Unit VII:
Energy

INTRODUCTION

The energy that we use to heat our homes, run hospitals and clinics, and transport our food enhance our lives, but energy choices also have an impact on health. Nationally, the effect of energy on health of the communities and vulnerable populations has been recognized in the Clean Power Plan. This national plan for energy is targeted to move away from greenhouse gas emitting fossil fuels (coal, gas, oil) and expands renewable energy (solar, wind, geothermal). Nurses have played a role in articulating the impact of energy extraction on communities through research, advocating for safer alternatives, and educating other nurses and health providers of environmental health risks of energy extraction (mining). Unit VII introduces the ANA resolution on healthy energy and addresses the important topic of Hydraulic Fracturing (Fracking) and its implications for health.

INTRODUCTION TO THE ANA ENERGY RESOLUTION: NURSE'S ROLE IN RECOGNIZING, EDUCATING AND ADVOCATING FOR HEALTHY ENERGY CHOICES TO THE AMERICAN NURSES ASSOCIATION HOUSE OF DELEGATES

Ruth McDermott-Levy, PhD, MPH, RN
Associate Professor, Villanova University
Director, Center for Global and Public Health
College of Nursing
Villanova, PA

Nurses caring about our energy choices? Really? What does this have to do with meeting the health needs of the patients, families, and communities that we serve? The truth is our energy choices matter. They affect communities where fossils fuels such as coal, oil and gas are extracted from deep within the earth. Additionally, burning fossil fuels for energy also contributes to greenhouse gases that lead to global climate change.

We have long been aware of the occupational risks of coal mining in this country from black lung disease to mining disasters such as West Virginia's Upper Big Branch mine explosion that claimed the lives of 29 minors in 2010. We are also aware that coal mining, including mountaintop removal, has had negative environmental consequences on air and water quality, thus impacting the communities where mining occurs. But burning coal for energy also leads to air quality problems and contaminated water for communities beyond the source of the coal. Furthermore, extraction of coal, oil, and natural gas can influence local air quality and contribute to greenhouse gas emissions that lead to climate change.

Health impacts of a newer method of oil and gas extraction by unconventional high volume hydraulic fracturing (or fracking) can be found in the next chapter of this unit. Unconventional natural gas development (UNGD) and oil extraction has been identified as an energy boom in the U.S. and is seen as a bridge to the U.S. energy needs. However, like other extraction methods, this energy technology is not without health risks. Pennsylvania's Department of Environmental Protection air quality monitoring from 2011-2013 showed an increase of 19 percent for volatile organic compounds (VOC's), 12 percent for particulate matter, and 8 percent for nitrogen oxides in 2013 when compared to 2011 in counties where UNGD was occurring (see air quality section for health impacts of these pollutants). The report did show, however, methane and carbon monoxide emissions have decreased since Pennsylvania started measuring in 2011 (Phillips, 2015). This decrease was reportedly related to improvements in natural gas well completion processes and indicates that with improved processes we are able to extract more safely. Part of insuring improvements in processes to protect community health was educating other nurses and advocacy on the part of ANHE nurses from Pennsylvania and Maryland. So, yes, nurses must be aware of the health impacts of energy and continue to educate others about the health impacts. Nurses must advocate to protect our own health, the health of our families, and the most vulnerable, especially the world's poor.

In 2012, nurses, Nina Kaktins, MSN, RN, Ruth McDermott-Levy, PhD, MPH, RN, and Barbara Sattler, DrPH, RN from Pennsylvania State Nurses Association and Maryland Nurses Association, collaborated to submit a resolution, Nurse's Role in Recognizing, Educating and Advocating for Healthy Energy Choices to the American Nurses Association House of Delegates. The ANA House of Delegates unanimously accepted the resolution. This resolution outlines ANA's positon on our energy choices to protect the health of our patients, family and communities.

REFERENCES

Phillips, S. (2015). Air pollution increases at Pennsylvania's natural gas sites. State Impact: Pennsylvania, April 20. Retrieved from https://stateimpact.npr.org/pennsylvania/2015/04/20/air-pollution-increases-at-pennsylvanias-natural-gas- sites/

UNCONVENTIONAL NATURAL GAS DEVELOPMENT AND NURSING

Lenore K Resick, PhD, CRNP, FNP-BC, FAANP, FAAN
Professor Emerita, Duquesne University
Pittsburgh, PA

Lydia H. Greiner, MSN, APRN, APMHNP-BC, Consultant
Southwest Pennsylvania Environmental Health Project
McMurray, PA

INTRODUCTION

Since the 1990s, unconventional natural gas development (UNGD) activities have increased across the United States. UNGD includes the entire process from choosing the site for the drilling (fracking) to the delivery of the gas to the consumer. Drilling and associated industrial activities are often in close proximity to residential areas including schools, play grounds, and farms. People living in regions where UNGD is occurring have reported experiencing health effects from these activities. The purpose of this chapter is to describe an overview of the process involved in UNGD and the emerging issues related to health and the environment that nurses need to consider when assessing their clients for possible environmental exposures.

OVERVIEW OF THE PROCESS OF UNGD

The process of UNGD includes hydraulic fracturing or fracking. The fracking process begins with dynamite detonations to identify the geological formations under the surface prior to the drilling.

The initial drilling is done vertically down to a distance of approximately 8000 feet. After the vertical shaft is completed, horizontal shafts are drilled. Approximately 2-5 million gallons of water mixed with chemicals and propping materials such as sand are injected under high pressure down the well and out into the horizontal shafts. The high pressure is needed to create openings or fractures in the gas-bearing rock. The propping material enables the fractures in the rock to remain open and provide a way for the trapped gas to flow out of the horizontal shafts into the well. The released gas that flows into the well also contains waste water. The waste water includes the chemical mixture and salts injected into the well, as well as the heavy metals, hydrocarbons, radioactive materials and other substances from deep under the surface of the earth. At the well, the gas and the waste water are separated, and the waste water is stored in open pits or in tanks near the well (http://www2.epa.gov/hydraulicfracturing).

In some areas, such as Western Pennsylvania, the open pits, or impoundments, are lined with black plastic. Misters are used in these impoundments to spray the waste water into the air to aid in evaporation. Any waste water that remains is moved via tanker trucks to be disposed of in deep injection well sites often in another state or miles from where the drilling took place. An estimated 60% of the water injected into the wellhead during the drilling process will come back with the gas. This growing volume of waste water can also be recycled to be used in multiple wells (Easton, n. d. retrieved from http://www.waterworld.com/articles/wwi/print/volume-28/issue-5/regional-spotlight-us-caribbean/fracking-wastewater-management.html).

Drilling is a 24-hour/7 day per week operation. There is constant activity related to the drilling site including transportation of materials, machinery, water, sand, and chemicals by diesel trucks. Often times the drilling sites are located in rural regions. It is not unusual for these diesel trucks to have to travel over one lane, dirt roads to and from the drilling site.

Activities at the drilling site include gas production and onsite condensing stations. After fracking is completed, flaring is often used as a controlled burning of natural gas at the well site to test and stabilize the well. Flaring can last for several days or weeks. This process of burning natural gas is also used during emergencies at processing plants and compressor stations or to take care of small amounts of waste gas. Flaring involves bright columns of flames shooting into the sky associated with noise 24 hours per day (Penn State Extension, 2013).

Additional components of UNGD include compressor stations which are used to maintain pressure and velocity of the natural gas to keep the gas flowing in the pipelines to distant ports and refineries. Pipelines can run for hundreds of miles through residential and rural areas to the final destination (Keystone Energy Forum, n.d.). Herbicides are often used to control the vegetation along the pipelines. The capacity of pipelines to transport the products from the site of extraction to the final destination is augmented by railroad tank cars. These tank cars carrying flammable fluids pose a risk in the event of puncture or accident (http://time.com/2970282/a-year-after-a-deadly-disaster-fears-grow-about-the-danger-of-crude-oil-shipped-by-rail/; http://www.phmsa.dot.gov/hazmat/safe-transportation-of-energy-products; Taylor, 2013).

OVERVIEW OF CHEMICALS, FINE PARTICULATES, DIESEL EXHAUST ASSOCIATED WITH UNGD

Exact chemical composition of fracking fluid is proprietary information and because of this, specific chemicals cannot be identified at any one drilling site. However, Colburn and

colleagues (2011) identified 353 chemicals used in the fracking process. These chemicals were found to result in adverse health effects involving the integument, respiratory, cardiovascular, gastrointestinal, nervous, and endocrine systems. A percentage of these identified chemicals were known carcinogens, neurotoxins, and endocrine disruptors. Different times and lengths of exposures to these chemicals can result in different symptoms and diseases. Epidemiological studies have shown that some cancers take years to develop after exposures to carcinogens used in other industries (EPA, 2000a, Benzidine).

It is well documented that endocrine disruptors may take a generation or generations to manifest their effect on human and animal reproduction (Alonso-Magdalena, Morimoto, Ripoll, Fuentes, & Nadal, 2006; Timms, Howdeshell, Barton, Bradley, Richter, & von Saal, 2005; Vandenberg, Maffini, Wadi, Sonnenschein, Rubin, & Soto, 2007).

The following substances have been identified in fracking fluids: barium, arsenic, volatile organic compounds, poly-aromatic hydrocarbons, benzene, ethybenzene, toluene, and xylenes (BTEX), methylene chloride, glycols, radium, acetaldehyde and formaldehyde, and microbial contamination and biocides (Colburn, Kwiatkowski, Schultz, & Bachran, 2011). Benzene is a known carcinogen (EPA, 2000a). Toluene is considered a "potential occupational carcinogen" and is associated with euphoria, hallucinations, dizziness, slurred speech, respiratory symptoms, depression, and coma and death with large acute exposures. Chronic exposures to toluene may result in liver, kidney and neurological damage, contact dermatitis, and is considered a possible teratogen. Xylenes, although not classified as carcinogen at this time, has been known to cause irritation of the eyes, nose, throat and gastrointestinal and neurological symptoms with acute exposure. Long term exposure has been known to result in headaches, tremors, fatigue, dizziness, lack of coordination, as well as respiratory, kidney and cardiovascular disease (EPA ,2000b).

Fine particulate matter, a result of silica dust and carbon monoxide, has also been identified in and around drilling sites (Esswein, Kiefer, Snawder, & Breinstein, 2012). Crystalline silica is a known lung carcinogen. Silicosis develops after chronic exposure. Inhalation of silica dust is associated with chronic obstructive pulmonary disease, chronic renal disease, and autoimmune diseases (Esswein, Kiefer, Snawder, & Breinstein, 2012).

Diesel exhaust is associated with human health hazards (National Center for Environmental Assessment, Office of Research and Development, U. S. EPA, 2002). Long term inhalation is "likely" to result in a lung cancer risk to humans as well as cause lung disease. Acute, short term exposures can result in irritation and inflammation as well as cause an exacerbation of pre-existing conditions such as allergies, bronchitis and asthma (EPA, 2014a). Diesel exhaust also contributes to the dissemination of other toxins such as fine particulates and nitrogen oxides.

ENVIRONMENTAL HEALTH ISSUES

The environmental health issues surrounding the process of UNGD are complex. There are three major sources of exposure to chemicals and other potential health hazards associated with UNGD. Individuals could be exposed through contact with contaminated air, water, or soil. Potential sources of air contamination include fine particles of silica dust from the sand used in the fracking fluid, diesel exhaust, emission from the well head, flaring off of the methane, evaporation of waste water from impoundments, venting of condensation tanks during filling, compression stations emissions, and herbicide spraying to control vegetation along pipelines.

A potential source of water & ground soil contamination includes leakage that seeps from impoundments into the ground soil. Contaminated soil can affect food supply in the form of crops and meat production through undetected animal exposure. Because animals reproduce more frequently than humans, animal health can be an early indication of potential impacts of UNGD on human health (Bamberger & Oswald, 2012).

Individuals living in close proximity to extraction activities or downwind from the industrial sites have reported negative health effects (Bamberger & Oswald, 2012; McKenzie et al, 2012; Resick, Knestrick, Counts, & Pizzuto, 2013; Subra, 2009, 2010; Wilson, Subra, & Sumi, 2013). Negative health effects include burning of the eyes, decrease in the ability to smell, bleeding from the nose, "a sweet metallic taste" in the mouth, and a gradual decrease in the ability to taste. Commonly reported dermatological signs and symptoms include a burning sensation, lesions, rashes, and chemical burns. Pulmonary complaints include an increase the symptoms of chronic conditions such in asthma and chronic obstructive pulmonary disease. Potential exposures occur to air borne contaminants such as fumes from evaporation of the drilling fluids in fracking pits. Individuals living near industrial sites may experience air contaminated by increased traffic from diesel trucks and the fine particulates of silica dust from the sand used in the fracking fluids (Saberi, Propert, Powers, Emmett, & Green-Mckenzie, 2014). Gastro-intestinal symptoms of abdominal pain have been reported. Neurologically, individuals have reported headache, dizziness, and confusion (Wilson, Subra, & Sumi, 2013).

McKenzie et al. (2012) found that people living within a half mile of exposure to air pollutants experienced greater health risks. In addition to physical complaints, individuals close to UNGD sites also have reported feelings of powerlessness (Resick et al., 2013) as well as generalized symptoms such as stress (Greiner et al, unpublished manuscript), fatigue, and sleep disturbance. Non chemical exposures may include continuous noise created by the increased truck traffic, compressor stations, and drilling operations and continuous light related to flaring.

ENVIRONMENTAL HEALTH CONCERNS FOR SPECIAL POPULATIONS

Young children, pregnant women, and older adults are at greater risk for exposures to environmental toxins (EPA, 2010). Children are more vulnerable to environmental toxins. They are smaller in stature which makes them closer to the ground surfaces to absorb contaminants. Children have a faster metabolism rate so their breathing is faster. Faster respiration enables the absorbing of potential contaminates at a faster rate than that of adults. Associations between children living near high traffic areas and childhood asthma have been reported in the literature (Li, Williams, Jalaludin, & Baker, 2012).

Childbearing age women and pregnant women are also vulnerable to these toxins. The literature reports low birth weight, small for gestational age, and low APGARs reported in births of women living near UNGD activities (Hill, 2012). Also congenital heart defects and a trend toward neural tube defects were found in mothers living near UNGD activity (McKenzie, Guo, Witter, Savitz, Newman, & Adegate, 2014)

Older adults who tend to have chronic illnesses are at risk. The literature reports an exacerbation of symptoms related to diesel exhaust that may aggravate chronic lung problems. Long term exposure has been reported to increase the risk of cancer of the lung (Office of Environmental Health Hazard, California, 2007).

COMMUNITY HEALTH ISSUES RELATED UNGD

The literature reports changes in local communities brought about the "boom and bust" cycles of the drilling activities (Perry, 2012). One example, North Dakota, has experienced one of the largest economic booms in the country due to the UNGD. The crime rate has increased in the boom period to more than 7% in the last year of this boom cycle (Michael, 2013). In Pennsylvania, cases of sexually transmitted infections were found to be higher in rural counties where UNGD occurred compared to rural counties where no UNGD was occurring (Food & Water Watch, 2013).

IMPLICATIONS FOR NURSES

Standard of Practice and Education

The 2010 edition of the American Nurses Association (ANA) publication, *Nursing: Scope and Standards of Practice*, included a new Standard 16: Environmental Health. This Standard mandated that environmental health knowledge and skills are a requirement for all nurses at the entry level of practice and this has been supported in the third edition in 2015 (ANA, 2010). Because the process of UNGD is a relatively new environmental health concern, nursing education at both the entry level and advanced practice level may not include information about the need to assess for possible environmental exposure as a cause of presenting illnesses.

Clinical Practice

For all levels of nursing, it is important to assess if the client is living near or working near or with oil and gas drilling activities; if so, a more in depth assessment needs to be completed. This screening may include an individual exposure health assessment, a home exposure assessment, and a residential environmental screening. In rural areas, special consideration must be given if the water source is well water and must include questions about animal exposure such as livestock and health of pets.

Research

Research is needed to investigate not only the health but also the economic, social and long range greenhouse effects of UNGD. Without such studies, humans, animals, and the earth will potentially be at great risk now, in the future, and for generations to come.

Advocacy

Nurses and other health care providers have an ethical obligation to "first do no harm" and to promote disease prevention and health promotion interventions. When there is an absence of evidence-based studies, the Precautionary Principle serves as a guide to practice. The *Precautionary Principle* states "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" (Wingspread, 1998). The American Nurses Association adopted the Precautionary Principle in 2003 (Nursing World, 2003).

Nurses play a vital role in the advocacy of health for individuals, families, and communities. In this role, the nurse has a great deal to contribute by staying informed of environmental health issues, meeting with elected officials, taking part in community meetings, and sharing

information about health and safety issues in the community.

OIL AND GAS DRILLING AS A GLOBAL HEALTH PHENOMENON

Concern about environmental health and UNGD is a global issue. Several European countries including France and Bulgaria have placed a ban on UNGD (Finkel & Hays, 2013). Drilling has resumed in the United Kingdom after a short halt related to two small earthquakes (Finkel & Hays, 2012). China (Ng, 2013) and Poland have begun exploration of UNGD. Africa is in a position to be a large region for UNGD (Weeden, 2013).

SUMMARY

The environmental health concerns involved in UNGD are complex. Little is known about the health effects related to UNGD. Environmental health concerns related to UNGD are a global health concern and not limited to drilling in the United States. Contamination concerns are not from one source, but from multiple routes including possible contamination from air, water, and ground sources. The profession of nursing is charged with having environmental health knowledge and skills. Nurses are held to the standard of including environmental health knowledge and skills in their practice which includes assessment for environmental health concerns.

ONLINE RESOURCES

Since early 2012, the Southwest Pennsylvania Environmental Health Project (SWPA-EHP) has been in operation in Southwestern Pennsylvania, an area which has experienced a proliferation of natural gas drilling. The purpose of this private non-profit group is to provide education and referrals to area residents experiencing adverse health and resources to health care providers in the areas. This organization has environmental health assessment tools related to oil and gas drilling activities available for health care providers:

- Individual Exposure Health Assessment
- Home Exposure Assessment related to Oil and Gas Drilling Activities

Tox Town is a good online resource to learn sources of toxic chemical exposure and how this exposure could affect health. *Tox Town* also includes an overview on fracking

Physicians Scientists and Engineers for Health Energy (PSE) has developed online educational modules that can be accessed for no cost.

REFERENCES

Alonso-Magdalena, P., Morimoto, S., Ripoll, C., Fuentes, E. & Nadal, A. (2006). The estrogenic effect of bisphenol-A disrupts the pancreatic ß-Cell function *in vivo* and induces insulin resistance. Retrieved from Environmental Health Perspectives 114:106-112.

American Cancer Society. (2013). Benzene. Retrieved from http://www.cancer.org/cancer/cancercauses/othercarcinogens/intheworkplace/benzene.

American Nurses Association (ANA). (2010). *Nursing: Scope and Standards of Practice*. Second Edition. Silver Spring, MD: Nursebooks.org.

American Nurses Association (ANA). (2012). Retrieved from http://www.nursingworld.org/MainMenuCategories/WorkplaceSafety/Healthy-Work-Environment/Environmental-Health/PolicyIssues/nurses-role-in-recognizing-educating-advocating-healthy-energy-choices.pdf

Bamberger, M., & Oswald, R.E. (2012). Impacts of gas drilling on human and animal health. *New Solutions, 22*, (1), 51-77> doi:10.2190/NS.22.1.e. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22446060

Centers for Disease Control (1989). Toluene diisocyanate (TDI) and toluenediamine (TDA): Evidence of carcinogenicity. Retrieved from http://www.cdc.gov/niosh/docs/90-101

Colborn, T., Kwiatkowski, C., Schultz, K., & Bachran, M. (2011). Natural gas operations from a public health perspective. *Human and Ecological Risk Assessment: An International Journal*. Retrieved from http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/fracking%20chemicals%20from%20a%20public%20health%20perspective.pdf

Easton, J. (n.d.) Fracking waste water management. Retrieved from http://www.waterworld.com/articles/wwi/print/volume-28/issue-5/regional-spotlight-us-caribbean/fracking-wastewater-management.html

Environmental Protection Agency (EPA). (2000a). Benzidin. Retrieved from http://www.epa.gov/ttn/atw/hlthef/benzidin.html

Environmental Protection Agency (EPA). (2000b). Xylenes (mixed isomers). Retrieved from http://www.epa.gov/ttn/atw/hlthef/xylenes.html

Environmental Protection Agency (EPA). (2014a). Diesel exhaust and your health. Retrieved from http://www.epa.gov/region1/eco/diesel/health_effects.html

Environmental Protection Agency (EPA). (2014b). Hydraulic fracturing. Retrieved from http://www2.epa.gov/hydraulicfracturing.

Environmental Protection Agency. Relative Risk Reduction Strategies Committee. Human Health Subcommittee. (1990). *The report of the Human Health Subcommittee: Relative risk reduction project: Reducing risk, Appendix B.* Washington, DC: U.S. Environmental Protection Agency, Science Advisory Board.

Esswein, E., Kiefer, M., Snawder, J., & Breitenstein, M. (2012). Worker exposure to crystalline silica during hydraulic fracturing. Retrieved from http://blogs.cdc.gov/niosh-science-blog/2012/05/23/silica-fracking/

Finkel, M. L., & Hays, J. (2013). The implications of unconventional drilling for natural gas: A global public health concern. *Public Health, 127*(10), 889. doi:10.1016/j.puhe.2013.07.005

Finkel, M. L., Hays, J., & Law, A. (2013).The shale gas boom and the need for rational policy. *American Journal of Public Health*, 103(7), 1161-1162.

Finkel, M.L., & Law, A. (2011). The rush to drill for natural gas: A public health cautionary tale. *American Journal of Public Health,* 101, 784-785. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3076392/

Food & Water Watch. (2013). The social costs of fracking: A Pennsylvania case study. Retrieved from http://www.foodandwaterwatch.org/reports/the-social-costs-of-fracking/

Foxall, K. (2007). Toluene, toxicological overview. Retrieved from http://www.hpa.org.uk/webc/hpawebfile/hpaweb_c/1194947395545

Fracking-wastewater-management. Retrieved from http://www.waterworld.com/articles/wwi/print/volume-28/issue-5/regional-spotlight-us-caribbean/fracking-wastewater-management.html

Greiner, L., Resick, L. K., Brown, D., & Glaser, D. Self-reported health, function and sense of control in a convenience sample of adult residents of communities experiencing rapid growth of unconventional natural gas extraction: A cross-sectional study. Unpublished manuscript.

Health Protection Agency (2007). Toulene. Retrieved from http://www.hpa.org.uk/webc/hpawebfile/hpaweb_c/1194947395545

Hill, E. (2012). Working paper. Unconventional gas development and infant health: Evidence from Pennsylvania. The Charles H. Dyson School of Applied Economics and Management, Cornell University, Institute of Medicine. Health Impact Assessment of Shale Gas Extraction: Workshop Summary. Washington, DC: The National Academies Press, 2014. Keystone Energy Forum. (n.d.). Pipe Lines. Retrieved from http://www.keystoneenergyforum.com/topics/pipelines

Law, A. The rush to drill to natural gas: A public health cautionary tale. *American Journal of Public Health*, 101, 784-785. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3076392/

Li, S., Williams, G., Jalaludin, B., Baker, P. (2012). Panel studies of air pollution on children's lung and function and respiratory symptoms: A literature review. *Journal of Asthma*,49(9), 895-910.

Malo. S. (2014). A year after a deadly disaster fears grow about the danger of crude oil shipped by rail. Retrieved from http://tarsandssolutions.org/in-the-media/a-year-after-a-deadly-disaster-fears-grow-about-the-danger-of-crude-oil .

McKenzie, L.M., Guo, R., Witter, R. Z., Savitz, D. A., Newman, L.S. & Adgate, J. L. (2014). Birth outcomes and maternal residential proximity to natural gas development in rural Colorado. *Environmental Health Perspectives*, doi: 10.1289/ehp.1306722. Retrieved from http://ehp.niehs.nih.gov/1306722/

McKenzie, L. M., Witter, R. Z., Newman, L. S., & Adgate, J. L. (2012). Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment*, 424, 79-87. doi: 10.1016/j.scitotenv.2012.02.01

Michael, J. (2013). Crime up 7.9 percent last year in North Dakota. Bismark Trubrune. Retrieved from http://bismarcktribune.com/bakken/crime-up-percent-last-year-in-north-dakota/article_f0a23ec4-f940-11e2-ad25-0019bb2963f4.html

National Center for Environmental Assessment, Office of Research and Development, U. S. EPA, (2002). Health assessment document for diesel engine exhaust. Retrieved from http://www.epa.gov/region1/eco/diesel/health_effects.html

Ng, E. (November 22, 2013). China turns increasingly to unconventional energy production such as shale gas. Retrieved from http://www.scmp.com/news/china/article/1363225/china-turns-increasingly-unconventional-energy-production-such-shale-gas

Nursingworld. (2003). The American Nurses Association adopts the precautionary principle. Retrieved from http://www.nursingworld.org/MainMenuCategories/

WorkplaceSafety/Healthy-Work-Environment/Environmental-Health/PolicyIssues/PrecautionaryApproach.pdf

Office of Environmental Health Hazard, California. (2007). Health effects of diesel exhaust. Retrieved from http://www.oehha.ca.gov/public_info/facts/dieselfacts.html

Penn State Extension. (2013). Gas flaring. Retrieved from http://extension.psu.edu/natural-resources/natural-gas/news/2013/gas-flaring

Perry, S. L. (2012). Development, land use, and collective trauma: the Marcellus Shale Gas boom in rural Pennsylvania. *Culture, Agriculture, Food and Environment*, *34*(1), 81-92 Pipeline and hazardous materials safety administration http://www.phmsa.dot.gov/home http://www.phmsa.dot.gov/hazmat/osd/calltoaction

Resick, L. K., Knestrick, J.M., Counts, M.M., & Pizzuto, L. K. (2013). The meaning of health among mid-Appalachian women within the context of the environment. *Journal of Environmental Studies and Sciences*, 3, 290-296.

Rutkowski,M. (May 2013) Shale gas in Poland. Retrieved from http://www.shale-gas-information-platform.org/areas/the-debate/shale-gas-in-poland.html

Saberi, P., Propert, K. J., Powers, M., Emmett, E., & Green-McKenzie, J. (2014). Field survey of health perception and complaints of Pennsylvania residents in Marcellus Shale region. *International Journal Res. Public Health*, 11, (6), 6517-6527. Doi 10.3390/ijerph110606517. Retrieved from:http://concernedhealthny.org/field-survey-of-health-perception-and-complaints-of-pennsylvania-residents-in-the-marcellus-shale-region/

Scottish environmental protection agency. Unconventional gas. Retrieved from http://www.sepa.org.uk/customer_information/energy_industry/unconventional_gas.aspx

Southwest Pennsylvanian Environmental Health Project. Retrieved from www.environmentalhealthproject.org/

Southwest Pennsylvania Environmental Health Project. (2014). Retrieved from http://www.environmentalhealthproject.org/wp-content/uploads/2014/04/reveh-2014-0002-Brown-et-al.pdf

Subra. (2009). Health survey results of current and former DISH/Clark ,Texas residents. Retrieved from https://www.earthworksaction.org/files/publications/DishTXHealthSurvey_FINAL_hi.pdf

Subra, W. (2010). Community health survey results: Pavillion, WY residents. Retrieved from http://www.earthworksaction.org/files/publications/PavillionFINALhealthSurvey-201008.pdf

Taylor, A. (2013). Freight train derails and explodes in Lac Megantic, Quebec. Retrieved from http://www.theatlantic.com/photo/2013/07/freight-train-derails-and-explodes-in-lac-megantic-quebec/100548

Timms, B.G., Howdeshell, K.L., Barton, L., Bradley, S., Richter, C. & vom Saal, FS. (2005). Estrogenic chemicals in plastic and oral contraceptives disrupt development of the fetal mouse prostate and urethra. Proceedings of the National Academy of Sciences, 10.1073/pnas.0502544102

Toluene. Retrieved from http://www.hpa.org.uk/webc/hpawebfile/hpaweb_c/1194947395545

Townsend. (n.d). Pipeline vegetation management. Retrieved from http://www.townsendcorporation.com/services/vegetation-management/pipelines/

U S Department of Transportation. Retrieved from http://www.phmsa.dot.gov/home

Vandenberg, L.N.,Maffini, M.,Wadia,P., Sonnenschein, C., Rubin,B. & Soto, A. (2007). Exposure to environmentally relevant doses of the xenoestrogen bisphenol-A alters development of the fetal mouse mammary gland. *Endocrinology. 148*(1):116-27.

Waterworld. Fracking wastewater management. Retrieved from http://www.waterworld.com/articles/wwi/print/volume-28/issue-5/regional-spotlight-us-caribbean/fracking-wastewater-management.html

Weeden, S. (2013). Natural gas developers swarm to East Africa. Retrieved from http://www.epmag.com/EP-Magazine/Natural-gas-developers-swarm-East-Africa_118082

Wilson, S., Subra, L., & Sumi, W. (2013). Reckless endangerment while fracking the Eagle Forge. Retrieved from http://www.earthworksaction.org/files/publications/FULL-RecklessEndangerment-sm.pdf

Wingspread. (1998). Precautionary principle. Retrieved from http://www.gdrc.org/u-gov/precaution-3.html