

Oil and Gas Literature Take-Aways

NOTE: This report contains summary statements from literature provided by Jeff Stoll Public Health Environment Consulting (JSPHEC). Statements include summary information from articles and contain links to original articles when possible or an email link for inquiry to JSPHEC.

Air quality

Weld County methane emissions from oil and gas production and processing in Colorado has most likely underestimated the methane attributed to natural gas by a factor of two.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Hydrocarbon Emissions Characterization in the Colorado Front Range - A Pilot Study by NOAA Gabrielle Petron 2012 - 1/1/2012

Referring to the Hydrocarbon Emissions Characterization in the Colorado Front Range - A Pilot Study by NOAA Gabrielle Petron 2012. The analysis of the tower (300-m tall tower in SW corner of Weld County) reveals a strong alkane and benzene signature in the air masses coming from northeastern Colorado (natural gas is composed primarily of "alkanes" such as methane, ethane and propane, with methane comprising up to 90% of the gas). Using a Mobile Lab platform sampling was conducted downwind from different methane sources and both the tower and mobile lab revealed a common source for the alkanes. The alkanes did not correlate with combustion tracers, so the authors hypothesize that the observed alkanes were emitted by the same source located over the Denver-Julesburg Basin. The measured alkanes indicate that Weld County methane emissions from oil and gas production and processing in Colorado has most likely underestimated the methane attributed to natural gas by a factor of two.

Potential Uncertainties

More measurements are needed to further evaluate the various potential sources associated with oil and gas operations (For example, glycol dehydrators and condensate tank flash emissions). More targeted multi-species well-calibrated atmospheric measurements are needed to evaluate current future bottom-up inventory emissions calculations for fossil fuel sector and to reduce uncertainties on absolute flux estimates for climate and air quality relevant trace gases.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Shale gas activities have not resulted in VOC levels that pose a health concern (Texas).

A.G. Bunch, C.S. Perry, L. Abraham, D.S. Wikoff, J.A. Tachovsky, J.G. Hixon, J.D. Urban, M.A. Harris, L.C. Haws -- Science of The Total Environment, Volumes 468-469; pages 832-842 - 1/15/2014

- VOCs associated with shale gas were all below health-based CVs.
- VOCs associated with shale gas showed acceptable chronic risk and hazard.
- Shale gas activities have not resulted in VOC levels that pose a health concern.
- Findings useful for understanding potential health risks in other shale plays

Measured air concentrations were compared to federal and state health-based air comparison values (HBACVs) to assess potential acute and chronic health effects. None of the measured VOC concentrations exceeded applicable acute HBACVs. Only one chemical (1,2-dibromoethane) exceeded its applicable chronic HBACV, but it is not known to be associated with shale gas production activities. Annual average concentrations were also evaluated in deterministic and probabilistic risk assessments and all risks/hazards were below levels of concern. The analyses demonstrate that, for the extensive number of VOCs measured, shale gas production activities have not resulted in community-wide exposures to those VOCs at levels that would pose a health concern. With the high density of active wells in this region, these findings may be useful for understanding potential health risks in other shale play regions.

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Literature Take-Aways

Health effects from air emissions during development of UNG are more likely to occur in residents living close to well pads

Lisa McKenzie, Colorado School of Public Health, Science of the Total Environment -- Human health risk assessment of air emissions from development of unconventional natural gas resources - 3/22/2012

Risk assessment can be used as a tool in HIAs to identify where and when public health is most likely to be impacted and to inform risk prevention strategies directed towards efficient reduction of negative health impacts. These preliminary results indicate that health effects resulting from air emissions during development of unconventional natural gas resources are most likely to occur in residents living nearest to the well pads and warrant further study. Risk prevention efforts should be directed towards reducing air emission exposures for persons living and working near wells during well completions.

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Residents are not exposed to unacceptable risks to human health from the inhalation of airborne concentrations of VOCs.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Garfield County Air Toxics Inhalation Screening level Human Health Risk Assessment, June 2005-May 2007 - CDPHE - 1/1/2012

Referring to the Garfield County Air Toxics Inhalation Screening level Human Health Risk Assessment, June 2005-May 2007 - CDPHE Disease Control and Environmental Epidemiology Division. Overall, the non-cancer hazards on either a chronic or short-term (average) basis do not exceed an acceptable value of one and the cancer risk estimates are at, or slightly above, the upper-end of EPA's acceptable risk range (1 to 100 excess cancers per 1 million individuals). Although the estimated exposures are not likely to result in significant cancer and non-cancer health effects, this screening-level analysis stresses the need for continued air monitoring and source apportionment.

Potential Uncertainties

The monitoring study only looked at a total of 43 air toxics and some important air toxics are absent which may underestimate potential risks. Most importantly, the study is based on the limited monitoring data collected on a once per month or once per quarter basis which is significantly lower than the EPA National Air Toxic Program recommended data collection frequency on a once per 6-day basis. Additionally, science is currently unable to assess exposures to multiple air toxics simultaneously. Overall, uncertainties and limitations exist in the methods used to assess exposure and toxicity. Due to these limitations, this investigation is best viewed as a "snapshot" of air quality.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Literature Take-Aways

Residents are not being exposed to unacceptable health risks via inhalation of airborne concentrations of measured air toxics such as non-methane organic compounds and carbonyls.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Garfield County Air Toxics Inhalation: Screening Level Human Health Risk Assessment, 2008- CDPHE Disease Control and Environmental Epidemiology Division - 1/1/2012

Referring to the Garfield County Air Toxics Inhalation: Screening Level Human Health Risk Assessment, 2008- CDPHE Disease Control and Environmental Epidemiology Division. The available information suggests a potential for public health impacts across the oil and gas development areas in Garfield County. The estimated cumulative lifetime cancer risks for the 6 air toxics with known toxicity values are at or slightly above the high-end of EPA's acceptable cancer risk range of 1 to 100 excess cancers in a million (1E-06 to 1E-04) across all monitoring sites. Each of the 20 individual air toxics assessed at any monitoring site have a chronic noncancer hazard estimate well below an acceptable value of one. However, when accounting for the cumulative chronic noncancer hazards for all of these 20 air toxics the chronic noncancer hazard estimate is just below the acceptable level of one across the two monitoring sites.

The findings of this risk assessment support the need for the following:

- Continue long-term air monitoring; increase the frequency of sampling; and include in the sampling of a complete list of contaminants associated with oil and gas development.
- Implement short-term (acute) air monitoring by collecting 1-hour air samples in order to evaluate health risks posed by intermittent peak exposures.
- Determine source apportionment including sources other than the oil and gas operations, such as stationary industrial sources and mobile traffic sources.
- Continue management of the risk posed by potential exposures to air toxics as a result of increase in oil and gas development activities (e.g., additional monitoring, sample analysis, and action as appropriate).

Potential Uncertainties

Overall, it is important to note that the cancer risks are likely to be underestimated in this assessment because cancer toxicity values are only available for a small number of air toxics. Also, health risk assessments provide predictions of hypothetical health risks, which are intended as screening tools for risk managers and cannot be used to make realistic predictions of biological effects. Finally, this investigation is best viewed as a "snapshot" of air quality due to the uncertainties and limitations in the methods used to assess exposure and toxicity.

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Literature Take-Aways

The current state of the science is unable to assess exposures to complex mixtures of air toxics.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2010 (Principal Investigator Raj Goyal) - 1/1/2012

Referring to the Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2010 (Principal Investigator Raj Goyal). It should be noted that the current state of the science is unable to assess exposures to complex mixtures of air toxics, especially, synergistic and antagonistic interactions at low levels.

Potential Uncertainties

The cancer risks and noncancer hazards for 65 out of 86 contaminants cannot be quantitatively estimated due to limited toxicological information evaluation based on the available toxicity information. It should be noted that the current state of the science is unable to assess exposures to complex mixtures of air toxics, especially, synergistic and antagonistic interactions at low levels. Not all compounds that may have been associated with natural gas development were measured.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

The harm to people's health from breathing ambient air in Garfield County cannot be determined.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2010 (Principal Investigator Raj Goyal) - 1/1/2012

Referring to the Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2010 (Principal Investigator Raj Goyal). It cannot currently be determined if breathing ambient air in the monitored areas of Garfield County could harm people's health.

Potential Uncertainties

The cancer risks and noncancer hazards for 65 out of 86 contaminants cannot be quantitatively estimated due to limited toxicological information evaluation based on the available toxicity information. It should be noted that the current state of the science is unable to assess exposures to complex mixtures of air toxics, especially, synergistic and antagonistic interactions at low levels. Not all compounds that may have been associated with natural gas development were measured.

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Literature Take-Aways

All well completions should be converted over to green completion technology in Colorado and elsewhere.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Analysis of Data Obtained from the Garfield County Air Toxics Study – Summer 2008 - CDPHE Air Pollution Control Division - 1/1/2012

Referring to the Analysis of Data Obtained from the Garfield County Air Toxics Study – Summer 2008 - CDPHE Air Pollution Control Division. The data collected at each of these sites indicates that the completion activities have the potential for higher emissions of organic compounds into the surrounding area compared to drilling operations. This study provides support for the push to convert all well completions over to green completion technology in Colorado and elsewhere. The addition of this technology could help reduce future emissions. The addition of sampling around well pads that are undergoing activities other than drilling and completion could also be useful.

Potential Uncertainties

The scope of this air monitoring effort was not intended to serve as an all encompassing large scale assessment of all possible processes within the energy development industry or address every potential variable (seasonality, temporal, operational, etc.). Rather, it was designed to compare and estimate the potential emissions from these two processes taking place on a well pad.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Risk prevention efforts should be directed towards reducing air emission exposures for persons living and working near wells during well completions.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources – Colorado School of Public Health 2012. - 1/1/2012

Referring to the Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources – Colorado School of Public Health 2012. These preliminary results indicate that health effects resulting from air emissions during development of unconventional natural gas resources are mostly likely to occur in residents living nearest the well pads and warrant further study. Risk prevention efforts should be directed towards reducing air emission exposures for persons living and working near wells during well completions.

Potential Uncertainties

As with all risk assessments, scientific limitations may lead to over- or underestimation of the actual risks. The risk assessment also was limited by the spatial and temporal scope of the available monitoring data. The ½ mile cut point for defining the two different exposed populations in the exposure scenarios was based on complaint reports from residents living within ½ mile of existing unconventional natural gas development, which were the only available data. The actual distance which residents may experience greater exposures from air emissions may be less than or greater than a ½ mile, depending upon dispersion and local topography and meteorology. These limitations and uncertainties in our risk assessment highlight the preliminary nature of the results.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Literature Take-Aways

Emissions associated with hydraulic fracturing are within standards set by the air quality regulations according to a study of the Inglewood Oil Field in Los Angeles County, California.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Air Emissions: Emissions associated with high-volume hydraulic fracturing were within standards set by the regional air quality regulations of the South Coast Air Quality Management District.

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Health effects resulting from air emissions during development of unconventional natural gas resources are mostly likely to occur in residents living nearest the well pads.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources – Colorado School of Public Health 2012 - 1/1/2012

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<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Community

Literature Take-Aways

Noise and vibration associated with high-volume hydraulic fracturing are within the limits of community standards according to a study of the Inglewood Oil Field in Los Angeles County, California.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Noise and Vibration: Noise and vibration associated with high-volume hydraulic fracturing and high-rate gravel packing operations at the Inglewood Oil Field were within the limits set forth in the Community Standards District (CSD). (NOTE: 68 dB within 200 feet, which is in the range of normal conversation, or perhaps a piano played)

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Literature Take-Aways

There are possible public health benefits as well as occupational, environmental and community hazards that exist.

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

Finally, material in the technical reports should be understood as providing a thorough hazard identification for hydraulic fracturing, and when appropriate, a prioritization according to likelihood of occurrence. The reports do not provide a scientific risk assessment for aspects of hydraulic fracturing.

This report is concerned with potential hazards that are not only chemical (i.e., toxicants) but also those that are physical, biological, and psychosocial. In many ways, this report may be considered a hazard identification piece. While a number of hazards have been identified, largely from studies performed outside of Michigan, there exists limited data linking these hazards with human exposures, thus limiting the opportunity to conduct a risk assessment.

Possible hazards in the workplace include accidents and injuries, exposure to excessive noise and inadequate lighting conditions, exposures to silica and industrial chemicals, and shift or night work. Possible hazards in the surrounding environment include impaired local and regional air quality, water pollution, and degradation of ecosystem services. Possible hazards in nearby communities include increased traffic and motor vehicle accidents, stress related to risk perception amongst residents, and boomtown-associated effects such as a strained healthcare system and road degradation. Public health benefits exist, and these may include improved economic conditions in communities and energy or pollution tradeoffs related to a shift away from coal and oil. The risks and benefits can vary from local to global scales.

Public policy should be grounded in strong, objective peer-reviewed science rather than anecdotes and beliefs. Speculative conclusions and opinions about possible hazards based solely upon anecdotes and oversimplified chronologies are not a sufficient foundation to advance state regulatory reforms or policies. Nevertheless, health concerns expressed by community members, especially those with scientific plausibility and those recurring across temporal and spatial scales need to be taken seriously. In this report, all currently available evidence was reviewed and considered.

In October 2012, the Center for Local, State and Urban Policy (CLOSEUP) at the University of Michigan Ford School, conducted a telephone survey of 415 Michigan residents. Of those interviewed, via an open-ended question on the 'primary potential benefit of fracking', 20% were in support of hydraulic fracturing due to the industry's ability to create jobs and stimulate local investments. Further, 82% of survey respondents indicated that natural gas was 'very important' (36%) or 'somewhat important' (46%) to Michigan's economy. According to a 2010 HIS Global Insight report, the hydraulic fracturing industry has created over 600,000 jobs nationwide to date. This number is projected to reach 1.6 million by the year 2035. In Michigan, a 2012 HIS Global Insight report found that unconventional natural gas development accounted for 28,063 total jobs in 2010 and is projected to increase to 63,380 jobs by 2035.

The largest percentage of workers falls in the general services category, which includes an estimated 45% of the 601,348 workers nationally. The lowest categories of job creation are in government and agriculture, both estimated at about 1% of workers nationally¹⁴. When broken down by individual well operation, there is an average of 420 workers per location across 150 occupations. Approximately 90% of these jobs occur during the development and drilling phases of a hydraulic fracturing operation. Typically pre-drilling requires a time period of about six to nine months, with actual drilling occurring over two months¹⁶. Thus the vast majority of jobs associated with hydraulic fracturing operations are short-term temporary positions, but workers may move across sites and thus these positions may be longer-term.

Literature Take-Aways

A majority of hydraulic fracturing jobs require little post-secondary education; however, most do require experience-driven skills, unique industry related knowledge, and are highly intensive 12,16,17 . Long-term residents of rural communities often find the prerequisite drilling experience an employment barrier, and thus workers are typically brought in from outside the community to fill such positions. While there is a lack of data tracking the residency of workers, many are thought to be transient or of a migrant worker population. According to a report on the history of Pennsylvania's energy industry and the 2010 census data, about 40% of drilling companies utilized non-resident, temporary employees. This is especially true for the larger energy companies who hire from an international pool and have access to supply-chain services.

These trends can be changed if local training and education facilities were more widely available to residents of targeted natural gas rich communities. It is important to also note that migrant workers may experience unique health effects

Occupational hazards found at a typical hydraulic fracturing operation are similar to those present at most construction sites. Notable physical hazards may include slips and falls, hand and finger injuries, muscle strains, exposure to extreme temperatures and inadequate lighting conditions, fires and explosions, and injuries caused by moving vehicles, heavy equipment, high pressure lines, pinch points, and working in confined spaces 20 . Long work hours and shift work can increase workers risk of fatigue, which can negatively affect safety and performance and lead to a number of health conditions such as cardiovascular disease and diabetes. Properly training workers in the safety protocols related to each job performed can aid in avoiding many of these hazards. Also, every worker should have the appropriate personal protective equipment for the job that they will be performing and be properly trained on how to use this equipment.

Occupational hazards found at a typical hydraulic fracturing operation are similar to those present at most construction sites. Notable physical hazards may include slips and falls, hand and finger injuries, muscle strains, exposure to extreme temperatures and inadequate lighting conditions, fires and explosions, and injuries caused by moving vehicles, heavy equipment, high pressure lines, pinch points, and working in confined spaces.

The U.S. Department of Labor, Bureau of Labor Statistics (BLS), reports fatal and non-fatal injuries and illnesses for the oil and gas industry as a whole, which includes natural gas extraction and hydraulic fracturing. Fatal injuries for the oil and gas industry between 2004 and 2008 ranged from 98 to 125 deaths annually. In 2008, the major causes of fatal injuries were transportation (49%), contact with objects and equipment (30%), and fires and explosions (18%). Based on BLS data, between 2003 and 2009 there were 202 motor vehicle fatalities for workers in the oil and gas sector, and the fatality rate for motor vehicle accidents is approximately 8.5-times greater than for other occupational sectors.

In terms of non-fatal injuries, in 2011 the injury and illness rate for the oil and gas industry in the United States was 0.9 incidents per 100 workers, with over half of these incidents resulting in days spent away from work or job transfer or restriction.

There are a few news reports on injuries and deaths from outside of Michigan. For example, in North Dakota a hydraulic fracturing worker was killed and another worker was injured on January 19th, 2013 at a site located north of Watford City. Reports indicate that a pipe became disconnected and fatally struck the worker in the head. There have also been reports that the traumatic injury rate in the Watford City (pop. 2,482) region has increased 200% since 2007 from incidents related to the hydraulic fracturing operations there. (NOTE: This is likely only 2 cases based on the size of the population).

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Literature Take-Aways

Hydraulic fracturing does not create or contribute to abnormal health risks in the community. (Los Angeles County).

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Community Health: The Los Angeles County Department of Public Health conducted a community health assessment that found no statistical difference of the health of the local community compared to Los Angeles County as a whole. Conventional hydraulic fracturing and high-rate gravel packs operations took place at the oil field, within the period addressed by the health assessment. Given the fact that public health trends in the area surrounding the field were consistent with public health trends throughout the L.A. Basin it is reasonable to conclude that the conduct of hydraulic fracturing during the analyzed period did not contribute or create abnormal health risks.

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

There are possible community hazards

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

Possible hazards in nearby communities include increased traffic and motor vehicle accidents, stress related to risk perception amongst residents, and boomtown-associated effects such as a strained healthcare system and road degradation.

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Economy

Oil and gas accounts for 51, 200 quality jobs in Colorado.

Leeds School of Business, University of Colorado, Business Research Division -- Assessment of Oil and Gas Industry: 2012 Industry Economic and Fiscal Contributions in Colorado - 7/1/2013

The broad oil and gas supply chain accounted for some 51,200 jobs, many of which are among Colorado's more lucrative positions; core jobs in drilling, extraction, and support activities pay wages more than twice Colorado's average wage.

http://www.cred.org/wp-content/uploads/2013/11/UniversityofColorado_LeedsSchoolofBusiness_OilNaturalGasIndustry_EconomicStudy2012.pdf

Literature Take-Aways

The oil and gas industry generated \$29.6 billion output in Colorado's economy and directly contributed almost \$1.6 billion to public revenue in 2012

Leeds School of Business, University of Colorado, Business Research Division -- Assessment of Oil and Gas Industry: 2012 Industry Economic and Fiscal Contributions in Colorado - 7/1/2013

CONCLUSION

This study quantified the economic and fiscal contributions of Colorado's oil and gas industry in 2012. The oil and gas industry generated \$29.6 billion output in Colorado's economy and directly contributed almost \$1.6 billion to public revenue in 2012. A major source of economic activity was employment. The broad oil and gas supply chain accounted for some 51,200 jobs, many of which are among Colorado's more lucrative positions; core jobs in drilling, extraction, and support activities pay wages more than twice Colorado's average wage. A major contributor of the public revenue collected from the oil and gas industry was property taxes. Largely due to a high assessment ratio used to value production, property taxes amounted to some \$600.7 million in 2012.

Further research is needed to capture the full impact of the oil and gas industry in Colorado. For example, the scope of this study required that private leases and royalties be estimated using government rates, while actual rates may be significantly higher. Also, as this report focuses on the impact in 2012, updates in future years would help describe this constantly changing industry.

While our study illustrated the market contributions of the oil and gas industry, there are many potentially positive and potentially negative nonmarket economic impacts related to the oil and gas industry (e.g., locally sourced energy, air quality, substitution, water usage, etc.). While environmental and societal impacts of this extraction industry are currently being fiercely debated, the economic contributions of the industry should be present in the discussions calling for drilling moratoriums, understanding that in Colorado, the industry impacts thousands of jobs and billions in wages, funds state and local government (including schools), and makes purchases from every industry. Future research could attempt to quantify these nonmarket economic impacts and include them in the overall cost-benefit analysis.

http://www.cred.org/wp-content/uploads/2013/11/UniversityofColorado_LeedsSchoolofBusiness_OilNaturalGasIndustry_EconomicStudy2012.pdf

Literature Take-Aways

The economic impact from a statewide ban on fracking would be severe.

Richard Wobbekind and Brian Lewandowski; Leeds School of Business, University of Colorado-Boulder -- HYDRAULIC FRACTURING BAN: The Economic Impact of a Statewide Fracking Ban in Colorado - 3/1/2014

A study using a calibrated dynamic economic modeling system developed by Regional Economic Models Inc. (REMI) shows that a statewide fracking ban would result in 93,000 fewer jobs, \$12 billion in lost gross domestic product (GDP) and an annual reduction of \$985 million in tax revenue for local and state governments between 2015 and 2040.

The study also finds that a statewide fracking ban would cost local and state governments \$567 million per year in lost annual tax revenues for each of the first five years, and \$985 million annually on average through 2040.

CONCLUSION

This report shows the estimated economic impacts associated with a statewide fracking ban. It is based on currently known economic factors of the industry related to production, prices, employment, and taxes. A statewide fracking ban would prove damaging to the Colorado economy, setting the state back an average of 68,000 jobs in the first five years and \$8 billion in GDP. Over the long term (2015-2040), the impact of a ban would result in average 93,000 fewer jobs and \$12 billion in lower GDP when compared to a baseline scenario.

<http://www.cred.org/wp-content/uploads/2014/03/Economic-Impact-of-Fracking-Moratorium-Final-Report-March-2014-032414-3.pdf>

Literature Take-Aways

Largely due to a high assessment ratio used to value production, property taxes amounted to some \$600.7 million in 2012.

Leeds School of Business, University of Colorado, Business Research Division -- Assessment of Oil and Gas Industry: 2012 Industry Economic and Fiscal Contributions in Colorado - 7/1/2013

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While our study illustrated the market contributions of the oil and gas industry, there are many potentially positive and potentially negative nonmarket economic impacts related to the oil and gas industry (e.g., locally sourced energy, air quality, substitution, water usage, etc.). While environmental and societal impacts of this extraction industry are currently being fiercely debated, the economic contributions of the industry should be present in the discussions calling for drilling moratoriums, understanding that in Colorado, the industry impacts thousands of jobs and billions in wages, funds state and local government (including schools), and makes purchases from every industry. Future research could attempt to quantify these nonmarket economic impacts and include them in the overall cost-benefit analysis.

http://www.cred.org/wp-content/uploads/2013/11/UniversityofColorado_LeedsSchoolofBusiness_OilNaturalGasIndustry_EconomicStudy2012.pdf

Literature Take-Aways

Incorrect perceptions of environmental impacts can reduce property value by 26 percent

Resources For the Future, Discussion Paper, Lucija Muehlenbachs, El isheba Spiller , and Christopher Timmins -- Shale Gas Development and the Costs of Groundwater Contamination Risk - 3/1/2013

Even if shale gas operations do not contaminate groundwater in the short run, the stigma from the possibility of future groundwater contamination may be capitalized negatively into property values, resulting in important long-term consequences for homeowners.

While shale gas development can result in rapid local economic development, negative externalities associated with the process may adversely affect the prices of nearby homes. We utilize a difference-in-differences estimator with additional controls for house fixed effects and the boundary of the public water service area in Washington County, Pennsylvania to identify the capitalization of groundwater contamination risk in property values, differentiating it from other externalities, lease payments to homeowners, and local economic development. We find that proximity to wells increases property values. However, groundwater contamination concerns fully offset those gains by reducing property values up to 26 percent.

Even if shale gas operations do not contaminate groundwater in the short run, the stigma from the possibility of future groundwater contamination may be capitalized negatively into property values, resulting in important long-term consequences for homeowners. Important for housing markets and local tax revenues, the environmental impact of shale gas development and the perception of the risks associated with these processes, as well as increased truck traffic or the visual burden of a well pad, could depress property values.

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Environmental

There are possible environmental hazards

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

Possible hazards in the surrounding environment include impaired local and regional air quality, water pollution, and degradation of ecosystem services.

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General

Literature Take-Aways

Review of literature on health impacts and uncertainties to address with future research

John L. Adgate, Bernard D. Goldstein, and Lisa M. McKenzie; Colorado School of Public Health, University of Colorado Denver; Graduate School of Public Health, University of Pittsburgh -- Environmental Science and Technology - 2/10/2014

The rapid increase in unconventional natural gas (UNG) development in the United States during the past decade has brought wells and related infrastructure closer to population centers. This review evaluates risks to public health from chemical and nonchemical stressors associated with UNG, describes likely exposure pathways and potential health effects, and identifies major uncertainties to address with future research.

The most important occupational stressors include mortality, exposure to hazardous materials and increased risk of industrial accidents. For communities near development and production sites the major stressors are air pollutants, ground and surface water contamination, truck traffic and noise pollution, accidents and malfunctions, and psychosocial stress associated with community change. Despite broad public concern, no comprehensive population-based studies of the public health effects of UNG operations exist. Major uncertainties are the unknown frequency and duration of human exposure, future extent of development, potential emission control and mitigation strategies, and a paucity of baseline data to enable substantive before and after comparisons for affected populations and environmental media. Overall, the current literature suggests that research needs to address these uncertainties before we can reasonably quantify the likelihood of occurrence or magnitude of adverse health effects associated with UNG production in workers and communities.

Health

Increased risk of childhood cancer near HF facilities is not supported by research

Journal of Occupational and Environmental Medicine, Volume 55, Number 7 -- Childhood Cancer Incidence in Pennsylvania Counties in Relation to Living in Counties With Hydraulic Fracturing Sites - 7/1/2013

Objective: Evaluate whether childhood cancer incidence is associated with counties with hydraulic fracturing (HF). Methods: We compared cancer incidence in children in Pennsylvania counties before and after HF drilling began, using standardized incidence ratios (SIRs) and 95% confidence intervals (CIs). Results: The total number of cancers observed was close to expected both before drilling began (SIR = 0.94; 95% CI, 0.90 to 0.99) and after drilling (SIR = 1.02; 95% CI, 0.98 to 1.07) for counties with oil and natural gas wells. Analyses for childhood leukemia were also unremarkable (SIR for leukemia before drilling = 0.97 [95% CI, 0.88 to 1.06]; SIR for leukemia after drilling = 1.01 [95% CI, 0.92 to 1.11]). A slightly elevated SIR was found for central nervous system tumors after drilling (SIR = 1.13; 95% CI, 1.02 to 1.25). This was because of a slight excess in those counties with the fewest number of wells. Conclusions: This study offers comfort concerning health effects of HF on childhood cancers.

The observed number of childhood cancers both before and after drilling were as expected, on the basis of Surveillance, Epidemiology, and End Results (SEER) cancer incidence rates. This research does not support a conclusion that populations living in the vicinity of HF activities are at increased risk of childhood cancer, childhood leukemia, or childhood CNS tumors.

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Literature Take-Aways

The health of people in Garfield County is not different from the health of residents in other Western slope counties.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker - 1/1/2012

Referring to the Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker. Based on the data available to us from state, hospital association, and healthcare provider sources, the health of people in Garfield County is not different from the health of residents in other Western slope counties.

Potential Uncertainties

Lack of baseline health data with which to determine trends or changes, relatively new presence of the industry in the region and both risk and causation involve probability statements; may not be able to say with certainty that a particular health condition is caused by an exposure to potentially toxic materials. There are numerous gaps and uncertainties in our understanding of pollution from natural gas operations in Garfield County. The motivation for the recommendations is to reduce these uncertainties and fill data gaps. Better information is needed in order to make complete and accurate evaluation to threats to human health.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

We cannot say conclusively that negative health trends are directly related to natural gas industry activities.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker - 1/1/2012

Referring to the Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker. We cannot say conclusively that any of these health trends are directly related to the presence of natural gas industry activities or to other factors.

Potential Uncertainties

Lack of baseline health data with which to determine trends or changes, relatively new presence of the industry in the region and both risk and causation involve probability statements; may not be able to say with certainty that a particular health condition is caused by an exposure to potentially toxic materials. There are numerous gaps and uncertainties in our understanding of pollution from natural gas operations in Garfield County. The motivation for the recommendations is to reduce these uncertainties and fill data gaps. Better information is needed in order to make complete and accurate evaluation to threats to human health.

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Literature Take-Aways

There is not a health crisis in Garfield County.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker - 1/1/2012

Referring to the Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker. At the present time based on our data sources there is not a health crisis in Garfield County, but there are some health trends that should be monitored. We cannot say conclusively that any of these health trends are directly related to the presence of natural gas industry activities or to other factors. Based on the data available to us from state, hospital association, and healthcare provider sources, the health of people in Garfield County is not different from the health of residents in other Western slope counties.

Potential Uncertainties

Lack of baseline health data with which to determine trends or changes, relatively new presence of the industry in the region and both risk and causation involve probability statements; may not be able to say with certainty that a particular health condition is caused by an exposure to potentially toxic materials. There are numerous gaps and uncertainties in our understanding of pollution from natural gas operations in Garfield County. The motivation for the recommendations is to reduce these uncertainties and fill data gaps. Better information is needed in order to make complete and accurate evaluation to threats to human health.

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To say whether health disparities are related to UOG or to other factors requires more information.

Environmental Review, Vol. 20, 2012; www.nrcresearchpress.com/er -- Environmental pathways of potential impacts to human health from oil and gas development in northeast British Columbia, Canada - 6/1/2012

There are a myriad of potential health impacts from UOG development in NEBC. Contaminants from UOG activity can reach human receptors through the air, water, soil, and food pathways. Some contaminants such as PAH or radioactivity may be inhaled, absorbed, and ingested reaching people through all pathways. Many of these contaminants including air pollutants, radiation (such as radon), and volatile hydrocarbons in air or soil, are associated with lung cancer, respiratory ailments, and related mortalities — health indicators for which NEBC shows disparity. Modelling results and observations to date have found that levels of some contaminants are high enough to cause negative human health impacts; however, to determine whether or not UOG related contaminants are the cause of health disparities requires further research. That research must include long-term spatially

representative monitoring of contaminants in the environment as well as spatial epidemiological analyses of potentially related health symptoms and any confounding lifestyle factors.

Non-contaminant stressors such as noise, and indirect stresses on livelihood and wellbeing may also be impacting human health in NEBC. Due to the density of sources, the nature of practices, and the sharing of land between industry and residents, there is a potential for impacts to public health from UOG. To protect human health and manage associated impacts, the combined influence of all UOG activities and their stressors must be considered.

Accordingly, there seems to be a correlation in British Columbia between UOG activity and increased rates of lung cancer, morbidity, and respiratory diseases. However, correlation does not mean cause and effect. Residents in NEBC also smoke and drink more than the rest of the province's population (Fang et al. 2010). Therefore, to say whether NEBC's health disparities are related to UOG or to other factors requires more information.

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Literature Take-Aways

No negative effect on health and environment due to hydraulic fracturing according to study of the Inglewood Oil Field in Los Angeles County, California.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Groundwater: Groundwater beneath the Inglewood Oil Field is not a source of drinking water, although the water quality must meet the standards for such a source. Groundwater beneath the Baldwin Hills is geologically isolated from the surrounding Los Angeles Basin and any water supply wells. Routine tests by the water purveyor show the community's water supply meets drinking water standards, including the period of high-rate gravel packs and conventional hydraulic fracturing, as well as the first high-volume hydraulic fracture in September 2011. In addition, the Inglewood Oil Field has an array of groundwater monitoring wells to measure water quality. Apart from arsenic, which is naturally high in groundwater of the Los Angeles Basin, the analyzed constituents meet drinking water standards. Before-and-after monitoring of groundwater quality in monitor wells did not show impacts from high-volume hydraulic fracturing and high-rate gravel packing.

Well Integrity: Tests conducted before, during and after the use of hydraulic fracturing and high-rate gravel packing showed no effects on the integrity of the steel and cement casings that enclose oil wells. There is also an ongoing program of well integrity tests at the Inglewood Oil Field.

Methane: Methane analyzed in soil gas and groundwater, as well as carbon and hydrogen isotopic ratios in methane, at the Inglewood Oil Field did not show levels of concern. There was no indication of impacts from high-volume hydraulic fracturing or high-rate gravel packing.

Ground Movement and Subsidence: Before-and-after studies of high-volume hydraulic fracturing and high-rate gravel packing at the Inglewood Oil Field showed no detectable effect on ground movement or subsidence.

Induced Earthquakes: Before-during-and-after measurements of vibration and seismicity, including analysis of data from the permanently installed California Institute of Technology accelerometer at the Baldwin Hills, indicates that the high-volume hydraulic fracturing and high-rate gravel packs had no detectable effects on vibration, and did not induce seismicity (earthquakes).

Noise and Vibration: Noise and vibration associated with high-volume hydraulic fracturing and high-rate gravel packing operations at the Inglewood Oil Field were within the limits set forth in the CSD.

Air Emissions: Emissions associated with high-volume hydraulic fracturing were within standards set by the regional air quality regulations of the South Coast Air Quality Management District.

Community Health: The Los Angeles County Department of Public Health conducted a community health assessment that found no statistical difference of the health of the local community compared to Los Angeles County as a whole. Conventional hydraulic fracturing and high-rate gravel packs operations took place at the oil field, within the period addressed by the health assessment. Given the fact that public health trends in the area surrounding the field were consistent with public health trends throughout the L.A. Basin it is reasonable to conclude that the conduct of hydraulic fracturing during the analyzed period did not contribute or create abnormal health risks.

Literature Take-Aways

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Natural gas production uses chemicals.

Journal of Pediatric Nursing; Vol. 27; pg 383-389 -- Environmental Health Advocacy: An Overview of Natural Gas Drilling in Northeast Pennsylvania and Implications for Pediatric Nursing - 1/1/2012

Because many chemicals used in the fracking process have known harmful effects at certain concentrations (PA-DEP, 2010), the influx of these additives into the environment is of grave concern.

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There is limited data linking hazards with human exposure.

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

This report is may be considered a hazard identification piece. While a number of hazards have been identified there exists limited data linking these hazards with human exposures, thus limiting the opportunity to conduct a risk assessment.

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Better information is needed in order to make complete and accurate evaluation to threats to human health.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker - 1/1/2012

Potential Uncertainties

Lack of baseline health data with which to determine trends or changes, relatively new presence of the industry in the region and both risk and causation involve probability statements; may not be able to say with certainty that a particular health condition is caused by an exposure to potentially toxic materials. There are numerous gaps and uncertainties in our understanding of pollution from natural gas operations in Garfield County. The motivation for the recommendations is to reduce these uncertainties and fill data gaps. Better information is needed in order to make complete and accurate evaluation to threats to human health.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Literature Take-Aways

Health hazards from cancer and noncancer hazards in the ambient air of Garfield County are indeterminable.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2008 (Principal Investigator Raj Goyal) - 1/1/2012

Referring to the Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2008 (Principal Investigator Raj Goyal). Data reviewed in this health consultation indicate that the ambient air quality in Garfield County constitutes an indeterminate public health hazard, for all current exposures, based on the estimated theoretical cancer risks as well as noncancer hazards and the uncertainties associated with the available data.

Potential Uncertainties

Three major sources of uncertainty were factored into this conclusion: (1) the ability to realistically and continuously monitor ambient air at all places of interest and in the breathing zone of the exposed population; (2) the reality that some of the monitoring locations may detect emissions from sources other than the oil and gas development activities; and (3) the inability to adequately capture intermittent peak exposures, as indicated by grab sampling events. Overall, given the uncertainty in the limited data and uncertainty in the exposure patterns of the community, more air monitoring is urged.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Methane

Analysis of methane in soil gas and groundwater in the Inglewood Oil Field in Los Angeles County, California show no level of concern caused by hydraulic fracturing.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Methane: Methane analyzed in soil gas and groundwater, as well as carbon and hydrogen isotopic ratios in methane, at the Inglewood Oil Field did not show levels of concern. There was no indication of impacts from high-volume hydraulic fracturing or high-rate gravel packing.

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Occupational

Literature Take-Aways

There is an association between increased clinic visits and increases in ground-level ozone levels. (Sublette County, Wyoming)

Thomas O. Forslund -- State of Wyoming Department of Health - 3/1/2013

The results of this study suggest an association of ground-level ozone with clinic visits for adverse respiratory-related effects the day following elevations of ground-level ozone in Sublette County. This analysis evaluated ground-level ozone across the range of concentrations observed, with the majority of days below the regulatory standards. These results are consistent with other studies in the published literature. Improved awareness and education of the public and providers of the adverse respiratory-related health effects from ground-level ozone in Sublette County should continue.

There are possible workplace hazards

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

Possible hazards in the workplace include accidents and injuries, exposure to excessive noise and inadequate lighting conditions, exposures to silica and industrial chemicals, and shift or night work.

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Motor vehicle crashes are the leading cause of work-related fatality in the oil and gas industry

Kyla D. Retzer, Ryan D. Hill, Stephanie G. Pratt (National Institute for Occupational Safety and Health, Oil and Gas Extraction Safety and Health Program) -- Accident Analysis and Prevention Journal - 11/1/2012

Motor vehicle crashes are the leading cause of work-related fatality in the U.S. as well as in the oil and gas extraction industry. This study describes the characteristics of motor vehicle-related fatalities in the oil and gas extraction industry using data from the U.S. Bureau of Labor Statistics' Census of Fatal Occupational Injuries. It compares the risk of dying in a motor vehicle crash in this industry to other major industries and among different types and sizes of oil and gas extraction companies. There were 202 oil and gas extraction workers who died in a work-related motor vehicle crash from 2003 to 2009. The motor vehicle fatality rate for workers in this industry was 8.5 times that of all private wage and salary workers (7.6 vs. 0.9, $p < .0001$). Workers from small oil and gas establishments (<20 workers) and workers from well-servicing companies were at greatest risk of dying in a motor vehicle crash. Pick-up trucks were the most frequent type of vehicle occupied by the fatally injured worker ($n = 104$, 51.5%). Safety belt non-use was identified in 38.1% ($n = 77$) of the cases. Increased focus on motor vehicle safety in this industry is needed, in particular among small establishments. Extraction workers who drive light duty vehicles need to be a specific focus.

Literature Take-Aways

An occupational health hazard was determined to exist for workplace exposures to crystalline silica.

Eric J. Esswein, Michael Breitenstein, John Snawder, Max Kiefer, and W. Karl Sieber -- Journal of Occupational and Environmental Hygiene, 10: 347–356 - 7/1/2013

Full-shift, PBZ exposures to respirable crystalline silica is an occupational exposure hazard for workers at hydraulic fracturing sites. Quartz was the only silicate mineral identified; median percentage quartz in the 111 PBZ samples was 53%. Workplace concentrations of airborne respirable silica exceeded OELs by factors of 10, 20, or more, with Sand Mover and Transfer Belt Operators having the highest relative exposures. Although workers typically wore elastomeric half-mask, air-purifying (or filtering-facepiece style) respirators, due to the magnitude of the silica concentrations measured, half-masks may not be sufficiently protective because, in some cases, respirable crystalline silica concentrations exceeded the maximum use concentration (10 times the OEL) for that type of respirator. Although effective engineering controls for crystalline silica are well established in other industries, controls to limit silica-containing dust generation during hydraulic fracturing are only now emerging due to the relatively recent understanding of the hazard and magnitude of exposure risks. Sand movers configured with some proposed controls (e.g., a mini-baghouse retrofit assembly, skirting and shrouding at the base of the machine and on the dragon tail, and use of caps on fill ports) are described in Figures 1 and 2 in the online supplemental material discussing controls and recommendations. At one site (Bakken formation in North Dakota) substitution of a ceramic proppant for a portion of silica sand resulted in lower overall measured silica exposures, but assessing the technical and economic feasibility of using ceramic proppant was beyond the scope of this study.

<http://dx.doi.org/10.1080/15459624.2013.788352>

A small number of cases of "take home" lead exposure in children of oil field workers has been documented. (Oklahoma)

Fahad Khan, MPH -- The Journal of the Oklahoma State Medical Association - 6/1/2011

Public health

There are public health benefits that exist.

University of Michigan -- Public Health Technical Report: Hydraulic Fracturing in the State of Michigan - 9/3/2013

Public health benefits exist, and these may include improved economic conditions in communities and energy or pollution tradeoffs related to a shift away from coal and oil. The risks and benefits can vary from local to global scales.

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Literature Take-Aways

There are industry factors that could present a public health risk.

Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE) -- Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker - 1/1/2012

Referring to the Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker. Risk modeling indicates that there are industry factors that could present a public health risk. Benzene emissions during uncontrolled flow back present the greatest cancer threat. The results of the risk assessment for air also indicate that reference concentrations for non-cancer effects may be exceeded for some situations. The use of best management practices can reduce that risk.

<http://www.cred.org/wp-content/uploads/2014/05/Risk-Assessment-and-Health-Studies-Summary.pdf>

Regulation

Oil and Gas Commission regulations are protective of the environment

David Neslin, Director, Colorado Oil and Gas Conservation Commission -- Testimony before the U.S. Senate Committee on Environment and Public Works & Subcommittee on Water and Wildlife - 4/12/2011

These regulations are important, and we believe they have substantially improved our protection of water resources. But we have not stopped there. We are continuing to take proactive, cost-effective steps to ensure oil and gas development, and hydraulic fracturing in particular, protects public health and the environment.

http://www.cred.org/wp-content/uploads/2014/07/Director_Neslin_Senate_Testimony_041211.pdf

The COGCC should continue to permit oil and gas operations that use hydraulic fracturing techniques.

Mike Van Dyke, Ph.D., CIH, Section Chief, Environmental Epidemiology, Occupational Health, and Toxicology, CDPHE -- Letter to Robert J. Frick, Hearing Manager, Colorado Oil and Gas Conservation Commission regarding Earth Guardians Request for Rulemaking pursuant to Rule 510. - 4/7/2014

Because the scientific literature does not support the claim that “science unequivocally shows that hydraulic fracturing is adversely impacting human health.” The COGCC should continue to permit oil and gas operations that use hydraulic fracturing techniques. At the same time, it is important for COGCC and other stakeholders to continue to explore methods for filling the critical data gaps on human exposure to facilitate more robust studies on the potential for health impacts from oil and gas activities.

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Seismicity

Literature Take-Aways

No detectable level of ground movement or subsidence due to hydraulic fracturing was detected according to study in the Inglewood Oil Field in Los Angeles County, California.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Ground Movement and Subsidence: Before-and-after studies of high-volume hydraulic fracturing and high-rate gravel packing at the Inglewood Oil Field showed no detectable effect on ground movement or subsidence.

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Hydraulic fracturing does not produce detectable effects on vibration, and does not induce seismicity (earthquakes) according to study of the Inglewood Oil Field in Los Angeles County, California.

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

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Induced Earthquakes: Before-during-and-after measurements of vibration and seismicity, including analysis of data from the permanently installed California Institute of Technology accelerometer at the Baldwin Hills, indicates that the high-volume hydraulic fracturing and high-rate gravel packs had no detectable effects on vibration, and did not induce seismicity (earthquakes).

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Water quality

Literature Take-Aways

Study of well integrity in the Inglewood Oil Field in Los Angeles County, California show no effect from hydraulic fracturing. (Los Angeles County).

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

Well Integrity: Tests conducted before, during and after the use of hydraulic fracturing and high-rate gravel packing showed no effects on the integrity of the steel and cement casings that enclose oil wells. There is also an ongoing program of well integrity tests at the Inglewood Oil Field.

Methane: Methane analyzed in soil gas and groundwater, as well as carbon and hydrogen isotopic ratios in methane, at the Inglewood Oil Field did not show levels of concern. There was no indication of impacts from high-volume hydraulic fracturing or high-rate gravel packing.

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Air Emissions: Emissions associated with high-volume hydraulic fracturing were within standards set by the regional air quality regulations of the South Coast Air Quality Management District.

Community Health: The Los Angeles County Department of Public Health conducted a community health assessment that found no statistical difference of the health of the local community compared to Los Angeles County as a whole. Conventional hydraulic fracturing and high-rate gravel packs operations took place at the oil field, within the period addressed by the health assessment. Given the fact that public health trends in the area surrounding the field were consistent with public health trends throughout the L.A. Basin it is reasonable to conclude that the conduct of hydraulic fracturing during the analyzed period did not contribute or create abnormal health risks.

<http://www.cred.org/wp-content/uploads/2014/07/Hydraulic-Fracturing-Study-Inglewood-Field10102012.pdf>

Literature Take-Aways

Hydraulic fracturing does not impact ground water

David Neslin, Director, Colorado Oil and Gas Conservation Commission -- Natural Gas Drilling: Public Health and Environmental Impacts; Testimony before the U.S. Senate Committee on Environment and Public Works & Subcommittee on Water and Wildlife - 4/12/2011

"...our environmental professionals have investigated hundreds of groundwater complaints over the years. To date, we have found no verified instance of hydraulic fracturing harming groundwater.

http://www.cred.org/wp-content/uploads/2014/07/Director_Neslin_Senate_Testimony_041211.pdf

According to before and after monitoring in the Inglewood Oil Field in Los Angeles County, California, no impact on groundwater quality was detected due to hydraulic fracturing . (Los Angeles County).

Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning -- Hydraulic Fracturing Study: PXP Inglewood Oil Field - 10/10/2012

This study draws on several sources, including sources in the peer-reviewed literature, the Inglewood Oil Field CSD, the 2008 Environmental Impact Report (EIR) conducted for the CSD, data and analyses provided by the contractor who conducted the recent hydraulic fracturing and

high-rate gravel packing operations at the field, and from numerous contractors performing monitoring studies before, during, and after the recent hydraulic fracturing and high-rate gravel packing operations at the field.

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