fracking inquiry

From: sonya mckay [redacted]
Sent: Sunday, 25 February 2018 10:46 PM
To: fracking inquiry
Subject: Fw: Submission: NT Scientific Inquiry into Fracking
Attachments: NT Scientific Inquiry into Hydraulic Fracking.pptx; NT Scientific Inquiry into fracking - Climate Change – There is an issue.pptx; NT scientific inquiry into fracking - JULIANA v US.pptx; fracking-air-pollution-IB.pdf

See Gasland 2010 @ https://www.youtube.com/watch?v=9jAgGWBuekA
GasLand 2010

GasLand 2010

Produced by Josh Fox, this film investigates instances of air and water pollution caused by fracking. Ground wat...

See REPORT: Five Major Health Threats from Fracking-Related Air Pollution
@ https://www nrdc.org/sites/default/files/fracking-air-pollution-IB.pdf through https://www nrdc.org/media/2014/141216

REPORT: Five Major Health Threats from Fracking-Related Air Pollution

SAN FRANCISCO (December 16, 2014) – A growing body of evidence shows that people both near and far from oil and ...

NRDC ISSUE BRIEF

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Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities

Just off Interstate Highway 25, Drill Rig in front of homes in the town of Frederick in Weld County, Colorado. Pipes, vehicles and storage tanks also stand in front of homes as hazy, snow capped Rocky Mountains stand in the background.

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INTRODUCTION

Hydraulic fracturing ('fracking') and other well stimulation methods have led to a rapid expansion of oil and gas development in the United States.[1] This expansion has brought oil and gas development closer to backyards and communities and increased the potential for human exposure to new contaminants and threats. At the same time, a growing body of new research points to health threats from unconventional oil and gas development and fracking in particular. Although health discussions, particularly in eastern states, have focused on drinking water contamination, there is mounting evidence for a range of health threats from air pollution as well. For example, research has linked pollution from fracking to unhealthy levels of smog and of toxic air contaminants. Exposure to this pollution can cause eye, nose, and throat irritation, respiratory illnesses, central nervous system damage, birth defects, cancer, or premature death.[2] At the same time, the oil and gas industry has been exempted from many regulations that limit air pollution from industrial activity.[3] At the federal level, the Environmental Protection Agency (EPA) recently issued new standards to limit harmful air pollution from the oil and gas industry—but these still contain major gaps.[4] Health protective regulations are also hampered by lack of scientific data on the potential cumulative risks posed by the combined emissions from a dense network of wells and associated infrastructure such as pipelines, compressor stations, and roads. State regulations are patchy and enforcement often cannot keep up with the industry's rapid expansion, resulting in insufficient protection from air pollutants.

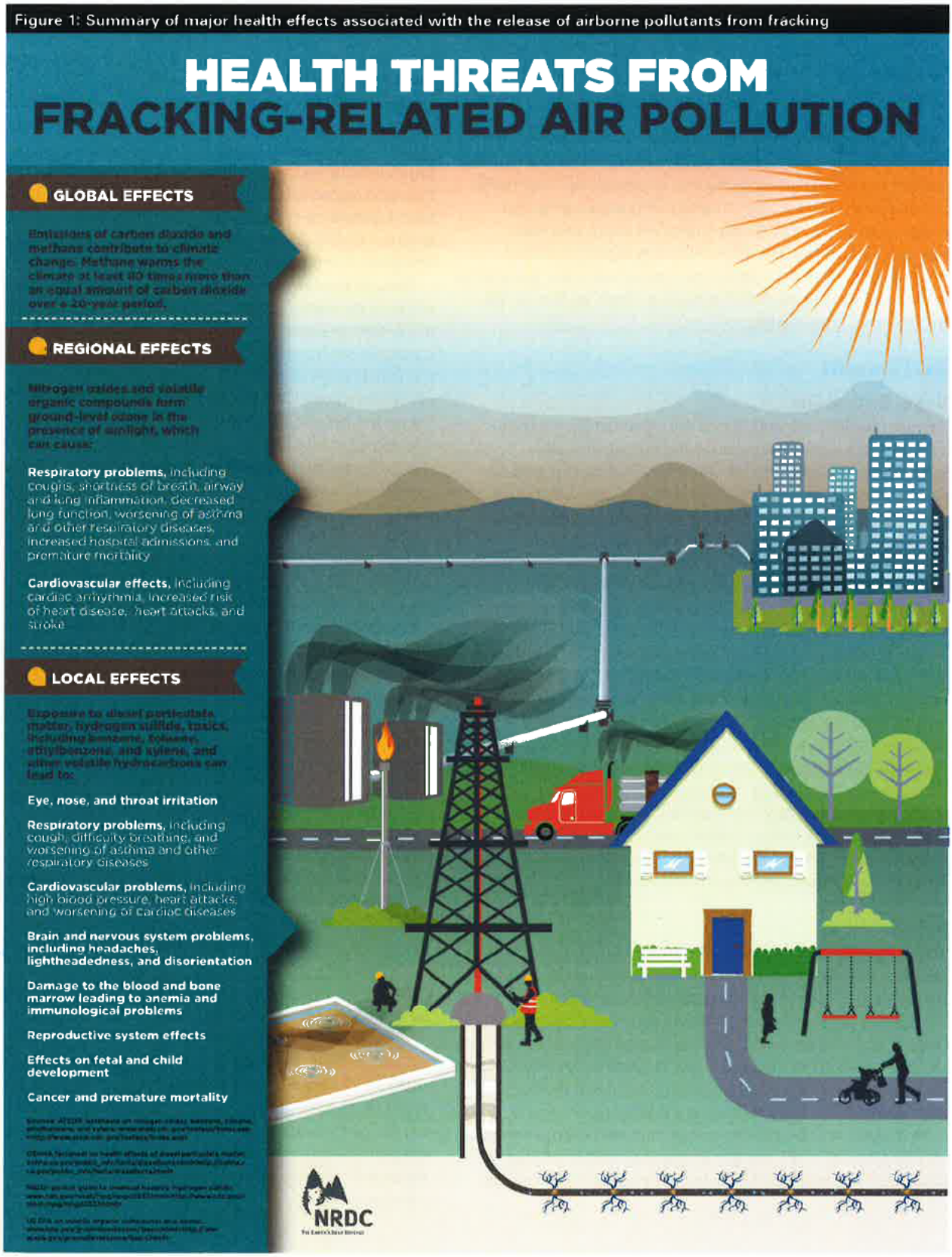
HEALTH STUDIES FIND IMPACTS FROM FRACKING-RELATED AIR POLLUTION

Conventional oil and gas production has been known for some time to create harmful air emissions.[5] With the increase in fracking activity, more and more studies now document emissions of airborne pollutants at and near fracking sites that are known to cause cancer and harm the nervous, respiratory, and immune systems (see Figure 1). At the same time, people and communities in areas with many hydraulically fractured wells report health problems consistent with these types of exposures.[6,7,8,9,10] While it is difficult to measure actual exposures to pollutants from nearby fracking operations and establish clear links to adverse health outcomes, some studies found associations between air pollutants that are present at oil and gas production sites and health impacts observed in nearby communities.[11,12] In Colorado, for example, an evaluation of birth defects in areas with high concentrations of oil and gas activity found that mothers who lived near many oil and gas wells were 30 percent more likely to have babies with heart defects.[13] Similarly, preliminary results from a study in Pennsylvania show impacts among newborns that could be linked to air pollution such as increases in low birth weight.[14]

In many rural areas, the boom in oil and gas activity has been linked to unhealthy spikes in ozone concentrations.[15] In 2008 and 2011, increased ozone concentrations in Wyoming's Sublette County were associated with subsequent increases in outpatient clinic visits for respiratory problems.[16] Researchers who looked at air pollution levels near fracking sites in Colorado also found an increased risk of chronic and sub-chronic effects mainly stemming from oil and gas related pollutants, which can harm the respiratory and neurological systems and lead to symptoms like shortness of breath, nosebleeds, headaches, dizziness, and chest tightness.[17]

Thus, while research into the health effects of air pollution from unconventional oil and gas development is ongoing, there is mounting evidence that it causes pollution, which can affect the health of workers and communities.

Figure 1: Summary of major health effects associated with the release of airborne pollutants from fracking



AIR POLLUTION FROM FRACKING

A comprehensive literature review identified 15 different oil and gas development processes and sources—including the drilling process, wastewater, and condensate tanks—that can release air contaminants (see Figure 2 in the Appendix).[18] The authors conclude that "there is legitimate concern that local air pollution may produce adverse effects in individuals who live near the high emitting site or processes." The rapid expansion of fracking, both in areas with existing oil and gas operations and previously undrilled areas, can lead to an increase in the type of pollution generally found at conventional oil and gas development and to other pollutants specific to fracking, such as silica sand, fracking chemicals, and flowback wastewater.

Local Impacts

Diesel Emissions

Diesel emissions originate from the combustion engines of heavy trucks and machinery used during well site preparation, drilling, and production. Exhaust from diesel engines contains hundreds of toxic chemicals. Of greatest concern is the fine diesel soot particles, which can lodge deep within the lungs, increasing health risks including: emergency room visits, hospital admissions, asthma attacks, cardiopulmonary disease (including heart attack and stroke), respiratory disease, adverse birth outcomes, and premature death (from pneumonia, heart attack, stroke and lung cancer).[19,20] Researchers are concerned about local residents' increased risk of exposure to diesel exhaust.[21] A study of regional air quality impacts from natural gas extraction in Pennsylvania's Marcellus Shale included diesel emissions from truck traffic, well drilling and hydraulic fracturing, gas production, on-site combustion, and compressor stations in the monetary damage calculations.[22] The National Institute for Occupational Safety and Health (NIOSH) expressed concern about the levels of diesel particulate matter measured at 11 oil and gas sites in Colorado, Arkansas, Pennsylvania, Texas, and North Dakota.[23]

Toxics

Toxic air pollutants originate from direct and fugitive emissions of hydrocarbons at the well and from associated infrastructure such as condensate tanks, dehydrators, wastewater impoundment pits, and pipelines. The fracking process involves dozens of chemicals and the process returns oil, gas, fracking chemicals, formation brines, and mobilized compounds, including heavy metals and naturally occurring radioactive materials (NORM) to the surface.

Hydrogen sulfide (H_2S) is a toxic and explosive gas that may be present in oil and gas formations and is produced along with the hydrocarbons. It is damaging to the central nervous system and can be lethal at higher concentrations (~1000 ppm).[24] While oil and gas workers may be required to wear protective respirators,[25] no such protections are considered for surrounding communities.

Benzene, toluene, ethylbenzene, and xylene (BTEX) and other toxic hydrocarbons, such as formaldehyde, released from oil and gas operations and equipment can lead to health impacts ranging from irritation of eyes, nose, mouth, and throat to aggravated asthma and other respiratory conditions, blood disorders, harm to the developing fetus, immune system-related diseases, and cancer (e.g., leukemia, non-Hodgkins lymphoma).

A study commissioned by the West Virginia Department of Environmental Protection found that, at many sites, a 625-feet distance from oil and gas activity—above the distances set by many states—still resulted in benzene concentrations above levels the Center for Disease Control and Prevention (CDC) considers "the minimum risk level for no health effects."[26] At least one of the BTEX compounds was found at all of the seven drilling sites examined. A health risk assessment in Colorado's heavily drilled Garfield County identified many hydrocarbon pollutants (including trimethylbenzenes, aliphatic hydrocarbons, and xylenes) associated with adverse respiratory and neurological effects.[27] It further found that concentrations of benzene, toluene, ethylbenzene, and xylene increased with proximity to the well site and were up to nine times higher during well completion than during well production. In tight gas fields in rural northeastern Utah, researchers estimated the total annual mass flux of volatile organic compounds (VOCs) from the surveyed gas fields to be equivalent to the emissions from 100 million cars.[28] The benzene levels measured in this study also exceeded health standards set by the Agency for Toxic Substances Disease Registry (ATSDR) and the California Environmental Protection Agency (CalEPA) to protect against harm to the developing fetus, immune system and blood.

Silica

Silica—the main component of 'frac sand'—is used widely and in large quantities to hold open the fractures created during the fracking process.[29] Inhalation of respirable silica can cause silicosis, an irreversible lung disease,[30] as well as lung cancer in miners, sandblasters, and foundry workers.[31] Silica inhalation is now also recognized as an occupational health hazard among oil and gas workers. NIOSH researchers collected 111 personal breathing zone (PBZ) samples at 11 sites in 5 states. At each one, they found that full-shift samples exceeded occupational health criteria,[32] in some cases by 10 times or more. This means that even if workers are properly using half-mask air-purifying respirators, they would not be sufficiently protected, because the measured concentrations exceed the masks' maximum use concentration.[33]

Regional Pollution

Ozone smog

Fracking-related processes and other stages of the oil and gas production process release nitrogen oxides and VOCs, which react in the presence of sunlight to form ozone ('smog'). Exposure to ozone is associated with a variety of respiratory and cardiovascular effects, including shortness of breath, reduced lung function, aggravated asthma and chronic respiratory disease symptoms, inflammatory processes, and premature death.[34] A growing number of studies have attributed emissions of ozone precursors from rapidly growing oil and gas development[35] to significantly elevated ozone concentrations in Wyoming,[36] Colorado,[37] Utah,[38,39,40] Pennsylvania,[41,42] Texas,[43,44] and Oklahoma.[45] In the study on Wyoming's Sublette County, tight gas production activities caused winter ozone levels[46] to spike above the EPA's 8-hour ozone standard of 75 parts per billion 13 times between February 14 and March 15, 2011.[47] In Utah's Uintah Basin ambient 1-hour ozone levels exceeded 150 ppb—twice the federal standard.[48]

Workers Not Protected

In addition to the community health concerns from fracking, worker safety at oil and gas production sites is also coming under increased scrutiny, in part because the oil and gas industry is one of the most dangerous occupational sectors in the country. According to statistics released by the Bureau of Labor Statistics there were 545 fatalities at U.S. oil fields between 2008 and 2012, of which 216 occurred in Texas.[49] At this level, the industry's fatality rate is 2.5 times higher than the accident-prone construction sector and more than 8 times higher than the industrial sector as a whole.[50] A major contributing factor to the industry's high fatality rate are traffic accidents, which also impact neighboring communities.

On-site toxic exposures present another health hazard to oil and gas workers. In 2010, at least four worker deaths may be linked to chemical and petroleum vapor exposure at or near flowback tanks at oil well sites in North Dakota and Montana.[51] Air samples collected by NIOSH in the personal breathing zone of workers at six flowback sites in Colorado and Wyoming identified benzene as the primary VOC of concern, especially near the hatches of the flowback tanks. Of the 17 samples, 15 met or exceeded the NIOSH Recommended Exposure Limit (REL) of 0.1 ppm.[52]

The unprotected inhalation of silica dust and diesel fumes also threatens worker health and may lead to cancers and other illnesses many years after exposure.[53] Workers may even bring contaminated clothes and boots home, putting their families at risk.

CURRENT POLICIES AND REGULATIONS PROVIDE INADEQUATE HEALTH PROTECTIONS

The oil and gas industry enjoys numerous exemptions from parts of key environmental and health protection laws, including the Clean Air Act, the Clean Water Act, and Hazardous Waste Laws.[54] These exemptions lead to weak regulations and inadequate monitoring for air pollutants and toxins from oil and gas facilities. As fracking and other extreme stimulation techniques move closer to towns and cities, this creates an information, legal, and regulatory vacuum that hampers communities' knowledge of and ability to protect themselves from harmful oil- and gas-related emissions and associated health impacts.

Faulty Inventories Underestimate Air Pollution

State and federal inventories provide important information for tracking and regulating air emissions of greenhouse gases, VOCs, and other hazardous air pollutants. Recent research indicates that these inventories may significantly underestimate air pollution from the oil and gas sector for a variety of reasons, including data gaps, uncertainty in the efficiency of emissions control equipment, use of obsolete or unrealistic emissions factors, incomplete reporting by operators, and changes in industry practices. One investigation led by the National Oceanic and Atmospheric Administration (NOAA) in Colorado's heavily drilled Denver-Julesburg Basin concludes that the state inventory for total VOCs emitted by oil and gas activities—which contribute to ozone formation and cause local toxicity—may be too low by a factor of at least two and that benzene emissions are seven-fold higher than reported in the state inventory.[55] An earlier systematic review of eleven "top-down" (starting with levels of pollutants in the atmosphere and attributing those emissions to sources) and a number of "bottom-up" (starting with measurement of a set of sources' emissions and extrapolating to aggregate emissions) studies looking at methane emissions from the sector estimates that total U.S. methane emissions from all sources were 25 percent to 75 percent higher than the U.S. Greenhouse Gas Inventory estimates for 2011, and finds that oil and gas are important contributors to these unreported emissions.[56] This review also concludes that a small number of "superemitters" could be responsible for a large fraction of the industry's methane leakage that had not been accounted for in the Inventory. In sum, the studies strongly suggest that oil and gas development is making a larger contribution to climate change than previously thought and that inventories may underestimate other pollutants.

Gaps in Federal Air Quality Regulations

In 2012, EPA issued two urgently needed standards aimed at limiting dangerous air pollution from oil and gas operations, including gas wells that are hydraulically fractured.[57] Although the rules are an improvement over the status quo, they fall short of the full level of health protection needed. The new rules, which are scheduled to take effect in 2015, will reduce well-site VOC emissions by 95 percent, but EPA monitoring will rely heavily on self-reported emissions data and the rules only apply to new gas wells and existing well sites will not be required to reduce pollution. In addition, the EPA still allows up to one ton of BTEX emissions from single glycol dehydrators per year.[58] And EPA relied relied on an analysis of health risks that was based on inadequate, inaccurate and incomplete emission inventories, omnitted pollutants with adverse health effects, excluded several sources of pollution, and failed to protect the most vulnerable populations.[59] The rules also fail to consider existing best practices that are already being deployed by many facilities to control pollution and prevent health impacts to surrounding communities. These technologies—such as improved efficiency, leak prevention systems, and emission controls—are readily available, feasible, and can even save the industry money.[60]

Lacking Enforcement

Federal and state agencies in charge of monitoring and enforcing oil and gas regulations have been overwhelmed by the industry's rapid growth. The Bureau of Land Management (BLM), charged with inspecting wells on federal lands and designating 'high priority wells' in need of greater environmental and groundwater protection, inspected only 40 percent of the 3,486 high priority wells between 2009 and 2012.[61] State oil and gas regulators, environmental protection departments, and public health agencies are left to fill in the gaps created by inadequate and constrained federal regulatory oversight. The result is a patchwork of state regulations and a distribution of responsibilities that leaves many loopholes and is plagued by a lack of resources for adequate inspections and enforcement. The Pennsylvania Department of Environmental Protection (DEP), for example, inspected fewer than 14 percent of active wells[62] and only 20 percent of producing wells in 2011.[63] A report for Texas found that enforcement actions were brought on only 2 percent of 55,000 logged violations.[64] There are no comprehensive national figures on enforcement in the oil and gas sector and state records are inconsistent in detail and accessibility.[65]

Companies are not mandated by federal regulations to disclose the identities or quantities of chemicals used during hydraulic fracturing operations on private or public lands. These chemicals can volatilize into the air from tanks and wastewater impoundments and contribute to air pollution. Some states have begun to set their own rules for chemical disclosure. Unfortunately, these laws often have shortcomings, including the non-disclosure of the composition of proprietary or "trade secret" fracking fluid products, insufficient penalties for reporting inaccurate or incomplete information, and allowances for after-the-fact reporting.[66] The industry-funded fracking fluid disclosure website FracFocus.org has been criticized in a review by researchers at Harvard Law School for inadequate transparency, accuracy, and user-friendliness.[67] The researchers concluded that "FracFocus is not an acceptable regulatory compliance method for chemical disclosures," but it is the official reporting site used by at least 11 states.[68]

These limitations leave lawmakers, regulators, public safety officers, and the public uninformed and ill-prepared to anticipate and respond to possible environmental and health hazards and emergencies associated with hydraulic fracturing fluids.

CONCLUSIONS

There is mounting evidence that air pollution from oil and gas operations threaten the health of nearby communities and immediate protections are needed. They should have the right to protect themselves by restricting or prohibiting these techniques within their jurisdictions. Where possible, ongoing unconventional oil and gas development should be put on hold to conduct comprehensive health assessments before determining whether or how these technologies should be allowed to proceed. In areas already bearing the brunt of fracking-related pollution and with no moratoria, strong safeguards are needed to control emissions and limit pollution.

RECOMMENDATIONS

The following is needed to ensure comprehensive health protections from air pollution:

- Protective standards at the federal and state level for communities and workers that ensure pollution controls including but not limited to:
  - Reduced Emission Completions (REC), also known as "green completion," to reduce methane and other VOC leaks for all wells, not only gas wells[69]
  - Leak detection and repair (LDAR) programs
  - Advanced technologies to control fugitive emissions
  - Reduction of diesel particulate matter through the use of cleaner combustion engines and alternative fuel types
  - Limitations on venting and flaring gas associated with oil production and ensuring that all gas is captured and sold or used on-site

- Comprehensive characterization of all pollution sources in unconventional oil and gas development and quantitative assessment of pollutants and emission rates through research and updated federal and state inventories
- Improved air quality monitoring before, during, and after well development and around all sources
- Expansion of the federal and state ozone monitoring network to better characterize air quality in rural areas highly impacted by pollution from oil and gas development
- Identification and implementation of adequate and protective setback requirements to reduce the exposure of residents to intermittent and chronic levels of air pollutants and toxins[70]
- Closure of regulatory loopholes in federal environmental programs to fill data gaps, increase transparency and oversight of the oil and gas industry and ensure public health protections
- Rigorous scientific studies in regions with intensive oil and gas development examining the effects of air pollution on the health of the local population, including comprehensive health impact assessments prior to new site development and followed by ongoing evaluations.[71]

WHAT RESIDENTS CAN DO

Residents can take the following actions to reduce their potential exposure to dangerous air pollutants:

Get informed

- Learn about possible pollution in your area:
  - Visit the U.S. EPA website for information on ozone and particulate levels
  - Contact your state environmental agency or health department for information on local monitoring for other air pollutants
  - Visit NRDC's Don't Get Fracked! Information Center to learn how to protect yourself and your family from pollution linked to hydraulic fracturing
  - For more information on specific oil and gas-related pollutants visit:
    - Benzene
    - Hydrogen sulfide (H_2S)
    - Diesel
    - Other toxics
- If you are worried about health symptoms or impacts, make sure to see your doctor and consult healthcare providers knowledgeable about the health impacts of air pollution. More resources are available through the following organizations:
  - The Pediatric Environmental Health Speciality Units (PEHSU)
  - Association of Environmental Medicine Clinics

Protect the most vulnerable

- Young children, the elderly, and individuals with respiratory conditions (e.g., asthma) can be sensitive to lower levels of pollution and should avoid exercise or extended outdoor activity when odors are present or agency websites (EPA or state) indicate poor air quality.

Take Action

- Improve air quality monitoring in your community
- Report spills and other environmental problems in your community
- Connect with your neighbors and set up a Citizen Science group
- Speak up and organize your community's defense
- Demand stronger protections

APPENDIX

Figure 2: Major air pollutants and air toxics released during the different fracking process stages and sources of equipment

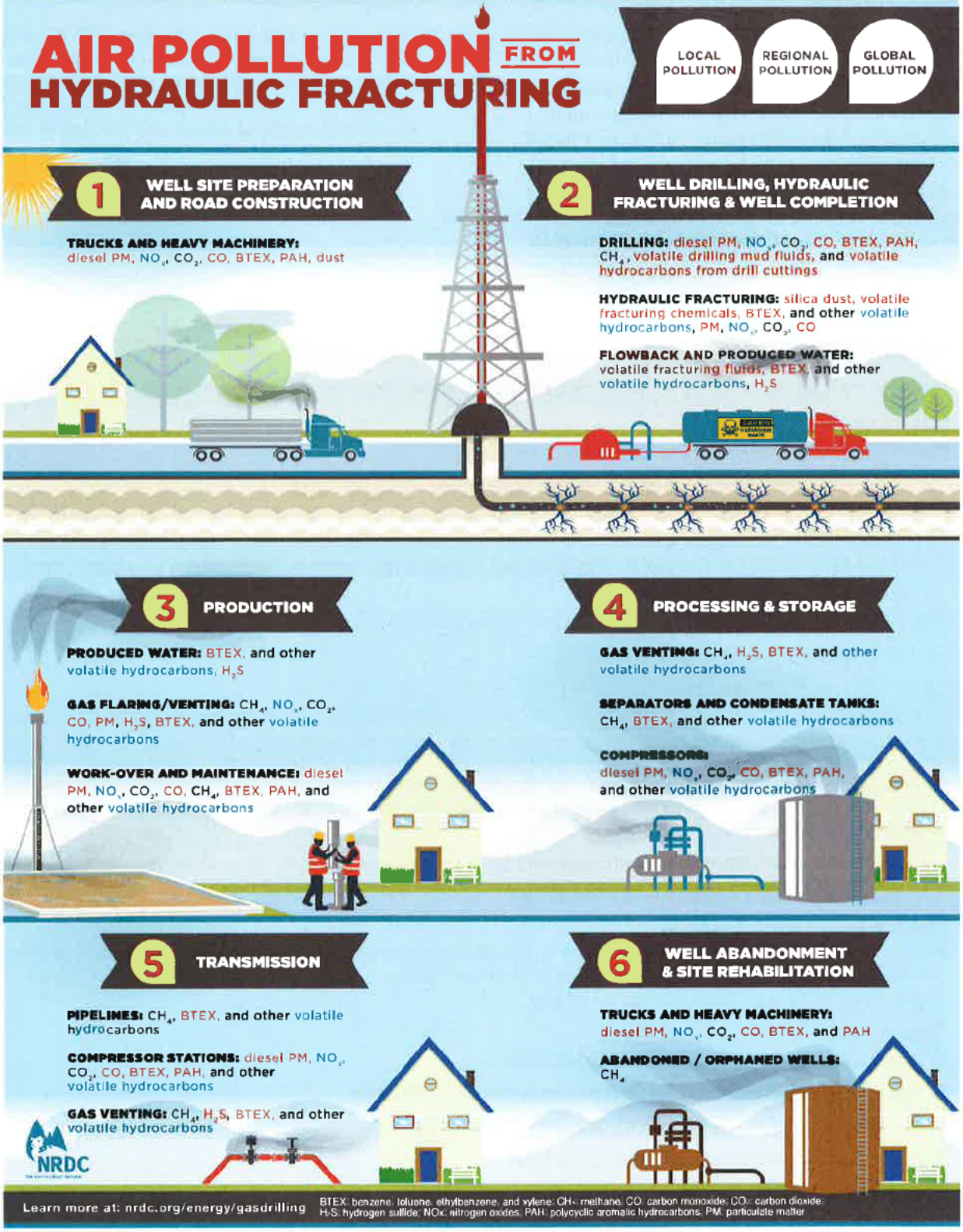


Table 1: Characterization of the main sources of air pollution from oil and gas development according to well process stage

	Local							Regional		Global	
	Particulate Matter (PM)		Volatile Organic Compounds (VOCs)							Greenhouse Gases	
Emissions Source	Diesel PM	PM_{10}	BTEX	PAH (incl. Naphthalene, Chlorobenzene, Phenol)	Other (incl. Formaldehyde, Ethylene glycol, Methanol)	H_2S	Respirable silica	VOCs	NO_x	CH_4	CO_2
Well site preparation (landscape clearing, soil movement, pipelines and other infrastructure)	●	●	●	●					●		●
Well drilling, hydraulic fracturing and well completion (drill rig, drilling muds and cuttings, fracturing fluid mixing, water trucks, pumps, generators, flowback	●	●	●	●	●	●	●	●	●	●	●
Well production (produced water, gas flaring/ venting, well maintenance work)	●	●	●	●	●	●		●	●	●	●
Processing and storage (gas venting, glycol dehydrators, separators, condensate tanks, compressors)	●	●	●	●	●	●		●	●	●	●
Transmission (compressors, gas venting, pipelines, tanker trucks	●	●	●	●	●			●	●	●	●
Well abandonment & site rehabilitation	●	●	●	●					●	●	●

Sources: Adgate, J., Goldstein, B., and McKenzie, L. 2014. "Potential Public Health Hazards, Exposures and Health Effects from Unconventional Natural Gas Development." *Environmental Science & Technology,* doi: 10.1021/es404621d. Moore, Christopher W. et al. 2014. "Air Impacts of Increased Natural Gas Acquisition, Processing, and Use: A Critical Review." *Environmental Science & Technology,* 11. doi:dx.doi.org/10.1021/es4053472.

Key: BTEX: benzene, toluene, ethylbenzene, xylene; CH_4: methane; CO_2: carbon dioxide; diesel PM: diesel particulate matter; H_2S: hydrogen sulfide; NO_x: nitrogen oxides; O_3: ozone; PAH: polycyclic aromatic hydrocarbons; PM_{10}: particulate matter of 10 micrometers or smaller in diameter.

Table 2: Health impacts of the main air pollutants by target organ and system		
Pollutant	**Target organ/system**	**Carcinogen**
Particulate Matter (PM)		
Diesel PM	Respiratory system; Cardiovascular system	●
PM_{10} and smaller	Respiratory system; Cardiovascular system	
Volatile Organic Compounds (VOCs)		
Benzene	Immune system; Blood; Fetal development, Nervous System	●
Toluene	Brain and nervous system; Respiratory system; Fetal and child development; Reproductive system	
Ethylbenzene	Fetal and child development; Liver; Kidney; Endocrine system; Auditory system	●
Xylene	Brain and nervous system; Fetal and child development	
Other VOCs (incl. Formaldehyde, Methanol)	Immune system; Respiratory system; Brain and nervous system; Fetal and child development; Liver; Kidney; Endocrine system	●
Other		
Hydrogen sulfide (H_2S)	Respiratory system; Brain and nervous system; Gastrointestinal system	
NO_x	Respiratory system	
Ozone (O_3)	Respiratory system; Cardiovascular system	
Respirable Silica	Respiratory system; Kidneys; Immune system	●
PAHs (incl. Naphthalene)	Immune system*, Reproductive system*; Brain and nervous system*; Developmental effects*	●**

* in animal studies

** probable carcinogens are among the PAHs emitted at unconventional oil & gas sites

Sources: Factsheet on the Health Effects of Diesel Exhaust. Available at http://oehha.ca.gov/public_info/facts/dieselfacts.html. U.S. EPA (1997). Health Effects of Particulate Matter. OAQPS Fact Sheet, July 17, 1997. Available at www.epa.gov/region7/air/quality/pmhealth.htm. OSHA (2014). Crystalline Silica, www.osha.gov/dsg/topics/silicacrystalline/health_effects_silica.html. ATSDR (2004). Interaction Profile For: Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX). ATSDR (2007). Public Health Statement for Benzene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=37&tid=14. ATSDR (2000). Public Health Statement for Toluene. Available at http://www.atsdr.cdc.gov/phs/phs.asp?id=159&tid=29. ATSDR (2010). Public Health Statement for Ethylbenzene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=381&tid=66. ATSDR (2007). Public Health Statement for Xylene. Available at www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health. 2005. NIOSH Pocket Guide to Chemical Hazards: Benzene. 2005-149. National Institute for Occupational Safety and Health (NIOSH). www.cdc.gov/niosh/npg/npgd0049.html. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health. 2005. U.S. EPA. An Introduction to Indoor Air Quality. Volatile Organic Compounds. Available at www.epa.gov/iaq/voc.html. ATSDR (1995). Public Health Statement for Polycyclic Aromatic Hydrocarbons (PAHs). Available at www.atsdr.cdc.gov/phs/phs.asp?id=120&tid=25. U.S. EPA. NIOSH Pocket Guide to Chemical Hazards: Hydrogen Sulfide. 2005-149. National Institute for Occupational Safety and Health (NIOSH). www.cdc.gov/niosh/npg/npgd0337.html. ATSDR (2002). Factsheet on Nitrogen Oxides. California EPA, Office of Environmental Health Hazard Assessment (OEHHA). Health Effects of Ozone in the General Population. Available at www.epa.gov/apti/ozonehealth/population.html.

Key: BTEX: benzene, toluene, ethylbenzene, xylene; CH_4: methane; diesel PM: diesel particulate matter; H_2S: hydrogen sulfide; NO_x: nitrogen oxides; O_3: ozone; PAH: polycyclic aromatic hydrocarbons; PM_{10}: particulate matter of 10 micrometers or smaller in diameter.

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71 See, for example, the study being conducted by the Geisinger Health System in Pennsylvania: Geisinger Research, "Geisinger Leads Marcellus Shale Initiative Coalition Explores the Potential Health Effects of Natural Gas Mining in the Region," Geisinger Research Connections Winter: 1–3, 2013.

NT Scientific Inquiry into Hydrolic Fracking

"The recommendations have been developed to mitigate risks identified during the course of the Inquiry relating to water, land, air, public health, Aboriginal people and their culture, and the unique social and economic conditions of the Territory.

"It is not the role of the Inquiry to make a recommendation whether or not the moratorium on hydraulic fracturing in the Northern Territory should be lifted, that is a matter for Government.

"The overall conclusion of the Report is that risk is inherent in all development and that an onshore shale gas industry is no exception. However, if the recommendations made in this draft Report are adopted and implemented in full, those risks may be mitigated or reduced - and in many cases eliminated altogether - to acceptable levels having regard to the totality of the evidence.'

https://frackinginquiry.nt.gov.au/news/community-update-26

Draft final report @ https://frackinginquiry.nt.gov.au/inquiry-reports/draft-final-report

Summary https://frackinginquiry.nt.gov.au/inquiry-reports?a=465893

The burning of fossil fuels exacerbate climate change. The impacts of climate change are already said to be felt. This includes impacts to the Great Barrier Reef. There is suggested to be a lag with the continued impacts of climate change. Therefore, the worse effects will be felt by the next generation.

The US GAO report states that…*'Over the last decade, extreme weather and fire events have cost the federal government over $350 billion, according to the Office of Management and Budget. These costs will likely rise as the climate changes, according to the U.S. Global Change Research Program.'*

A lawyer dealing with climate change litigation case re: Juliana v US stated that..

*' **We have found reports like this 1983 report during the Ronald Regan administration from the Environmental Protection Agency 'Can We Delay A Greenhouse Warming'. And the conclusion of this report is that what we're facing in the near term is catastrophic…it's urgent.** And we are going to these bring these reports…we're going to bring the authors of these reports into the court room…they're going to testify about why the government knowingly chose climate change that will harm America over these children. Why the government made a cost benefit analysis of why the fossil fuel industry is more important than the lives of these kids. We're going to get the evidence in court of why the federal government refused to accept the years and years of data. The numerous reports that said we must do something because climate change is real, it's urgent, and its catastrophic.*

https://youtu.be/uZ5KTluKVis (around 53:30 minutes in)

So if the impacts of climate change are significant and the need to deal with climate change is urgent, then it makes absolutely zero sense to extract fossil fuels to burn them. It makes even less sense when the cost of renewable energy is more then competitive and is being shown to be reliable. For the sake of our childrens it appears the only mitigation possible for the worsening of climate change impacts is to stop extracting, distributing and burning fossil fuels and work on technological remediation.

Our children have a human right to life and more.

JULIANA v. U.S. CLIMATE LAWSUIT

Quote:

"Exercising my 'reasoned judgment,' I have no doubt that the right to a climate system capable of sustaining human life is fundamental to a free and ordered society." –

- U.S. District Judge Ann Aiken

https://www.ourchildrenstrust.org/us/federal-lawsuit/

Amended Complaint Against U.S.:

Includes facts re: Who had knowledge, & when, of climate change & its effects at pgg 51-55 at: https://static1.squarespace.com/static/571d109b04426270152febe0/t/57a35ac5ebbd1ac03847eece/1470323398409/YouthAmendedComplaintAgainstUS.pdf

Phil Gregory (Co-Counsel) also indicated how documents obtained via discovery are important…

Quote:

'in our case we are able to engage in what's called discovery. We can get the documents that have been hidden all along. And what have we found in this case. We have found the damming internal documents that will be the evidence at trial. We have found reports like this 1983 report during the Ronald Regan administration from the Environmental Protection Agency 'Can We Delay A Greenhouse Warming'. And the conclusion of this report is that what we're facing in the near term is catastrophic…it's urgent. And we are going to these bring these reports…we're going to bring the authors of these reports into the court room...they're going to testify about why the government knowingly chose climate change that will harm America over these children. Why the government made a cost benefit analysis of why the fossil fuel industry is more important than the lives of these kids. We're going to get the evidence in court of why the federal government refused to accept the years and years of data. The numerous reports that said we must do something because climate change is real, it's urgent, and its catastrophic.

https://youtu.be/uZ5KTluKVis (around 53:30 minutes in)

Climate Change – Is there an Issue

Video @ https://www.climaterealityproject.org/video/climate-101-bill-nye

Who Knew about Climate Change

NASA tells Congressional Committee in 1988

'Dr. James E. Hansen of the National Aeronautics and Space Administration told a Congressional committee that it was 99 percent certain that the warming trend was not a natural variation but was caused by a buildup of carbon dioxide and other artificial gases in the atmosphere.'

'The rise in global temperature is predicted to cause a thermal expansion of the oceans and to melt glaciers and polar ice, thus causing sea levels to rise by one to four feet by the middle of the next century.'

http://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html?pagewanted=all

InsideClimate news re: #ExxonKnew

'As early as 1977 Exxon scientists began to warn top executives that the buildup of carbon dioxide from burning fossil fuels was warming the planet, posing catastrophic risks to people around the world and threatening the company's core business.'

'Management's first reaction was to authorize a deep dive into climate research, but this forthright response did not last a decade. Instead, Exxon and its industry peers funded and developed a sprawling network to disseminate scientific misinformation.'

'The result of an eight-month effort supported by our entire staff, Exxon: The Road Not Taken is a nine-part, 21,000-word examination of Exxon's four-decade engagement with climate change. It is based on company memos dating from the 1970s and 1980s that we obtained exclusively and published for the first time with the permission of our sources. We also conducted dozens of interviews with former employees, scientists and officials and searched through archives and the existing scientific, academic and journalistic literature.'

21 January 2016 cover letter for entry for Pulitzer at:

http://www.pulitzer.org/finalists/insideclimate-news

Climate Change - Evidence

- *'Global Temperature Rise*
- *Warming Oceans*
- *Shrinking ice sheets*
- *Glacial Retreat*
- *Decreased Snow Cover*
- *Sea Level Rise*
- *Declining Artic Sea Ice*
- *Extreme Events*
- *Ocean Acidification'*

https://climate.nasa.gov/evidence/

IPCC (International Panel on Climate Change

'Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems. {1}'

'Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen. {1.1}'

'Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible (medium confidence). The globally averaged combined land and ocean surface temperature data as calculated by a linear trend show a warming of 0.85 [0.65 to 1.06] °C 2 over the period 1880 to 2012, when multiple independently produced datasets exist (Figure SPM.1a). {1.1.1, Figure 1.1}'

https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

IPCC (International Panel on Climate Change

'Since the beginning of the industrial era, oceanic uptake of CO2 has resulted in acidification of the ocean; the pH of ocean surface water has decreased by 0.1 (high confidence), corresponding to a 26% increase in acidity, measured as hydrogen ion concentration. {1.1.2} Over the period 1992 to 2011, the Greenland and Antarctic ice sheets have been losing mass (high confidence), likely at a larger rate over 2002 to 2011. Glaciers have continued to shrink almost worldwide (high confidence). Northern Hemisphere spring snow cover has continued to decrease in extent (high confidence). There is high confidence that permafrost temperatures have increased in most regions since the early 1980s in response to increased surface temperature and changing snow cover. {1.1.3} The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was very likely in the range 3.5 to 4.1% per decade. Arctic sea-ice extent has decreased in every season and in every successive decade since 1979, with the most rapid decrease in decadal mean extent in summer (high confidence). It is very likely that the annual mean Antarctic sea-ice extent increased in the range of 1.2 to 1.8% per decade between 1979 and 2012. However, there is high confidence that there are strong regional differences in Antarctica, with extent increasing in some regions and decreasing in others. {1.1.3, Figure 1.1}'

https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

IPCC (International Panel on Climate Change

'Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. {1.2, 1.3.1}'

https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Climate Science Special Report (CSSR)

QUOTE…

'The climate of the United States is strongly connected to the changing global climate. The statements below highlight past, current, and projected climate changes for the United States and the globe.'

'Global annually averaged surface air temperature has increased by about 1.8°F (1.0°C) over the last 115 years (1901–2016). ***This period is now the warmest in the history of modern civilization.*** *The last few years have also seen record-breaking, climate-related weather extremes, and the last three years have been the warmest years on record for the globe. These trends are expected to continue over climate timescales.'*

'This assessment concludes, based on extensive evidence, that it is extremely likely that ***human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century****. For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence.'*

'In addition to warming, many other aspects of global climate are changing, primarily in response to human activities. ***Thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor****.'*

https://science2017.globalchange.gov/chapter/executive-summary/

US GOVERNMENT ACCOUNTABILITY OFFICE (GAO) REPORT

QUOTE…

'Over the last decade, extreme weather and fire events have cost the federal government over $350 billion, according to the Office of Management and Budget. These costs will likely rise as the climate changes, according to the U.S. Global Change Research Program. In February 2013, GAO included Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks on its High-Risk List.'

'GAO recommends that the appropriate entities within the Executive Office of the President (EOP), including the Office of Science and Technology Policy, use information on potential economic effects to help identify significant climate risks and craft appropriate federal responses. EOP entities and the Environmental Protection Agency did not provide official comments on the report.'

https://www.gao.gov/assets/690/687466.pdf

UNESCO IMPACTS OF CLIMATE CHANGE ON WORLD HERITAGE CORAL REEFS-A FIRST GLOBAL SCIENTIFIC ASSESSMENT (2017)

'UNESCO's World Heritage Centre released the first global scientific assessment of climate change impacts on World Heritage coral reefs. Soaring ocean temperatures in the past three years have subjected 21 of 29 World Heritage reefs to severe and/or repeated heat stress, and caused some of the worst bleaching ever observed at iconic sites like the **GREAT BARRIER REEF (AUSTRALIA),** Papahānaumokuākea (USA), the Lagoons of New Caledonia (France) and Aldabra Atoll (Seychelles). The analysis predicts that all 29 coral-containing World Heritage sites would cease to exist as functioning coral reef ecosystems by the end of this century under a business-as-usual emissions scenario.'

'Climate change has been impacting coral reefs for more than three decades through the bleaching and mortality of corals due to heat stress. Bleaching events are becoming more frequent, more widespread and more severe, and are having major impacts on coral reefs globally. Warming is projected to exceed the ability of reefs to survive within 1-3 decades for the majority of World Heritage sites containing coral reefs, and the impact is aggravated by the additional pressures such as ocean acidification and local stressors.'

'this study predicts that 25 of the 29 World Heritage reefs will experience twice-per-decade severe bleaching by 2040, a frequency that will rapidly kill most corals present and prevent successful reproduction necessary for recovery of corals. **All properties will experience annual severe bleaching, and thus will cease to host functioning coral reef ecosystems, by the end of the century unless CO2 emissions are reduced.'**

'For the first time, a ubiquitous global threat - heat stress sufficient to cause frequent severe bleaching and mortality - now threatens the OUV of World Heritage sites in a way that cannot be resolved through local management alone. **The only viable solution is for all countries with world heritage coral reefs to not only act to reduce local stressors but also to reduce their greenhouse gas emissions to net zero, along with supporting active co2 removal from the atmosphere and upper ocean'**

'Delivering on the paris agreement target of "holding the increase in the global average temperature to well below 2°c above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°c"32 offers the only opportunity to prevent coral reef decline globally, and across all 29 reef-containing natural world heritage sites.'

http://whc.unesco.org/en/news/1676

COAL SHOULD REMAIN IN THE GROUND (2017)

'The assessment shows that between 80 and 90 percent of coal reserves worldwide will need to remain in the ground, if climate targets are to be reached. This compares with approximately 35 percent for oil reserves and 50 percent for gas reserves.'

https://wedocs.unep.org/bitstream/handle/20.500.11822/22101/EGR_2017_ES.pdf?sequence=1&isAllowed=y

NOAA Artic Report

‘Permafrost in the Arctic is thawing faster than ever, according to a new US government report that also found Arctic seawater is warming and sea ice is melting at the fastest pace in 1,500 years.

The annual report released on Tuesday by the National Oceanic and Atmospheric Administration showed slightly less warming in many measurements than a record hot 2016. But scientists remain concerned because the far northern region is warming twice as fast as the rest of the globe and has reached a level of warming that’s unprecedented in modern times.

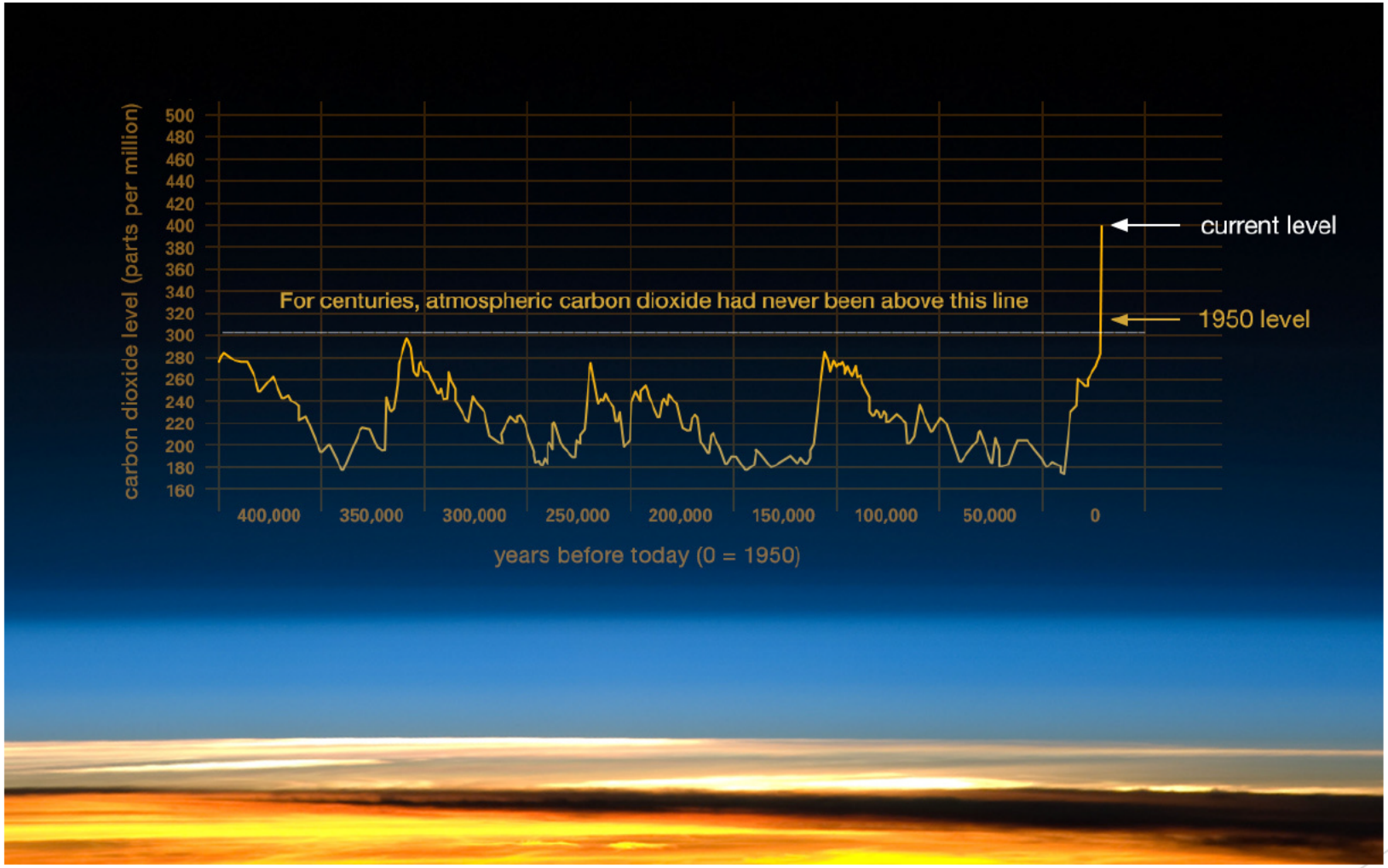
“2017 continued to show us we are on this deepening trend where the Arctic is a very different place than it was even a decade ago,” said Jeremy Mathis, head of NOAA’s Arctic research program and co-author of the 93-page report.

“What happens in the Arctic doesn’t stay in the Arctic; it affects the rest of the planet,” said acting NOAA chief Timothy Gallaudet. “The Arctic has huge influence on the world at large.”

Arctic sea ice usually shrinks in September and this year it was only the eighth lowest on record for the melting season. But scientists said they were most concerned about what happens in the winter - especially March - when sea ice is supposed to be building to its highest levels.’

https://www.theguardian.com/environment/2017/dec/12/arctic-permafrost-sea-ice-thaw-climate-change-report?CMP=share_btn_tw

Climate Change – Evidence
Atmospheric CO2 has increased since the industrial revolution.



https://climate.nasa.gov/evidence/

Australia will require further action to meet 2030 Paris Agreement targets

UN ASSESSMENT FROM GAP EMISSIONS REPORT – AUSTRALIA LIKELY TO REQUIRE FURTHER ACTION TO MEET 2030 TARGETS (2017)

'recent studies assessed suggest that Brazil, China, India and Russia are likely to – or are roughly on track to – achieve their 2030 NDC targets with currently implemented policies. Conversely, Argentina, Australia, Canada, the European Union, Indonesia, Japan, Mexico, South Africa, the Republic of Korea and the United States are likely to require further action in order to meet their NDCs, according to government and independent estimates.'

https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf?sequence=1&isAllowed=y