash of oil and gas development to stimulate the economy or will oil and gas undermine our sustainability goals? California has the opportunity to build on our already strong economy with clean sustainable energy sources including solar, wind and energy conservation.

Frackings Downsides

- Air pollution
- Water contamination- aquifers, wells, rivers, drinking water
- Radioactive contamination
- Wastewater disposal, treatment
- Water scarcity
- Loss of agricultural land
- Loss of wildlife
- Deforestation
- Earthquake induction
- Fugitive methane
- Global Climate game changer
- Undermines renewable energy policy
- Public health studies inadequate
- Regulation inadequate

Health Professionals Call for Regulations/Moratorium on Fracking

Most of the discussion regarding hydraulic racking especially high volume horizontal fracking focuses on energy production and environmental regulation however hydraulic fracturing poses numerous significant threats to public health as discussed in more detail below. Toxins released cause water and air pollution with both acute and chronic health effects. **Experts agree that these risks have been inadequately studied prior to hydraulic fracking**. Health professionals are joining forces with scientists and law scholars to call for moratoriums on further hydraulic fracking until comprehensive independent

public health and safety testing is done and adequate regulations are in effect to protect individuals and communities.

The National Association of County and City Health Officials (NACCHO) recommends action to address the environmental and health impacts of hydraulic fracturing and supports numerous recommendations to improve regulations, transparency and accountability including 1**)"Federal, state, local, and tribal governments conducting Health Impact Assessments (HIAs) and health equity assessments prior to new hydraulic fracturing development projects** 2) Public health professionals from federal, state, and local governments being increasingly involved in policymaking, managing, and monitoring the natural gas industry. 3) Federal and state governments closing "loopholes" that exempt natural gas activities in environmental regulations (211)

U.S. Government Accountability Office September 2012. "Oil and gas development, whether conventional or shale oil and gas, pose inherent environmental and public health risks, but the extent of these risks associated with shale oil and gas development is unknown, in part, because the studies GAO reviewed do not generally take into account the potential long-term, cumulative effects." (215)

CDC. In January 2012, Christopher Portier, Director of the National Center for Environmental Health and Agency for Toxic Substances and Disease Registry at the U.S. Centers for Disease Control and Prevention in Atlanta, stated that "more research is needed for us to understand public health impacts from natural gas drilling and new gas drilling technologies." (202)

The Medical Society of the State of New York in 2010 passed a resolution to call for a moratorium on fracking which was renewed in 2013. **"The Medical Society of the State of New York supports a moratorium on natural gas extraction using high volume hydraulic fracturing in New York State until valid information is available to evaluate the process for its potential effects on human health and the environment"** (Council Action, December 9, 2010)."(185)

"Principles of public health emphasize the need for transparency in research and policy, a precautionary approach in the face of uncertainty, baseline and continued monitoring, and adapting management as understanding of risks increases." Katrina Korfmacher (213)

Physicians for Social Responsibility in March 2012 after review of the numerous risks of fracking including noise, diesel fumes, toxic pollution, fugitive methane and earthquake induction led them to adopt the following position on fracking.

“PSR supports a precautionary approach that includes a moratorium on the use of hydraulic fracturing until such time as impartial federal agencies such as the U.S. Environmental Protection Agency develop and implement enforceable rules that provide adequate protection for human health and the environment from fossil fuel extraction processes that use hydraulic fracturing. “ (175)

New York State Department of Health Commissioner Nirav Shah states in a letter to Governor Cuomo February 2013 **“ The time to ensure the impacts on public health are considered is before the state permits drilling.”** This quote was included in a separate letter signed by over 250 health and environmental professionals, health organizations and over one hundred and fifty elected officials to the New York Governor. The letter asked for a moratorium on fracking until completion of ongoing health studies, comprehensive independent Health Impact Assessment (HIA) that is site specific is completed and that there is transparent participation of health professionals and the public. (201)

Cornell Report, a review of 24 case studies describing human and animal effects of adjacent fracking processes. Livestock and house pets suffered a variety of adverse health effects including dermatologic, respiratory, neurological, urinary, digestive, reproductive and in some cases sudden death. There were similarities in human effects on the same properties studied. Dr. Michelle Bamberger, veterinarian and a member of the Ulysses Gas Drilling Advisory Board and Robert Oswald, Professor of Molecular Medicine at Cornell University wrote “Animals, especially livestock, are sensitive to the contaminants released into the environment by drilling and by its cumulative impacts. Documentation of cases in six states strongly implicates exposure to gas drilling operations causing serious health effects on humans, companion animals, livestock, horses, and wildlife.” (10)(216)

The researchers recommend

· Full disclosure of chemicals used when hydrofracking

· Prohibiting non-disclosure agreements when public health is at stake

· Increasing food safety testing and research, as the study documented that animals exposed to chemicals were not tested prior to slaughter, and little is known about the effects of hydrofracking on meat and dairy products;

· Improving the monitoring of routes of exposure, including in water, soil and air;

· Fully testing the air, water soil and animals prior to drilling and at regular intervals after drilling is completed

"**Without knowledge of all the chemicals being used, you can't test before drilling," said Bamberger. "And if we don't have pre-drilling tests then if you find a chemical post-drilling, how can you prove that" it came from hydrofracking?"(289) They further state,**

"Without complete studies, given the many apparent adverse impacts on human and animal health, a ban on shale gas drilling is essential for the protection of public health." (216)

Ecologist View. Acclaimed ecologist, distinguished scholar and author, **Sandra Steingraber, PhD** who is often cited as a modern Rachel Carson stated more directly in a press conference "New Yorkers now know a lot about fracking. The more we find out, the deeper our objections. And that's because, when you look under fracking's hood, you see terrifying problems. Behind the hard sell and soothing promises, this contraption is unsafe at any speed." (217) She later wrote **"Fracking is linked to every part of the environmental crisis—from radiation exposure to habitat loss—and contravenes every principle of environmental thinking. It's the tornado on the horizon that is poised to wreck ongoing efforts to create green economies, local agriculture, investments in renewable energy, and the ability to ride your bike along country roads."(218)**

"We've got to push the pause button, and maybe we've got to push the stop button" on fracking, said Adam Law, an endocrinologist at Weill Cornell Medical College in New York, in an interview at a conference in Arlington, Virginia. (191)

Legal Review of Regulation of Hydraulic Fracturing in California. An extensive legal review was performed in April 2013 by Michael Kiparsky Associate Director of the Wheeler Institute for Water Law and Policy at Berkeley Law and Jayni Foley Hein the Executive Director of the Center for Law, Energy & the Environment at Berkeley Law.

One of their many recommendations states, **"The legislature and DOGGR(California Department of Oil, Gas and Geothermal Resources) should not shy away from finding that there is not enough scientific knowledge or institutional capacity to effectively manage a sharp increase in the expansion of hydraulic fracturing in California. If it makes this determination, it may choose to slow its growth until more knowledge and capacity can be developed." (212)**

Toxic Trade Secrets

. ***"Of particular concern to me is that we learned that over the four-year period studied, fracking fluids used in Colorado contained some of the highest volumes of carcinogens in the country, and some of the most toxic." U.S. Rep Diana DeGette, House Energy and Commerce Committee (47)***

According to a report by the Energy and Commerce Commission Oil and Gas companies use about 750 different chemicals in more than 2,500 hydraulic fracturing products. Chemical additives used in fracturing fluids typically make up less than 2 percent by weight of the total fluid. This seems small however it may amount to 100,000 gallons of chemical additives over the life of each well. (7)(8) (11) (47) Many of these chemicals are solvents and can have short and long term health effects through inhalation and dermal exposure. " High concentrations of most solvents can cause narcosis (dizziness, nausea, fatigue, loss of coordination, coma and the like). This can increase the chances for mistakes and accidents." McCann (126) Solvents can cause chronic neurotoxicity with cognitive dysfunction including attention, verbal memory, and visuospatial skills. (310)

Manufacturers are not required to disclose the ingredients of their processes as they consider this "proprietary" protected information. (179) Prior to independent tests by environmental organizations chemicals in fracking were not known. (22) These additives include a toxic slurry of proppants, biocides, solvents, surfactants, viscosity modifiers, stabilizers and emulsifiers.

A favorite solvent mix is BTEX, a combination of benzene, toluene, ethylbenzene and xylene, all of which are listed as hazardous air pollutants **(HAP)** in the Clean Air Act and contaminants in the Safe Drinking Water Act. Toluene, ethylbenzene, and xylenes have harmful effects on the central nervous system. Benzene is a colorless liquid with a sweet odor that evaporates quickly. Short term effects include dizziness, weakness, headache, breathlessness, chest constriction, nausea, and vomiting. Long term benzene is a known carcinogen. It is well established that benzene can cause aplastic anemia and leukemia. (126)(241)(242)(310)

Renowned scientist Theo Colborn in a 2012 study identified 944 products used in the fracking process in the US, of which only 14% provided 95% to 100% of the ingredients, while 43% provided less than 1% of the ingredients. "The researchers generated profiles of possible health effects from the chemicals identified in the natural gas process. Of these identified chemicals, over 90% were found to affect the skin, eyes, and sensory organs; approximately 50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; and 25% could cause cancer and mutations."(279)

A few of the 100's of chemicals include:

***Methanol-** (HAP) Very common ingredient in fracking products. Corrosion inhibitor and surfactant. Efficient solvent causing nervous system dysfunction, headaches, dizziness, sleep disorders, visual damage, nausea, metabolic acidosis. Prompt treatment needed. (126)(245)

*__Naphthalene__-(HAP). Commonly used. Surfactant carrier. Respiratory tract irritation, nausea, vomiting, abdominal pain, fever or death. (246)

* **Sulfuric Acid**- Respiratory irritation

* **Formaldehyde**- (HAP)- respiratory irritation, sneezing, coughing, asthma, fatigue, skin rash, severe allergic reactions, nasopharyngeal cancer. (247)

*__Hydrogen Fluoride__-(HAP) Powerful toxin. Easily absorbed through skin. Rash, respiratory irritant, electrolyte dysfunction, visual loss, chronic lung disease, death from irregular heartbeat or rapid pulmonary edema. A lethal dose is 1.5 grams. (241)(243)

*__Ethylene Glycol__- Commonly used. Stabilizer. Odorless liquid with a sweet taste. Also used as antifreeze. Ingestion causes CNS depression, dizziness, cerebral edema, nausea, vomiting, abdominal cramps, metabolic acidosis, acute renal failure, cardiac failure. Treatment delay harmful and sometimes lethal. (126)(244)(245)

* **Gluteraldehyde**- Biocide. Commonly used. Headaches, nausea, respiratory irritation, difficulty breathing, asthma, rash, contact dermatitis, allergic dermatitis, skin sensitizer.

*__Crystalline silica dust__- Commonly used to keep frack rock open. Progressive pulmonary failure, lung cancer (203)

Shaleshocked

More than 1,000 cases of chemical contamination from fracking have been documented by courts and state and local governments in Colorado, New Mexico, Alabama, Ohio and Pennsylvania. These included cases where the toxic exposure was caused by well failures in which the concrete or steel meant to protect aquifers cracked under high pressure. In others frack wastewater was dumped in unlined pits and chemicals seeped into the water table. (221)

It is almost impossible to determine the exact cause of each contamination, or examine regional affects on humans, water or the environment however because much of the chemical composition of fracking fluids are considered proprietary. Not even the EPA knows what is in the drilling fluids. Wyoming was the first state in 2010 to require disclosure however because of the trade secrets law about 30% of the chemicals in fracking fluid are still not reported according to the Environmental Defense Fund. (47) (48) In addition fracking operators also can alter what is in the fluid they are using at any time during the fracking process. Thus the exact composition of the chemicals in the fluid may change moment to moment.

There is no requirement to monitor baseline levels of toxins in deep or superficial water bodies prior to or after fracking. This makes it virtually impossible to track the effects of fracking or conclude with any level of veracity that fracking is safe.

A Few Fracking Chemicals At a Glance (7)(8)(32)(49)(78)(280)

Arsenic

barium,

benzene

bromides

n-butanol

2-butoxyethanol (2BE

chlorides

ethylene glycol

ethylbenzene,

formaldehyde (Hazardous air pollutant)

Glutaraldehyde

Methylene Chloride-

Naphthalene

Nitrilotriacetamide

Polyethylene Glycol

Radon (Toxic air pollutant)-Lung cancer

Silica-sand (Toxic air pollutant)- Lung cancer

Strontium

Sulfuric Acid

toluene

triethylene glycol

xylene

Radioactive

Radium, a potent carcinogen, is one of the naturally occurring radioactive materials (NORM) pushed up from deep in the earth from fracking and which are commonly found in gas drilling wastewater. Radium takes 1,600 years to decay and gives off radon gas. Scientific America reported on November 9, 2009 that "the New York Department of Environmental Conservation analyzed 13 samples of fracking wastewater and found that they contained levels of radium-226, a derivative of uranium, as high as 267 times the limit safe for discharge into the environment and thousands of times the limit safe for people to drink." (283)

The New York Times ran a series of investigative articles on radioactivity in wastewater. They looked at never-reported studies by the EPA and a confidential study by the drilling industry that all concluded that radioactivity in drilling waste cannot be fully diluted in rivers and other waterways. (28)

Among The Times's findings:

" ¶More than 1.3 billion gallons of wastewater was produced by Pennsylvania wells over the past three years, far more than has been previously disclosed. Most of this water — enough to cover Manhattan in three inches — was sent to treatment plants not equipped to remove many of the toxic materials in drilling waste.

¶At least 12 sewage treatment plants in three states accepted gas industry wastewater and discharged waste that was only partly treated into rivers, lakes and streams.

¶Of more than 179 wells producing wastewater with high levels of radiation, at least 116 reported levels of radium or other radioactive materials 100 times as high as the levels set by federal drinking-water standards. At least 15 wells produced wastewater carrying more than 1,000 times the amount of radioactive elements considered acceptable.

The Times reviewed data from more than 65 intake plants downstream from some of the busiest drilling regions in the state. Not one has tested for radioactivity since 2008 and most have not tested since at least 2005, before most of the drilling waste was being produced. And in 2009 and 2010, public sewage treatment plants directly upstream from some of these drinking-water intake facilities accepted wastewater that contained radioactivity levels as high as 2,122 times the drinking-water standard. But most sewage plants are not required to monitor for radioactive elements in the water they discharge. So there is virtually no data on such contaminants as water leaves these plants." (155)

The National Academy of Science released a 700-page report in 2005 regarding the health risks from exposure to low levels of ionizing radiation. The report reconfirmed the previous knowledge that there is no safe level of exposure to radiation and that even very low doses can cause cancer. The risks from low dose radiation are cumulative and linear. The largest study of nuclear workers to date (2005),

conducted by the International Agency for Research on Cancer (IARC), set the allowable occupational radiation dose of 50 mSv per year (284)

Industry Response to Trade Secret Disclosure

The oil and gas industry have vigorously opposed disclosure of their “proprietary” chemicals which they feel need to be protected under federal trade secret laws. They maintain that the drilling fluids are made up of mostly non-toxic, even edible substances. Any disclosure of chemicals to the public would only scare and confuse people and this would lead to a competitive disadvantage for that company. “It is like coke protecting its syrup formula for many of these service companies,” said Scott Rotruck, vice president of corporate development at Chesapeake Energy, the nation’s largest gas driller, which has been asked by New York State regulators to disclose the chemicals it uses.” (221)

This may not be such a good example however as Coke is required to label all of their ingredients although not the exact recipe. In addition due to independent testing Coke was recently found to contain a carcinogen 4-methylimidazole, or 4-MI, a byproduct formed during the production of caramel color used in Coca Cola and Pepsi. They have been forced to change their production methods to reduce the levels of this toxic chemical in order to comply with California's Proposition 65 law. Otherwise they would have to label their drinks with a label stating it contains a known carcinogen. (251)(252)(253)

"A trade secret, as defined under U.S. law 18 U.S.C.-1839(3) (A) (B) (1996) has three parts: (1) information; (2) reasonable measures taken to protect the information; and (3) which derives independent economic value from not being publicly known." Owners of trade secrets seek to protect trade secret information from competitors by instituting special procedures for handling it, as well as technological and legal security measures. The law of protection of confidential information allows a perpetual monopoly in secret information - it does not expire as would a patent. The lack of formal protection, however, means that a third party is not prevented from independently duplicating and using the secret information once it is discovered. Companies often try to discover one another's trade secrets through lawful methods of reverse engineering.” (14)

"In more than two decades of practicing occupational medicine, I'll tell you how often I was able to make the right diagnosis and plan the right treatment when I didn't know what the patients were exposed to — zero times,"Howard Frumkin, dean of the School of Public Health at the University of Washington. (168)

The Story of Cathy Behr, R.N.

Cathy Behr, an emergency room nurse, was working the day shift at Mercy Regional Medical Center in Durango Colorado in April 2008 when Clinton Marshall came in soaked in fracking fluid after a drilling accident. The oil field worker was complaining of nausea and headaches. Behr spent about 10 minutes with him removing his boots and helping him to the shower. The smell was overpowering. The hospital took no chances evacuating then locking down the ER. Shortly after that Cathy Behr lost her sense of smell and developed blurred vision. A week later she was admitted to the ICU with heart, liver and respiratory failure. Three doctors diagnosed her with chemical poisoning. They contacted the company to find out what chemicals were in the "ZetaFlow" mix she was exposed to. They refused to provide anything more than the Material Safety Data Sheet which lists only some of chemicals but does not give specifics on the "propriety chemicals" noted on the MSDS as these are trade secrets. Her symptoms matched that of the MSDS for ZetaFlow however the intensive care physicians with no specific information had to guess how to treat her. Several weeks later the chemical ingredients were divulged. She eventually recovered most of her function.

After that serious medical emergency Colorado's Oil and Gas Conservation Commission considered regulations that would require companies to reveal trade secret ingredients of materials they use under certain circumstances. The oil and gas industry objected and threatened to leave the state altogether if forced to reveal proprietary secrets. "It is much like asking Coca-Cola to disclose the formula of Coke," one Halliburton executive testified. (219)(220)

In 2011 however new regulations took effect in Colorado that require energy companies to disclose the concentrations of all chemicals in hydraulic fracturing and also make public some information about ingredients considered trade secrets.

If companies claim a trade secret, they would still have to disclose the ingredient's chemical family. (222)(223) Companies would have to tell health care workers what those secret ingredients were in case of emergencies like that of Cathy Behr. There is one glitch however. Doctors are required to sign a non disclosure agreement in order to receive the information as discussed below.

Colorado faces more challenges as there is talk of a statewide referendum to ban fracking in 2014. (224)

Dr. Amy Pare: Treating Fracking's Mystery Lesions

Plastic Surgeon Dr. Amy Pare from suburban Pittsburg began treating several unrelated patients with an unusual skin problem about 7 years ago. Patients presented with bleeding, oozing raised lesions located mostly on the face and hands.

"We just removed them because they looked like cancers," said Dr. Pare. "They looked like squamous cell carcinomas, they look like lymphomas, but they're not." Doctor Pare sent biopsies to several pathologists. She got the same results. "It's not a lymphoma," said Pare. "It's not a leukemia, it's not skin cancer. It's a local inflammatory response. An inflammation is your body's response to an irritant. That's

all we can say." Dr. Pare found that all these patients lived near the same gas drilling site. A visit to a house of one of the patients revealed an overwhelming chemical smell from the water. Dr. Pare using advice from curbside consultations but with no research on health effects of fracking chemicals tested the urine and found high levels of phenol and hippuric acid. (255)(256) Although no conclusions could be drawn from the lab tests, the patients symptoms improved when the drilling company began trucking water into a "water buffalo" the drilling company provided so those affected could stop drinking from the well. "Knowing what chemicals they had been exposed to would have sped up the process" of treating the patients, said Dr. Paré, who specializes in treating skin conditions.

Fracking Our Families: The List of the Harmed

Jenny Lisak has given an unofficial voice to those in the shadows who state they have suffered collateral damage from fracking. (233) The U.S. Energy Administration tracks useful statistics on gas and oil exploration, reserves, production, consumption as well as energy consumption and greenhouse gas production. (235) The EPA and the USGS have documented some of the contamination of air and water. Missing however is a list of people with adverse health affects of fracking who either have not had documentation or who have signed a "gag order" not to discuss their case in exchange for money or to relocate. (257) As there is no official source that tracks health impacts of fracking Jenny has been compiling a "List of the Harmed" since 2012 through Pennsylvania Alliance for Clean Water and Air (PACWA). Entries are formed only if there is documentation by a news story or video. (234) As of 7/26/2013 there were 1558 entries from around the U.S. including Pennsylvania, Texas, Colorado, West Virginia, listing the name, facility, route of exposure, symptoms and link to the source of information. She receives many more emails without documentation but she does not enter these.

The stories are sad and compelling. Here are a few

Number 1: Pam Judy and family in Carmichaels, Pennsylvania. 2011. Compressor station 780 feet away . Air exposure. ***Symptoms: Headaches, fatigue, dizziness, nausea, nosebleeds, blood test show exposure to benzene and other chemicals.*** According to a letter Pam Judy wrote to Carmichaels City Council the Pennsylvania Department of Environmental Protection (PA DEP) performed air tests on her property. "The results of the 24 hour canister sampling revealed 16 chemicals including benzene, styrene, toluene, xylene, hexane, heptane, acetone, acrolein, propene, carbon tetrachloride and chloromethane to name a few." A later PA DEP report stated that the department could find no emission levels that would constitute a concern to the health of residents living near Marcellus operations and that the ***sampling results were used to characterize the acute non-cancer health risks associated with industry emissions.*** The report further states that ***they did not address the cumulative or long-term impact of air emissions or the lifetime cancer risks because this was a short-term study." Video of her testimony at http://www.marcellus-shale.us/Pam-Judy.htm***

Number 10: Mary Mc Connell in Bedford County, Pennsylvania. Columbia Gas Storage field three miles from the Steckman Ridge project. ***Symptoms: Headaches, breathing difficulty and sore muscles.*** According to the October 10, 2010 article in the Altoona Mirror "McConnell has been suffering headaches and having trouble breathing as well as sore muscles and other health issues. ***She's gone to the emergency room several times and has gotten blood tests that show levels of methane in her blood. There's nothing she can do, though, so she wears a gas mask around her house."*** McConnell said of the reasons behind buying the property with her late husband. "My plan is to die here, but not under these conditions."

Number 91. Ned Prather in Logan Mountain, Colorado. Source: Eighteen gas wells are located within 3,000 feet of his property with contamination of local drinking water source with benzene, toluene, ethylbenzine and xylene. ***Symptoms: Tremors, burning throat, stomach ache.*** According to the Denver Post article "***16 months after his nasty drink, no source has been pinned down for the contamination. The spring water still reeks with an odor somewhere between diesel fuel and permanent- wave solution.*** "I've always stuck up for oil and gas, but now when we need them to stand up and do what's right, they won't," Prather said. "If I was asked what has made me the maddest in all this, it's the oil and gas commission not doing what they are supposed to do."

Number 102. Brian Beadle in Hill County, Texas. 2008. Williams Production-Gulf Coast Co.gas wells . Contamination of local wells with sulfates and toluene . ***Symptoms (animal): Goats – Goats became swollen, three goats and two kids dead, llama dead.*** According to the Fort Worth Weekly "All their wells, which had produced clean, healthy water for years, were drilled into the Trinity Woodbine aquifer, which underlies much of North Texas. The neighbors shared another characteristic: All their properties were within a couple of hundred yards of two gas wells recently drilled by Williams Production-Gulf Coast Co. — one producing, the other abandoned and plugged after a drill bit was lost during the "fracking" process…***in the four months since the first tests were done on water from his well, levels of the deadly chemical haven't dropped — meaning, hydrologists say, that the solvent, which never occurs naturally in fresh water, is continuing to enter the aquifer.***

Number 690. Miriam, Fred and Julie Solloway in Otsego County. New York. Ross1 natural gas well facility. Exposure: Air and water contamination. Issues: Sulfur and chemical odor in air and water, noise . Many neighbors affected similarly. ***Symptoms: Blurry vision, severe stomach cramps, headaches, burning nose and throat, rashes, inability to sleep, aches, pains, hair loss, cannot drink the water anymore. Symptoms (animal): Horses refused to drink the water; horses and dogs sick, two horses were so sick they had to be euthanized.***

In a letter from the Solloway family written to the Otsego County Board of Representatives July 21, 2010" Within a month of the drilling starting, I was violently ill after drinking our water. Some of the symptoms were blurry vision, severe stomach cramps and collapsing. This is a water well that we had never had a problem with, or been sick from, since it was drilled…. The air pollution, including the stink, was so bad at times it burned noses and throats. The horses didn't want to go out of the barn….Symptoms were also experienced after repairing, for an hour, the fence that is only about 15 feet

from Potato Creek. The horses didn't want to, and many times refused to, drink the water from Potato Creek, even when it was brought to them in a bucket.

We don't call our WATER gold anymore. We call it POISON. The State Health Department has given us, and others affected, ridiculous excuses of causes of health symptoms such as: it must be your shampoo, it must be the sink traps, it must be dust."

Doctors Gaged by Industry:

Trade Secret Disclosure laws have loopholes

The slate of new chemical disclosure laws enacted in 14 of 29 states in the last 2 years are designed to help doctors treat patients exposed to fracking chemicals but unfortunately the disclosure agreements have a variety of serious loopholes that do not protect communities, public health or physicians. The chemical disclosures may come after the well has been fracked when exposure and harm cannot be contained or corrected. In addition states still typically allow trade secret protection. In some they allow for emergency disclosure of chemicals however it requires doctors to sign a legal non-disclosure agreement with the oil service company. In some states the reporting is just voluntary and on the FracFocus website which has significant deficiencies. See Harvard Report.(231)(254). **Also these disclosure laws only address emergency care not the long term cumulative impacts of chronic exposure to fracking toxins in the air or water.**

This is exemplified by the Wyoming Oil and Gas Conservation Commission which has the authority to grant exemptions from reporting Trade Secret ingredients and they have granted some some 50 secrecy requests, shielding information on over 190 different chemicals, by Halliburton and other oil and gas service companies. (230)

Fine Print on Disclosure Laws AKA "Doctor Gag Laws"

Texas was the first to pass formal disclosure legislation followed by Pennsylvania, Ohio, Colorado, however none of these laws are adequate to protect health professionals against lawsuits from the oil and gas industry or their patients let alone public health.

The legal fine print tells it all. (227) In Ohio, Pennsylvania, North Carolina and Colorado doctors can get access to information about trade secret chemicals in an emergency situation but they have to sign or verbally agree to confidential disclosure agreements first. These agreements state plainly that the physician or "recipient" of the chemical information hold confidential all "Trade Secret" or "Proprietary Information" about the identity of chemicals they were given. They can use this information for medical diagnosis or treatment only. Doctors are allowed to disclose information about the Trade Secret chemicals given to them by industry only if they are required to do so under court order or by a government agency. (227)

These laws do not protect the physician from being sued if he discloses this information to patients, other physicians or other public health agencies as they have not signed similar disclosure agreements and thus they could expose information about the chemicals to the public at large. In some areas where multiple families in a region have developed similar symptoms reportedly from fracking chemicals information cannot be obtained to help identify the source of the illness or notify others nearby thus preventing additional harm. It was found that the industry funded American Legislative Exchange Council was involved in passing a variety of fracking chemical disclosure laws. (177)(182)(185-190)(222)(225-232) As noted above they do not provide adequate protections.

Challenging Trade Secret Laws for Fracking

In a recent Wyoming case challenging trade secret laws for fracking fluids attorney Laura Beaton stated the court applied the Public Records Act's exemptions too broadly in its ruling allowing the drilling company to keep its chemicals secret. She noted the law does allow for trade secrets to be kept from the public, however, ***there is overriding public interest in having the information disclosed.*** (250) If the chemicals are known in advance, then testing can be done ahead of time to see if those chemicals are already present in the water. In addition disclosure may be needed in case of chemical poisoning. Industry states they are now using a chemical disclosure registry called FracFocus however it is only voluntary, reporting is spotty and sometimes incorrect and trade secrets are still not revealed. A Harvard Law School study recently highlighted these shortcomings. (231)(254). An NRDC review of fracking chemical disclosure laws came to similar conclusions. (236)

WATER

"Drinking water will be more valuable than oil or natural gas. Human beings survived for thousands and thousands of years without oil and without natural gas," he said. "We have never known humanity or life on this plant to survive without clean water." Vermont Governor Peter Shumlin regarding Vermont's passage of the first state fracking ban in the US. (142)

Horizontal high volume fracking presents several opportunities during production and waste disposal to permanently harm essential water supplies including aquifers, wells, streams and rivers. According to the National Groundwater Association "approximately 25% of the earth's total freshwater supply is stored as groundwater, while less than 1% is stored in surface water resources such as rivers, lakes, and near surface soil moisture… About 44% of the U.S. population relies on groundwater for their drinking water supply." (278) No state economy can thrive without a clean, reliable source of water. In California this is especially true.

Avenues to water contamination include:

* Methane leaks to aquifers with fracking

*Abandoned gas or oil wells improperly filled and sealed where contaminants could migrate to water supplies

*Surface spills or wastewater pond disposal

*Accidents during the transport, storage and use of fracking chemicals

*Accidents during the transport, storage and use of fracking wastewater

Pacific Institute Interview.

The Pacific Institute conducted extensive interviews with a diverse group of stakeholders, including representatives from state and federal agencies, academia, industry, environmental groups, and community-based organizations from across the United States. "Despite the diversity of viewpoints among those interviewed, there was surprising agreement about the range of concerns and issues associated with hydraulic fracturing. Interviewees identified a broad set of social, economic, and environmental concerns, foremost among which are impacts of hydraulic fracturing on the availability and quality of water resources.

In particular, key water-related concerns identified by the interviewees included (1) water withdrawals; (2) groundwater contamination associated with well drilling and production; (3) wastewater management; (4) truck traffic and its impacts on water quality; (5) surface spills and leaks; and (6) stormwater management." (277)

Protection of water is a central issue of fracking concerns. One major obstacle to protecting water is the loss of federal oversight in the Safe Drinking Water Act.

Environmental Deregulation:

The Safe Drinking Water Loophole and more…

Over the years the Oil and Gas Industry has pressed for gradual deregulation of many key environmental laws that protect public and environmental health. These include The Clean Air Act, The Clean Water Act, The Safe Drinking Water Act, The Superfund Act, The Resource Conservation and Recovery Act (regulation of hazardous waste), The National Environmental Policy Act and The Toxic Release Inventory. (100)(101)(102)(125)(239)(268)(269)(270) Some may argue that other statutes address the multiple issues of fracking but careful analysis demonstrates otherwise. Loopholes exist. Review of regulations regarding prevention of oil spills after the BP Horizon blow out in the Gulf of Mexico 3 years showed these were lacking. The year before the spill legislators failed to pass a measure revamping oversight of offshore drilling.

The latest chunk of regulation removed from the oil an gas industry was during the Bush-Cheney Administration in 2005 when the so-called Hallibuton Loophole in the Federal Energy Appropriations Bill was passed removing all meaningful oversight and regulation of gas and oil extraction from the Safe Drinking Water Act. (70). Just prior to that a 4 year EPA study which ended in 2004 found "little or no threat" regarding fracking on drinking water contamination thus the exemption passed. However the U.S. EPA official who oversaw the Bush administration's 2004 study of hydraulic fracturing says “its conclusions about safety have been exaggerated for years”. (267)

In 2010 the EPA was asked by congress to perform a second and more comprehensive research study on the potential impact of hydraulic fracturing on drinking water resources. This is expected to be ready by 2014. (265)

According to Fortune 500 in 2011 Halliburton was the largest multinational gas and oil service company in the world and works in 80 different countries. (261)(262)(263)(264) “Cheney was chief executive officer of Halliburton from 1995 through August 2000. The company's KBR subsidiary is the main government contractor working to restore Iraq's oil industry in an open-ended contract that was awarded without competitive bidding. Cheney still receives deferred compensation from Halliburton under an arrangement he made in 1998, and also retains stock options.” (265) Industry ties to government are strong.

Federal Regulations Needed

Many believe that one important step in fracking protections is to regulate the oil and gas industry at a higher federal level and not leave it to the states that have a patchwork of fragmented laws. (278) This would mean reversing the current exemptions in all the major federal environmental laws. Closing the loophole in the Safe Drinking Water Act would mandate basic reporting requirements for chemicals and wastewater being injected through underground sources of drinking water. (229) This is not likely to happen as Degette’s Frac Act which aims to do just that has languished for several years now. (47)(49) It is thus still up to the states to regulate and monitor the oil and gas extraction industry. (27)(49)

Recommendations by the National Groundwater Association are as follows

“NGWA believes that additional studies, research, and monitoring related to the potential for groundwater contamination from the installation, hydraulic fracturing, operation, and maintenance of oil and gas wells are needed, given the growing use of horizontal wells and hydraulic fracturing. “ and that

“All chemicals used in the oil or gas well hydraulic fracturing process should be disclosed to the appropriate governmental entity. This information is needed to ensure proper monitoring as well as to assess and respond to potential problems that may arise.

The US EPA’s study if adequately funded, implemented, and peer reviewed, will result in valuable data upon which to build. In the interim, the nation’s groundwater resource can best be protected by

ensuring that policies are in place and enforced at the appropriate level of government that promote proper well construction and maintenance, both water well and oil and gas; the filling and sealing of abandoned wells; water supply planning and minimization of freshwater use in oil and gas operations; careful chemical handling and waste disposal by the oil and gas industry; disclosure of chemicals used in oil and gas hydraulic fracturing; baseline testing of drinking water wells in proximity to future oil and gas operations; an integrated groundwater quality and level monitoring program tailored to these operations; as well as recognition of the timeframe of groundwater movement. (278)

Fracking Our Water: Faucets on Fire

Despite industry claims for decades that there has never been a documented case of contamination of underground drinking water there are many examples now. (147)(148)(149)(150)(151)(152)(158)(233)

Beyond the movie *Gasland*'s demonstration of Pennsylvania's flammable faucets there is growing peer reviewed research demonstrating the contamination of all water supplies due to fracking both from stray methane as well as frack chemical additives.

In a June 2013 study by the *Proceedings of the National Academy of Sciences*, a research team led by Robert Jackson of Duke University reported the following, "We analyzed 141 drinking water wells across the Appalachian Plateaus physiographic province of northeastern Pennsylvania, examining natural gas concentrations and isotopic signatures with proximity to shale gas wells. Methane was detected in 82% of drinking water samples, with average concentrations six times higher for homes <1 km from natural gas wells. (151)

Dr. Geoffrey Thyne, a hydrologist and former research professor at The Colorado School of Mines was asked to cease his study of the presence of toxic fracking fluids in the nearby West Divide Creek. He indeed found methane and small amounts of other toxins which he linked to the process of nearby fracking. (154)(155)

In Weatherford, Texas Steve Lipsky reported his family's drinking water had begun "'bubbling' like champagne" and that his well contained so much methane that the water pouring out of a garden hose could be ignited. The Parker County Fire Marshall thought it was a crank but when he asked for a demonstration he got more than he bargained for as the entire water well head caught fire. A gas monitor showed it was 15-16% methane, well into the explosive range. Water quality tests were then performed by the Railroad Commission finding levels of benzene, a known carcinogen, above the threshold limit for drinking water. The study linked the contamination from a horizontal fracked well nearby. After industry pressure studies were shut down. (156)(157)

Fracking relies heavily on water. For every barrel of oil obtained 9 barrels of water are used. (145)

Dealing with the Wastewater:

"We're burning the furniture to heat the house. In shifting away from coal and toward natural gas, we're trying for cleaner air, but we're producing massive amounts of toxic wastewater with salts and naturally occurring radioactive materials, and it's not clear we have a plan for properly handling this waste." John H. Quigley, former secretary of Pennsylvania's Department of Conservation and Natural Resources. (155)

As the number of fracking wells in the U.S. increases, so too does the volume of fracked wastewater that requires disposal. Up to 80% of the injected water from fracking returns to the surface where it is collected as wastewater. "Produced water" associated with shale extraction can contain high levels of harmful chemicals, metals, salts and naturally occurring radioactive materials(NORM) brought up from the earth with the water. Many of the chemicals found in holding ponds (evaporation pits) used to dispose of wastewater are considered hazardous waste by the Superfund Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) from which the oil and gas industry is exempt.

Current options for disposal of wastewater include storage tanks, recycling, water treatment then disposal in surface water but most commonly the waste is injected under pressure into underground wells as this takes the least amount of treatment and has less transportation costs. The later method does however induce earthquakes and threaten water supplies.

According to a recently published article Kent State University Professor Brian Lutz **"Wastewater produced by hydraulic fracturing ("fracking") for natural gas in the Marcellus Shale is already overwhelming disposal options and will continue to do so as gas development increases."** (164) There are currently no comprehensive national standards for the disposal of fracked wastewater.

Brine Wastewater: Expensive and Difficult to Treat

Wastewater contains large amounts of salts forced up from the rock with the frack water. This salty brine has high levels of total dissolved solids as well which cannot be adequately removed by traditional treatment facilities. Most wastewater treatment plants use a biological treatment process where freshwater microbes clean the water. High levels of salt and total dissolved solids (TDS) can interfere with the process. "If all of a sudden the water taken in is salty, it could kill the microbes, and pretty significant technology is involved in desalinization," said James Tierney, assistant commissioner for water resources at the New York State Department of Environmental Conservation. "That technology is used for turning saltwater into freshwater around the world, but it can be costly." (274)

Water Treatment Plants Struggle to Process Frack Water

Companies have for many years handled fracked water by sending it through sewage treatment plants. According to a New York Times article "Drillers trucked at least half of this waste to public sewage treatment plants in Pennsylvania in 2008 and 2009, according to state officials. Some of it has been sent to other states, including New York and West Virginia. Yet sewage treatment plant operators say they are far less capable of removing radioactive contaminants than most other toxic substances. Indeed, most of these facilities cannot remove enough of the radioactive material to meet federal drinking-water standards before discharging the wastewater into rivers, sometimes just miles upstream from drinking-water intake plants." (155)

A 2013 study in *Environment Science and Technology* suggests that treatment plants can't handle this water's high level of contaminants. Water flowing out of the treatment plants into the environment contain elevated levels of fracking chemicals in much higher amounts. Water was analyzed from a plant before and after fracking fluids were accepted. High levels of barium, strontium, bromides, chlorides and benzene, among other toxic chemicals were found in treated water from the plant after accepting frack water. (18) The levels far exceeded EPA drinking water standards. **On May 19, 2011 the Pennsylvania Department of Environmental Protection (PADEP) requested drilling companies to stop disposing their wastewater through wastewater treatment plants in that state.** (18)

Baltimore City Bans All Fracking Wastewater

In March 2013 the Baltimore City Council passed legislation to ban the treatment, disposal, discharge and storage of fracking wastewater in Baltimore City. "We know that the wastewater resulting from fracking can have serious environmental and health consequences," said Councilman Kraft. "This legislation will ensure that there will not be any disposal, storage, or treatment of this wastewater in Baltimore City." (27)

Hazardous Waste Dumps Refuse Frackwater Due to Radioactivity

What about putting frackwaste in a landfill? At the South Huntington Hazardous Waste Landfill in Pennsylvania this year a truck carrying fracking wastewater from the Marcellus Shale was refused. The truck triggered a radiation alarm as it entered the facility. The radiation was from radium 226 one of many naturally occurring radionuclides known to contaminate water in fracking operations. (25)

In Ohio they are proposing to move the frack wastewater on barges which has stirred a controversy there. If there is a spill many are concerned this will contaminate local rivers many depend upon for drinking water and where there is inadequate treatment prior to becoming tap water. (26)

Downstream Effects of Wastewater

Leaked documents from an EPA official regarding toxic waste from fracking led to an investigation and review by the New York Times. These documents revealed a 1990 study from the American Petroleum Industry that demonstrated a potential increase in cancer risk among people who often ingest fish from waters where drilling waste is discharged into rivers even larger than Pennsylvania rivers where there was concern prior. (50)

A University of Pittsburg study of radioactivity downstream from private water treatment plants that discharge directly into rivers found high levels of radioactivity. Samples collected a few months later by the Department of Environmental Protection at PA Brine's Josephine plant in Indiana County found levels of radium 226 in the discharge pipe that were 44 times the drinking water standard. Studies also found higher than normal concentrations of radium in the stream bed and stream banks of the Allegheny River and downstream of discharge points. (51)

AIR QUALITY

Air Quality Concerns from fracking

Air pollution caused by high volume hydraulic drilling is a growing threat. In 2009 Wyoming failed to meet federal standards for air quality for the first time in its history partly because of the fumes containing benzene and toluene from roughly 27,000 wells, the vast majority drilled in the past five years. In a sparsely populated Sublette County in Wyoming, which has some of the highest concentrations of wells, vapors reacting to sunlight have contributed to levels of ozone higher than those recorded in Houston and Los Angeles. (28)

Air pollutant emissions from high volume hydraulic fracking are from two main categories. There are emissions from **transportation** of freshwater, chemicals, wastewater and fossil fuels in addition to **chemical emissions** from natural gas drilling and processing.

Transportation Related Air Pollutants from Fracking

According to an in depth report by Seth Shonkoff, MPH from the university of Berkeley

"Each well requires between 2 to 7.8 million gallons of fracking fluid per fracking event. Since water, the primary constituent of fracking fluid, is not generally pumped directly to wells, water must be transported by diesel trucks, each of which has an approximate capacity of 3,000 gallons (EPA 2011). Because an average fracking event requires 5 million gallons of water (excluding the sand and the chemicals required), over 1,660 trucks (excluding trucks to carry chemicals and sand) are required for a single fracking event (EPA 2011). With each well expected to be fracked between one and ten times over its lifetime, and with thousands of such wells concentrated in high extraction regions, unprecedented levels of air pollution are being brought to these rural areas.

The pollutant of primary health concern emitted from the transportation component of hydraulic fracturing is fine diesel particulate matter (PM). A review by the California Air Resources Board (2008) indicates that there is a 10% (CI: 3% to 20%) increase in the number of premature deaths per 10 μg/m3 increase in PM2.5 exposure (CARB 2008). Additionally, nitrogen oxides (NOx) and volatile organic compounds (VOCs), other prevalent pollutants in diesel emissions, react in the presence of sunlight and high temperatures to produce tropospheric (ground-level) ozone, a strong respiratory irritant that is associated with increased respiratory morbidity and mortality. Transportation-related air pollution varies between different types of fracking…While coal-bed methane extraction requires approximately 16 to 115 trucks to transport between 50,000 to 350,000 gallons, respectively, of water per well, shale gas extraction requires, as mentioned, an average of roughly 1,660 trucks to transport an average of 5 million gallons of water per well (EPA 2011) and is likely more damaging to air quality."(279)

Natural Gas Extraction Hazardous Emissions

"The natural gas extraction process itself produces emissions of multiple health-hazardous air pollutants including benzene, toluene, ethylbenzene, and xylene (BTEX), formaldehyde, hydrogen sulfide, acrylonitrile, and methylene chloride. This results in elevated air pollution concentrations that far exceed US EPA guidelines for both carcinogenic and non-carcinogenic health risks (Armendariz 2009; Colborn, Kwiatkouwski et al. 2011; Larson, Breech et al. 2012). Fracking also produces fugitive methane (CH4), which, although not considered a health-damaging pollutant in its own right, atmospherically transforms to toxic ground-level ozone, as described above."(279)

Production of Ozone Exceeds All Other Mobile Sources

"Ozone precursor emissions from oil and gas extraction activities are predicted to be very high. For example, in the Dallas Fort-Worth Metropolitan Area (D-FW) in 2009 it is estimated that 165 tons of ozone precursor emissions (NOx and VOCs, and CH) were emitted per day while the entire mobile sector (cars, trucks, etc. – excluding air travel) of D-FW emitted only 121 tons per day (Armendariz 2009). In fact, it is estimated that during the summer of 2009, more than 300 tons of ozone precursor emissions were generated by fracking activities per day in D-FW, with over half of the fugitive emissions arising from the condensate and oil tanks used in the operations. In other words, oil and gas extraction was responsible for more tropospheric ozone levels than the entire fleet of cars, trucks, and other mobile sources combined (Armendariz 2009)." (279)(280)(281)

EARTHQUAKES

"The fluids (in wastewater injection wells) are driving the faults to their tipping point." Nicholas van der Elst (167)

Fracking Wastewater Injected into Wells Induces Earthquakes

Researchers have long known that fluid injection operations can trigger seismic events. In 2006 four earthquakes in Basel, Switzerland were initiated by one geothermal energy site. They ranged from 3.1 to 3.4 on the Richter scale. (52) One of Denver's largest earthquakes in 1967 was determined by the USGS to be caused by deep injection wells used to dispose of the government's hazardous waste.

Mounting evidence from many studies lead seismologists to believe that oil and gas activity has triggered earthquakes in Texas, Arkansas, Colorado and Ohio as well. (12) (13)(14)(15)(16)(115) These are regions that typically don't see much seismic activity. In the Dallas-Fort Worth area Dr. Cliff Frohlich from the University of Texas has found an 8 fold increase in earthquakes in the area. He has linked this to the high pressure injections from wastewater disposal wells that lie on a fault lines.

"All the wells nearest to the earthquake groups reported maximum monthly injection rates exceeding 150,000 barrels (equivalent to 6.3 million gallons) of water per month since October 2006," the study says. (15)

Oklahoma's strongest reported earthquake with modern instrumentation occurred in 2011 and was linked to wastewater injection back into the wells. There was progressive rupture of three faults in sequence causing a series of earthquakes and ultimately injuries in 2 people with destruction of 14 homes. The quake was felt in 17 nearby states. (52)

A recent 2013 study in Geology magazine found that number of earthquakes in the middle of the U.S. was 11 times higher than the average rate over the previous 30 years. One of the author's, geologist Heather Savage of Columbia states, "When you overpressure the fault, you reduce the stress that's pinning the fault into place and that's when earthquakes happen." (53)

Volume changes in the Ground Induce Earthquakes

Research recently published by Emily Brodsky, a UCSC geophysicist studying quakes at the Salton Sea geothermal field, suggests that earthquakes are induced not just by injection, but also by removal of fluid in the ground. "We show that the earthquake rate in the Salton Sea tracks a combination of the volume of fluid removed from the ground for power generation and the volume of wastewater injected," Brodsky said. "During the period of relatively low-level geothermal operations before 1986, the rate of earthquakes in the region was also low. Seismicity increased as the operations expanded. After 2001, both geothermal operations and seismicity climbed steadily." (285)

Distant Seismic Activity Can Trigger Quakes at Fracking Sites

A 2013 study funded by the National Science Foundation and the U.S. Geological Survey and published in *Science* has demonstrated that powerful earthquakes thousands of miles away can trigger minor quakes near oil and gas wastewater-injection wells, sometimes followed months later by quakes big enough to destroy buildings. Columbia University seismologists state they have identified earthquakes in Oklahoma, Colorado and Texas that were set up by injection well sites then triggered by major distant earthquakes. (167) "**Sensitivity to remote triggering is most clearly seen in sites with a long delay between the start of injection and the onset of seismicity and in regions that went on to host moderate magnitude earthquakes within 6 to 20 months. Triggering in induced seismic zones could therefore be an indicator that fluid injection has brought the fault system to a critical state."** (286) "The fluids (in wastewater injection wells) are driving the faults to their tipping point," Nicholas van der Elst, lead author of the study. (167)

What seems to happen is that wastewater injection leaves local faults "critically loaded," or on the verge of rupture. Even weak seismic waves from faraway quakes are therefore enough to set off a swarm of small quakes in a process called "dynamic triggering. (167)

Sinking Feeling: Land loss from oil and gas extraction

According to the United States Geologic survey (USGS) land loss associated with sinking of the earth from liquid extraction is more common than previously thought. The scientific term for this is land subsidence and this can be caused by large volume extraction of different underground resources including water, oil and gas, sulfur and salt. Evidence form several case studies since the 1920's has shown that the lowering of land elevation caused minor earthquakes and activated faults around the periphery of fields (71)

As reported in the USGS study one of the most dramatic cases was in Wilmington Field in Long Beach, California.(72)(73) As the oil reservoirs were depleted, sand compaction caused almost 9 m of land subsidence that flooded streets and wharfs and caused structural damage to bridges, railroads, and other harbor facilities. (73)

FRACKING OUR FARMS

"Texaco, Chevron and British Petroleum are all outbidding agricultural water interests (in California) by a 3-to-1 margin." (275)

"With a finite supply of water, Sacramento may have to choose between expanding food production or fracking wells and oil and natural gas production." (275)

"According to state ag business analysts, the energy companies' water grab will likely translate to higher food prices for consumers and increased cost to the production of bio fuels like ethanol that rely on the availability of cheap and abundant corn harvests." (275)

"One of our concerns, irrespective of chemical use, was the use of water. We're more concerned about millions of gallons used by fracking. We don't have millions to give. We don't use it as a Waterpik." Jim Fiolek, executive director of the Santa Barbara County Vintners Association, (293)

"As farmers, we're very aware of the first 1,000 feet beneath us and the groundwater that is our lifeblood. We look to the future, and we really do want to keep our land and soil and water in good condition." Tom Frantz, fourth generation farmer

"***Nobody is protecting us," said almond farmer Tom Frantz (291)***

Fracking Farmland

California has recognized for decades the necessity to preserve the maximum amount of its agricultural land not only to maintain the agricultural economy of the State but also for "the assurance of adequate, healthful, and nutritious food for future residents of the State and Nation." (292) **According to the California Department of Food and Agriculture California produces almost half of U.S. grown fruits and vegetables.**

"The state's 81,500 farms and ranches received a record $43.5 billion for their output last year, up from the $38 billion reached during 2010. California remained the number one state in cash farm receipts with 11.6 percent of the US total." (296)

Southern California's Kern County has been a primary food production area for generations. Their mission statement is " To Promote and Protect the Agricultural Industry, Environment and General Public." Hydraulic fracking in the area however has created irreparable harm in some areas and a broadened opposition from farmers. **Last year the Department of Oil, Gas and Geothermal Resources**

(DOGGR) in the Department of Conservation that regulates oil and gas asked the Kern County Board of Supervisors to streamline the process for permitting oil and gas wells. *Video*.(295)

This was well after a **Kern County almond farmer lost acres of almond trees after a single watering from his new well near an oil and gas fracking site** that used ponds to hold "produced wastewater. Fred Starrh in 2001 sued Aera Energy for allowing 600 million barrels of oil wastewater to seep from unlined ponds into the subsurface of his farm causing contamination of his groundwater. In 2009 Starrh was awarded $8.5 million from a jury trial but he is appealing the decision for over a billion dollars stating, "We can't use our water… It's heartbreaking to me," Across Kern County, "other farmers are waging similar fights. **With oil prices booming and energy companies eager to develop new wells, the state has granted oil companies permission to drill on farms without first assessing possible harm to the environment, as called for under the California Environmental Quality Ac**t." (275)

Case Studies of Livestock Illness and Fracking.

A Study of 24 cases in six states linking illness, reproductive failure and death in cows, horses, goats, llamas, chickens, dogs, cats, and other wildlife, and humans to nearby hydraulic fracking was performed by Robert Oswald and Michelle Bamberger. More than one-third of the cases involved conventional wells and the remainder comprising horizontal wells with high-volume hydraulic fracturing. (216)

Some of the cases include:

· In Louisiana, 17 cows died within one hour of direct exposure to hydraulic fracturing fluid. A necropsy report listed respiratory failure with circulatory collapse as the most likely cause of death.

· A farmer separated his herd of cows into two groups. 60 cows were in a pasture with a creek where hydraulic fracking wastewater was allegedly dumped; 36 cows were in separate fields without creek access. Of the 60 cows exposed to the creek water, 21 died and 16 failed to produce calves the following spring. None of the 36 cows in separated fields had health problems.

· Another farmer reported that 140 of his cows were exposed to hydraulic fracking fluid when wastewater impoundment was allegedly slit, and the fluid drained into a pasture and a pond. "These farmers saw workers slitting the liner to decrease the amount of liquid in the impoundment in order to refill it," said Bamberger. "We have heard it now on several occasions." Of the 140 cows, about 70 died, along with a high incidence of stillborn or stunted calves.

The authors state, "Complete evidence regarding health impacts of gas drilling cannot be obtained due to incomplete testing and disclosure of chemicals, and nondisclosure agreements. Without rigorous scientific studies, the gas drilling boom sweeping the world will remain an uncontrolled health experiment on an enormous scale." **The authors recommend a ban on hydraulic fracking but add, "In states that nevertheless allow this process, the use of commonsense measures to reduce the impact on human and animals must be required in addition to full disclosure and testing of air, water, soil, animals, and humans.** (216)(289)

Oil is Outbidding Agriculture for Water in California

Oil and gas companies are increasingly moving into traditionally agricultural areas. California's most fertile farmland lies over the Monterey Shale and an unprecedented number of potential permits. Farmers are understandably concerned about water contamination and their livestock and already at odds with oil and gas companies competing for fresh water (58)

"Texaco, Chevron and British Petroleum are all outbidding agricultural water interests by a 3-to-1 margin. For California farmers, the loss of hundreds of thousands of acre feet of water from the districts means an increase in rates and fewer acre feet allotments intended for new groves of pistachios and almonds, vineyards of grapes and fields of water-intensive alfalfa, tomatoes and corn,"(275)

Out of state oil companies have another good reason to explore for oil and gas here as they enjoy lower taxes. **"California is the fourth largest oil producing state in the nation and the only top ten producer that does not impose an oil severance tax**. In Alaska, the tax ranges from 25-50 percent, in Texas it's 4.75 percent and in Kansas, 8 percent." (294)

FRACKING OUR FUTURE

"The footprint for shale gas is greater than that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years." Robert Howarth (178)

"Methane is a powerful greenhouse gas, with a global warming potential that is far greater than that of carbon dioxide," Robert Howarth (178)

Oil and Gas Boom is a Bust for the Climate: Roasting Our Future

The identification of an abundance of deep "unconventional" fossil fuels have renewed widespread interest in reducing our dependence on foreign oil by replacing it with domestic oil. Oil companies are cashing in on this and luring states with talk of millions or billions of dollars in economic growth and jobs.

In 2009 there were an estimated 1.02 million onshore oil and natural gas wells in the United States. The total is expected to steadily increase by about 17,000–35,000 natural gas wells and 9,000–10,000 oil wells per year between 2012 and 2035. More than a million and a half miles of pipeline would be needed to connect the wells, processing plants, distribution facilities, and customers. (165)

This fossil fuel boom has caused conflicts in communities around the nation and the world where people concerned with the public health and environmental effects of fracking clash with oil companies.

(204)(205)(206) There is another serious looming effect of extracting even more gas and oil from our global landscape, climate change.

"The large GHG footprint of shale gas undercuts the logic of its use as a bridging fuel over coming decades, if the goal is to reduce global warming."Robert Howarth (178)

Fugitive Methane and Global Warming

Some experts question the validity of extracting natural gas or using it as a transition fuel on the road to renewable energy due to its climate changing ability. (178)(213)(303)(304) The EPA looked at total reported greenhouse gas emissions for 2011 from the oil and gas industry and found that natural gas accounted for about 47% of all green house gases from processing and transmission alone not taking into account production or unreported fugitive losses, leaks or spills. (299)

Tom Wigley, a senior research associate at the National Center for Atmospheric Research, looked at a variety of simulations for global climate change and reported that if natural gas were substituted for coal in energy production, climate change trends would not slow down. "People saying that coal is bad and natural gas is much better are only looking at a small part of the picture," said Wigley, who is also an adjunct professor at the University of Adelaide in Australia. (303)(304) It is estimated that somewhere from 3.6 percent to 7.9 percent of the methane in natural gas extraction is leaking into the atmosphere at various points along the shale gas production cycle. (93) In addition the oil and gas industry is the single largest producer of methane gas in the U.S., accounting for approximately 40% of all methane emissions. (134) ***According to the Intergovernmental Panel on Climate Change methane is 72 times more potent a greenhouse gas than CO2 using a 20 year timeline.*** (99)

Natural gas also emits climate altering carbon dioxide (CO2) during combustion. Fracked gas releases 58 percent less (CO2) than coal and 33 percent less CO2 than oil. However taken altogether scientists who have taken a close look at this issue report that gas comes in last behind all other fossil fuels in the race to reduce global warming. (213)

Howarth, et al analyzed the effects of methane from shale extraction and concluded "Note that particularly when viewed on the 20 year time horizon after emission, the **greenhouse gas footprint of shale gas is considerably greater than that for coal or diesel oil, when the full effects of the methane emissions are considered.** This includes direct emissions of CO2 during combustion, indirect emissions to develop the resource and fugitive emissions." (178) This refutes the premise that it is sensible at all to use natural gas as a transition fuel.

"Relying more on natural gas would reduce emissions of carbon dioxide, but it would do little to help solve the climate problem," says Wigley, who is also an adjunct professor at the University of Adelaide in Australia. "It would be many decades before it would slow down global warming at all, and even then it would just be making a difference around the edges."(303)

Keep the Coal in the Hole

Keep the Oil in the Soil

Keep the Gas in the Pass

If we use all the potential oil and gas in deposits stored now underground we will surely seal our global warming fate and roast our future. We have just recently reached 400 ppm of CO2 in the atmosphere. The best climate science in the world tells us we need to be at 350ppm (or less) to ensure a livable planet and limit global warming to no more than a 2 degree Celsius increase. (87)(128)(130) (133) That means we need to swiftly change energy policies and cut back on the use of fossil fuels altogether. (96-99)(109)

Although there are large reserves of deep shale oil in the U.S. and around the world the amount of "burnable" oil is estimated at about 20% of total declared proven fossil fuel reserves (not unexplored shale). Beyond that "burnable" amount unstoppable climate change will occur. (87)(88)(89)(116)(129)(131)(132)(133)

"Following detailed work by European research groups, the International Energy Association in 2012 said that if the world was to meet its climate change goals – giving it a better than even chance of limiting global warming to 2C – it needed to leave most of its fossil fuels in the ground." (132)

Oil and gas companies face an ethical dilemma, as they currently are planning to blow past these climate change limits in the next 8-10 years despite the fact that they no longer deny that global warming exists or that fossil fuels are a large contributor. (87)(111)(112)(113)(114)(115)

"Without a meaningful cap on global carbon emissions, the exploitation of shale gas is likely to increase total emissions." Dr. John Broderick (161)

Undermining Efforts to Transition to Renewable Energy

Continuing our dependence on oil or gas also undermines financial and political efforts to transition to clean renewable energy. (116-123) According to an extensive 2012 review of hydraulic fracking at the Tyndall Center for Climate change Research at eh University of Manchester, England, Dr. John Broderick states, **"The development of shale gas could also reduce and/or delay the incentive to invest in zero- and low-carbon technologies and renewable energy." (161)**

There is general agreement that the world will have to move to a low carbon economy if climate change is to be controlled. Among other things, this requires considerable investment in renewable energy.

“Energy and infrastructure investments made in the next 10–15 years will largely lock in the greenhouse gas emissions trajectory to 2050. This alone creates an immediate pressure to accelerate investment into clean alternatives.” According to Paul Stevens Emeritus Professor of Petroleum Policy and Economics at the University of Dundee and a Consulting Professor at Stanford University (162)

Oil and Gas Stocks at Risk

There are signs that oil and gas companies stock may be at risk. (95)(97)(98) An article in a Canadian Financial newspaper June 2013 stated that **bank analysts and credit rating experts are now “warning that energy sector valuations ignore the world’s climate change target and could be decimated if the international community puts its money where its mouth is and collectively moves to protect Mother Earth by attacking demand for oil, coal and gas.”** (94)

Oil and Gas Have Always Been a Dirty, Unhealthy Business

The production, transport and use **of all fossil fuels** have significant documented health and environmental impacts. Oil and gas development and combustion create air pollution and greenhouse gas emissions that lead to respiratory and cardiovascular disease, global climate change, surface and ground water contamination and wilderness destruction. (75)(76)(85) “Impacts on the landscape are so significant that Alberta's oil and gas industry now cuts more trees and destroys more habitat than the province's forest companies.” (67)

Cardiovascular Disease: The CDC’s new Environment and Public Health Tracking Network discusses the increasing role of air pollution in heart disease. (80) Heart disease is the leading cause of death for both men and women in the United States. The American Heart Association Scientific Statement in 2004 links fine particulates in the air from combustion of oil products to an increase in cardiovascular disease including heart attack, stroke and heart failure. (78) Short term exposure can cause acute illness while longer term cumulative exposure of particulate matter causes atherosclerosis which scientists believe is due to inflammation. (78) (79)

Water and Soil contamination: A large multidisciplinary United States Geologic Survey (USGS) study in 2003 looked at the environmental impacts of oil production in Oklahoma. They investigated the fate of chemicals and petroleum in wastewater, well contamination as well as soil contamination. Their conclusion was that **“Exploration for and production of petroleum have caused major detrimental impacts to soils, surface and ground waters, and the local ecosystems in the United States” and that these impacts were “widespread and pervasive. All wells show some degree of contamination from produced water and/or associated petroleum or its degradation products.”** (76)

Air Pollution: Another study of oil and gas production in the Rocky Mountains by the EPA in 2008 showed that "emissions from oil and gas production in Region 8 constitute a sizable share of total U.S. air emissions from this sector" creating 6% of all particulate matter and 30 % of all Hazardous Air Pollutants". They also found that "**oil and gas air emissions are the largest for VOCs, (volatile organic compounds) comprising over 40 percent of the regional total in 2002**." 15% of all the Rocky Mountain regions nitrous oxide (NO) emissions are from oil and gas production. The study concluded that "the combined, incremental effects of oil and gas production – in combination with other human activities – can pose threats to human health and the environment." Concern is rising as oil production increases in regions throughout the U.S. (77)

LEGISLATION

Fracking Moratoriums

Environmental concerns and lack of federal oversight have led to moratoria on hydraulic fracturing for shale gas extraction in parts of the USA as well as in other countries. (46)(318) Over 130 bills in 24 states have been introduced to address various aspects of fracking including disclosure to monitoring to sitting of wells near water sources to wastewater treatment to banning wastewater dumping. Only a few of these bills have passed so far. 14 states have enacted legislation to regulate or monitor fracking. (46) Nine states have proposed a moratorium or a ban on fracking altogether. Vermont is the first and only so far to have passed a permanent ban on fracking in May 2012. (39)(142) Many communities in New York have passed a fracking ban and the state has reinstated the fracking moratorium for the sixth year. (311) In 2010 the Delaware River Basin Commission, a compact of the Governors of New York, New Jersey, Pennsylvania and Delaware to manage water in the Delaware river basin, placed a 3 year moratorium on shale gas drilling. The commission is still performing water quality testing to establish baseline studies prior to drilling. (312)

Hydaulic fracturing moratoriums have also been placed in the province of Quebec, Canada (March 2011), France (July 2011), South Africa (August 2011) and Bulgaria (January 2012)(160), and Switzerland (207)

The City of Los Angeles has a pending resolution calling for a moratorium on hydraulic fracturing and the disposal of fracking wastewater until authorities "Make the determination that such processes are safe for public health, for the Los Angeles water supply and the environment."

In California several common sense bills including a moratorium which would have provided safeguards in fracking have failed. (30)(31)(37)(38)(316) One is still in the works as of now. See below.

Hydraulic Fracturing Regulations in California.

California Fracking

California is reported to be the fourth-largest-oil-producing state. According to a scientific review by Environmental Working Group 31 of 58 counties have about 52,000 wells. Hydraulic fracking is now reported in at least 6 counties: Kern, Los Angeles, Monterey, Sacramento, Santa Barbara and Ventura. (106) According to some reports the geologically complex Monterey Shale in California may have 15 billion barrels of oil deep under the rock and may be one of the biggest deposits of oil and gas in the U.S. Some people think that estimate is too high and it is used to promote oil and gas exploration which is in the initial stages. (57) (106) No one really knows how much oil and gas is there. So far nothing has been found although exploration is beginning. Denver based Venco, Inc plans to move aggressively forward in California to "unlock the potential of the field". (106) Deep horizontal fracking will be required in the Monterey Shale geologic formation. This could be a perilous proposition in California earthquake territory.

California's Division of Oil, Gas, and Geothermal Resources (DOGGR)

The Division of Oil, Gas, and Geothermal Resources in the Department of Conservation, regulates the drilling, operation, maintenance, and abandonment of oil and gas wells in California.(136)(137) Historically there has not been regulation, permiting, reporting, monitoring, or transparency with regards to hydraulic fracturing to stimulate wells. There has never been full disclosure of hydraulic fracturing chemicals. A fact sheet sent to the Environmental Working Group in 2010 stated "Although companies are not required to report the use of hydraulic fracturing for well stimulation in California, anecdotal evidence suggests fracking similar to that used in the eastern U.S. is not common in the state. Fracking generally involves the use of significant amounts of water. DOGGR is unaware of projects using unusual amounts of water."

In 2011 Assembly member Fran Pavley after seeing the movie *Gasland* sent a letter to the Supervisor of the DOGGR regarding fracking regulations in California(106)

The DOGGR responded that they were "unable to identify where and how often hydraulic fracturing occurs in the state", were "not aware of the amount of energy produced using hydraulic fracturing", had "no information" about water use, had "no data on the safety, efficacy and necessity" of the practice, had "no permitting process" and "no regulations currently in place specific to hydraulic fracturing."

The Environmental Working Group turned up dozens of scientific articles documenting that hydraulic fracturing is widespread in California and has been used to stimulate wells since 1953. (106)

A 2011 Federal EPA audit of DOGGR revealed a variety of "deficiencies" in its protection of underground drinking water, determinations of Zone of Influence Area of Review(AOR) and lack of regulation of fracture pressure among other issues. They also recommended inspections, compliance and enforcement, well planning and testing, well plugging and abandonment requirements. (306)

Governor Brown Fires State's Top Oil Regulators in 2011

November, 2011 Derek Chernow, acting director of the California Department of Conservation, and Elena Miller, head of the Division of Oil, Gas and Geothermal Resources, were removed from their positions by Governor Brown. After receiving notification from the EPA regarding issues with the permitting of wells the DOGGR in 2011 issued permits to only 14 projects out of 199 applications received. “Catherine Reheis-Boyd, president of the Western States Petroleum Association, applauded Brown’s actions, saying the industry has been at loggerheads with state regulators for two years. Miller, the ousted oil regulator, was a former lawyer for the California prison system appointed by former Gov. Arnold Schwarzenegger.” (314)(315)

As of February 2012, Mark Nechodom, newly appointed director of the Department of Conservation told environmental groups they had no plans to develop fracking regulations unless the legislature were to require it or there was “manifest damage or harm”. (106)

The DOGGR has released some preliminary regulations including chemical disclosures but some environmental groups feel the regulations are too weak. (108)(313) There is also continued political pressure to ease regulations to enhance the states oil producing capacity. (105)(307)

This lack of an adequate legal framework, the mounting evidence of major public health and environmental consequences and the expectation of increasing high volume horizontal fracking have led to a slate of bills in California over the last 3 years to attempt some protections. In other states some regulations have helped but there are still many issues with regards to adequate safety protections and adequate funding for strict monitoring and enforcement. Many still feel the only reasonable approach is a moratorium as was just reinstated in New York for the 6th straight year. (311)

Fracking Public Lands: Lawsuit Postpones Auction

After a lawsuit filed by environmentalists the U.S. Bureau of Land Management citing budget issues recently announced it would put off an auction planned in May 2013 for leases to drill 18,000 acres of BLM land including almost 1,300 acres of prime public lands near the Monterey Shale and 2,000 acres in Colusa County near Sacramento until October 2013. (63) (305) The federal judge ruled that BLM had failed to perform adequate environmental studies when the agency auctioned the drilling rights for parcels near the lush Salinas River Valley. It is home to the Salinas River which provides habitat for the threatened Steelhead trout and Salmon and irrigation for farmlands. The river comes from deep aquifers that are at risk for contamination. (63)

LEGISLATION ON FRACKING IN CALIFORNIA

"Currently, California does not require oil companies to disclose where they use the procedure or what chemicals they inject into the ground."(316)

Pavley's Fracking Bill AB4 is Sole Survivor

Of 10 bills that were proposed in the 2013 legislative session to regulate fracking only one Fran Pavley's AB4 has survived so far. (30) Pavley is best known for authoring the landmark Global Warming Solutions Act signed by Governor Schwartznegger in 2006 which improves auto fuel economy and reduces global warming gases. It has been a model for the Nation.

She decided to look into fracking in 2011 after seeing the movie *Gasland.* She spoke at a 2 day seminar organized by the American Groundwater Trust noting, "I sent a letter to DOGGR asking some basic questions. Where does the water used in fracking come from? They weren't able to answer that. What chemicals were used? They had no requirement to track that. How is the wastewater disposed of? They had no record." (308)

AB4 is Comprehensive but lacks a Safeguard Moratorium

Pavley's bill is comprehensive and includes many provisions for adoption of rules and regulations specific to well stimulation treatments, disclosure of chemicals and volumes used to appropriate government agencies, collaboration with appropriate government agencies for water usage and well stimulation reporting, notification to property owners 30 days before drilling, radiologic testing of fracked wastewater, wastewater handling information, acid drilling regulations, allows fees collected from oil and gas companies to be used for inspections, water quality sampling and monitoring and research studies, imposes civil penalties for violations, requires a comprehensive annual report to the legislature. It also requires the Natural Resources Agency to conduct an independent scientific study on well stimulation treatments both hydraulic fracturing and acid treatments to evaluate the hazards and risks such treatments pose to natural resources and public, occupational, and environmental health and safety to be done before January 1, 2015. The bill also provides for trade secrets to be revealed to physicians to diagnose or treat a patient and may share that information with the patient and other physicians however those persons are still subject to trade secret laws as well. (317)

SB4 however removes the original moratorium provision until regulations and safety measures are in place (309)

In addition there may be loopholes in regional water quality control with regards to safeguarding groundwater. The language leaves much of the monitoring and regulation to agencies "if warranted". Protection of groundwater is dependent on the agencies involved, available budget and strict enforcement. Also companies can still claim trade secret protection and do not have to reveal the

names until 30 days after the cessation of the well. How will agencies or property owners know what chemicals to test for prior to drilling? There is also no public comment period after a permit is granted.

Even with the strictest regulations and enforcement there are issues that cannot be resolved with hydraulic fracturing.

1) **Excessive water use, contamination and wastewater disposal**

2) **Loss of wine and agriculture industry due to competing water interests**

3) **Endangered species impacts**

4) **Earthquake induction local and remote**

5) **Inevitable spills and leaks**

6) **Fracking is poised to undermine California's ability to reduce greenhouse gases and comply with it's 2006 Global Warming Solutions Act.**

Summary

The entire oil and gas industry negatively impacts public health and the environment. Hydraulic fracking creates a newer and more toxic legacy within that framework. It threatens communities, wildlife, farmland, our precious and scarce drinking water and the natural beauty of our lands not to mention exacerbating global climate change. The science and documentation of harm along with lax federal regulations are pushing communities and states to impose much needed regulations with transparency and accountability. There is a desperate need to guide our economy wisely, in a sustainable way and not forsake public health or the environment for shortsighted goals such as a run of "cheap" gas. This resource needs to be developed without risking our health and safety.

The only sensible approach is an indefinite moratorium on hydraulic fracking and wastewater well injections until there are reversals of oil and gas loopholes in federal environmental laws, thorough independent studies affirming that fracking can be safely done without harm to public health, the environment or to our natural resources and if so with strict regulations, monitoring, and enforcement already in place. Input of public health experts is vital to the process. This needs to take into account the long term as well as short term impacts. Full chemical disclosure to the public is necessary. This has to include supporting a rapid switch to renewable energy.

We teach our children to make better choices to improve their chances to lead a happier and healthy adult life. As physicians, parents and grandparents we also need to make better choices for their future. Let us also be honest about our real need to work through our challenging addiction to fossil fuels and

venture into a new era of energy conservation and use of innovative forms of renewable energy. We owe this to future generations as much as to ourselves.

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