

ANNOTATED TRANSCRIPT

Hydraulic Fracturing Impacts Human Health:

Public Health Strategies to Reduce the Risks

**A webinar by Richard J. Jackson, MD,
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January 9, 2013

<http://video-archive.ph.ucla.edu/webinar-192013-jackson>

written transcription of webinar follows with commentary in italics by

- Anthony Ingraffea, PhD, PE, Dwight C. Baum Professor of Engineering, Cornell University;
- Kathleen Nolan, MD, MSL, Catskill Mountainkeeper; and
- Sandra Steingraber, PhD, Distinguished Scholar in Residence, Ithaca College and founder, Concerned Health Professionals of New York

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Preface

Richard Jackson, MD, is one of three consultants hired by the New York Department of Health to assist DOH Commissioner Nirav Shah in preparing a “health review” that will be incorporated into the Supplemental Generic Environmental Impact Statement on high volume hydraulic fracking.

As of this writing, on February 11, 2013, the SGEIS is awaiting only the completion of the DOH’s review—which, according to recent testimony by both DOH Commissioner Shah and Department of Environmental Conservation Commissioner Joe Martens—began as a compilation of health-related sections of the SGEIS prepared by staff from the NY Department of Environmental Conservation.

The entire review process has been conducted in complete secrecy and without public participation or transparency of any kind.

Neither the public nor members of the medical and scientific community know how the review has been scoped, nor what the charge to the reviewers was, nor what documents

they received to review. Two of the three reviewers are bound by non-disclosure agreements in their contracts and were paid for 25 hours of work. Dr. Richard Jackson completed his work pro bono and is not apparently restricted by a confidentiality agreement.

We do know, from recent reporting, that the three outside reviewers have already turned in their comments to the DOH. Resting on their work is the momentous decision by the DEC under the direction of Governor Cuomo—which could come at any day—to prohibit or permit high-volume fracking in New York State (or to further delay such a decision, possibly based on the need to conduct a rigorous comprehensive and participatory Health Impact Assessment, as long recommended by Concerned Health Professionals of New York and others.)

Troubling clues available to the people of New York State about what the DOH's secret review might contain are available to the people of New York State in this transcript of a national webinar that Dr. Jackson gave a month ago—January 9, 2013—on the health effects of fracking.

Dr. Jackson sent a link to this webinar to Sandra Steingraber and a dozen or so other members of the environmental health community on February 7.

<http://video-archive.ph.ucla.edu/webinar-192013-jackson>

With this link came the accompanying email message:

“Here is the webinar I offered at UCLA a few weeks ago on fracking. It is quite dense but perhaps helpful—truly I have learned a lot then and now. Please listen to the last part. Starts slow but the conclusions have much substance, I hope.”

In the spirit of openness and right to know—and bound by no confidentiality agreement of her own—Steingraber has chosen to share the contents of both this email and the webinar itself (both via the link above and the written transcription below) with the people of New York. The transcript is annotated (in italicized sections) by Steingraber together with Cornell engineering professor Anthony Ingraffea and physician and bioethicist Kathy Nolan. Each of us has been researching the process of shale gas extraction and attempting to understand the consequences of fracking for several years.

Sections we found particularly telling are bolded in red.

Viewing the 50-minute webinar allows you to see the Powerpoint slides and the sources of Dr. Jackson's information. One primary source references to a now-discredited study that was commissioned by the Marcellus Shale Coalition, an industry group. Not only has this study been retracted, two of its authors, with financial ties to the gas industry, went on to write another fraudulent study on shale gas economics on behalf of the University of Buffalo's Shale Resources and Society Institute. The resulting scandal prompted the university to defund and close the institute itself, which served as a platform for industry

propaganda rather than rigorous academic inquiry.

It is possible to play the webinar video while reading along with the annotated transcript below.

The first 13 minutes of the presentation focus on the public health and to some degree the climate dimensions of different fossil fuel energy sources (coal, tar sands, etc.). Here Jackson is gearing the listener up to put natural gas in a risk context.

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Welcome **[slide 1: Energy is a Public Health Issue]** and thank you for joining the Fielding School of public health continuing the conversation webinar. Over 250 communities in the US have passed resolutions to stop hydraulic fracturing, concerned that it introduces industrial activity without critical information about environmental public health impacts. Dr. Richard Jackson, professor and chair of environmental health sciences, is one of three individuals appointed to review NY State's environmental report on shale gas development. He will discuss what hydraulic fracturing means to the environment and suggest approaches to better protect human health. We want this to be a dialogue so we will allow plenty of time for questions. If you do have a question, simply type it in the field at the bottom of the chat window in the bottom left hand corner of your screen. Let's get started, Dr. Jackson.

Good afternoon. Happy New Year. I'm Dick Jackson, and I'm going to be talking about why energy is a public health issue, why public health has not been adequately at the table for a lot of the energy issues and that hydraulic fracturing is an example of one where public health must be at the table much more than we are.

“Hydraulic fracturing” requires further definition. Is the phrase used in this presentation to refer to a practice that has been used for decades on millions of oil and gas wells around the world? Or is it being used only to refer to shale oil and shale gas? Or as a shorthand for high-volume horizontal hydraulic fracturing, which makes use of high volumes of water, chemicals, and sand and long, lateral wellbores? Or is it a handle for the entire process of unconventional oil and gas development, which includes extraction, processing, transport, and end use—all of which come together as a package when an area is opened for high volume hydraulic fracturing and each one of which raises specific associated health risks?

[Slide 2 at 1:11: All sources and uses of energy have human health impacts] This rather elaborate diagram is pretty in its set of colors is remarkable because it summarizes estimated US energy use, about a hundred million quads per year in 2011. Pretty striking how small solar is how big natural gas, coal, and

petroleum are, as you go down the left side of the diagram & as you go over to the right side of the diagram its also striking how much energy is "rejected energy." It ends up not providing us the services we need and I'll come back to that as I go forward. **[slide 3 at 1:48: US Monthly Primary Energy Production, from MG information agency US government]** As I said we use per month about 70 quadrillion BTUs. Fascinating. It's about the same amount we were using in 1973, and we've added a hundred million population. **[2:09 min: Trends in Nondefense R&D by function]** So a lot has happened in terms of efficiency going forward and a lot more could happen. I'm going to come back to this slide because health researchers always are arguing for more health research, but one of the things I may be arguing for is more energy research. And you can see the green stripe there and how it went up during the 1970s and then diminished in the 1980s and was really negligible for about the last ten years. I think this is a health hazard, a health threat.

[2:40min: Hidden Costs of Energy] Every use of energy has its own set of hidden costs. This report from the Academy of Sciences very helpful & I drew upon it as I prepared my report here **[2:46min: Selected Energy Sources]**. Every single one of these energy sources here [lists] has some kind of impact, many of them are health impacts and I will touch on them before I get to hydraulic fracturing overall **[3:05min Wood and Biomass]**. Probably one of the biggest threats to human health worldwide, particularly for poor people in developing countries has been the enormous numbers of deaths: 500,000 deaths for children from lower respiratory illnesses in India alone in the year 2000 from unventilated cooking areas in homes. Think about how much work had to be done to just for that woman to be gathering that much wood to then cook a small fire to prepare her chai.

[3:40min Black Carbon] This has direct impacts, people that are breathing it overall, but in the process a large amounts of black carbon are put into the atmosphere. We've all seen tar burn or tires burn & we know how much carbon it puts into the air. Most people are aware that carbon dioxide is a greenhouse gas, causes global warming. **Methane is a greenhouse gas that aggravates global warming about 15 times more effectively than CO2,**

In fact, [the best science](#) shows that methane is 33 times more efficient at trapping heat than carbon dioxide over 100 years, and about 105 times more potent than carbon dioxide over 20 years. When considering health risks, we should look at the shorter time frame. A [recent study](#) reported in Nature, led by researchers at the National Oceanic and Atmospheric Administration, measured up to a 9 percent fugitive emission rate, indicating that methane emissions from HVHF and related operations have been significantly underestimated and demonstrating that reliance on HVHF dashes any chance of keeping greenhouse gases in the atmosphere at levels below what scientists say are necessary to avert catastrophic climate change.

but black carbon in the atmosphere absorbs heat when its floating around in micro particles and it makes things hotter, but it also when it lands on Greenland and on the Arctic ice, it causes much more absorption of heat into the, **[4:30min Coal Mining]** aggravating the melting on these areas. Global melting will be and is a human health issue.

Black carbon is also produced by burning diesel, and much diesel is burned over the life cycle of shale gas production.

Anyone that's driven through West Virginia is astounded at the scope of coal mining in the United States and as you go around the world it's even more striking. Of course there are health issues related to this. In West Virginia we've seen mountain top removal where overburden, as they call it, is removed from the valuable land there and is then put into gullies and streambeds and hollows with damage to the environment. And for a long time, people argued that we need this because it creates jobs, well, a site like this can be operated with not very many people. It generates wealth but doesn't necessarily generate that many jobs.

Shale gas extraction, too, is a capital-intensive industry with a [low job creation rate](#). Shale gas production also removes mountaintops, hillsides, and tears up valleys. See attached photos of shale gas developments in PA and WV.

The strip mining for frack sand is decimating the landscape of western Wisconsin and eastern Minnesota and filling communities with silica dust. Already, civil disobedience has broken out in these frack-sand communities. Opening New York State to HVHF will only push the demand and the price of frack sand higher.



Courtesy of Dick Martin, PA Forest Coalition



Courtesy Robert Donnan.



Courtesy of Robert Donnan.

[5:18min Coal Burning] We still produce a lot of energy in the United States from burning coal. Californians are pretty proud of the fact that we don't have a coal-burning power plant in California; you know we have nuclear and hydro and natural gas and petroleum, but the truth is we have two huge power plants that we draw on that are outside the state.

Six percent of all the CO₂ production by the human species is related to cement manufacturing. Think about when you start baking limestone: the CO₂ that's produced both by the baking process and also by the driving off the CO₂ when you do it.

Indeed, cement manufacturing is a huge contributor to greenhouse gases. And with two miles or more of cement lining needed for every shale gas or oil well—and twice or thrice that much when multiple well casings are used—horizontal high volume hydraulic fracking is a big consumer of cement, which adds to the total carbon footprint of shale/oil extraction.

With 50,000 to 100,000 Marcellus and Utica wells envisioned for our state, hundreds of thousands of miles of cement casing will be entombed forever in the earth beneath New York—along with hundreds of thousands of miles of steel pipe. According to estimates by Cornell engineer Anthony Ingraffea, the total tonnage of steel that would be entombed in the geological strata of New York State as shale gas well casings exceeds 2.5 times the total tonnage of the U.S. Navy fleet. The manufacture of this cement and steel—which, once buried, can never be recycled—is part of the carbon footprint of shale gas extraction.

Lots of coal is being burned for other kinds of manufacturing and still being used for building and heating. Fish in many parts of the country, women are told not to consume it, particularly if they are pregnant; young children should not be consuming fish in large part because of mercury that is falls from the atmosphere in large part again from coal-burning.

The extraction of shale gas, like coal, also exhumes heavy metals from deep geological strata and liberates them at the surface. These include not only mercury but also arsenic, lead, barium, strontium and radium. However, the potential exposure pathways are more complicated for shale gas, as the metals are not released into the atmosphere upon combustion but when cement liners fail or fractures intersect with aquifers directly, when drill cuttings and drilling muds are landfilled and when leachate from such landfills is sent through sewage treatment plants, when drill cuttings and drilling muds are landspread, when liquid fracking waste is spread on roads and fields as de-icer and for dust control, and when fracking wastewater is run through sewage treatment plants and ends up in downstream drinking water sources.

Did NY DEC and DOH ask outside reviewers to consider potential human exposure to heavy metals from these pathways?

[6:20min Aggregate "Hidden" Costs] A coal burning power plant when the worst top 20% of them produce far more damage than the rest, but look at this number: it's about \$800 million per year from the top one. These are "hidden" costs of coal burning, and I'm going to come back to that number as we go forward.

The aggregate hidden costs of shale gas have never been calculated, so it's impossible to compare the full cost of coal with the full cost of shale gas obtained via fracking. However, they include medical costs related to exposure to smog, hazardous air pollutants, and particulate matter from drilling and fracking related air pollution. ([Air pollution](#) from gas drilling in just one area, the Arkansas Fayetteville Shale region, imposed estimated health care costs exceeding \$10 million in one year alone.) Methane leaks from drilling and fracking operations contribute to global warming. Emissions of [methane](#) during well completion impose an estimated \$130,000 in social costs related to global

warming for every well drilled. Clearing forests in the Chesapeake Bay watershed—of which parts of the Southern Tier of New York State belong— increase nutrient and sediment loading. Drilling and fracking operations also bring with it [increased demand for public services](#), such as emergency response and can [decrease property values](#) in wide areas.

[6:44min Athabasca Basin tar sand mine] Somewhere less dense than coal but more dense than petroleum is tar sands. Perhaps many people have not seen the scope of the tar sands, for example, in Alberta. It takes about \$30 to make a barrel of oil, \$30 worth of energy to then generate an equivalent barrel of oil from these tar sands. **[7:10min Photo of coal transport]** So the economics are important to it but the scope and the volume of the materials produced and the quantities of water that are required **[7:17min Photo of large scale tar sands production]** for the production of these tar sands.

Dan Kaman gave me this picture and you can see the sulfur mountains, if you will, in the distance from the extraction of sulfur from the oil that's being produced **[7:31min Photo of sulfur blocks]** from these sites. There are the huge blocks of it, one after another, in the production; this ultimately has health effects as well.

The analog for shale gas extraction is millions of gallons of liquid flowback per well, which is toxic, full of heavy metals, and in some cases, radioactive. There is no way to turn this fluid back into potable water and no solution for its permanent containment.

[7:39min Petroleum] You know 125 years ago in Titusville PA, four guys with a, basically a water well drinking apparatus were able to strike oil at 75 feet. Nowadays it takes a billion dollar platform going down about a mile and then these platforms that drill down about a mile or two then go off to the side.

Deep offshore oil drilling indeed occurs in a mile or more of water depth but then drills down 5 to 7 miles into the rock strata. Directional drilling might or might not be used in such cases. HVVF in shale formations is the on-shore analogue to such offshore hydrocarbon quest: both are extreme forms of energy development.

And you don't need to tell anyone who lives along the gulf coast that petroleum production, oil production has health impacts; there's a health impact just by the loss of seafood production that is in an area, and most of are told that we ought to be eating more seafood and less red meat.

Shale gas extraction also impacts [food production](#), destroys productive farmland, and conflicts with requirements for organic certification. [Death of livestock](#) and [falling milk production](#) have been documented in intensely fracked areas of Pennsylvania, where the five counties with the heaviest Marcellus Shale drilling

activity experienced an 18.5 percent reduction in milk production between 2007 and 2010.

In his [Jan. 30 testimony](#) on the fracking health review, NY DOH Commissioner Shah said, in response to a question from Senator Liz Krueger about how he would protect consumers from food contaminated by fracking chemicals, “My review is related to just the public health aspect—that does not include food.”

Given that belief, can we trust that the three outside reviewers received any information on NY agriculture? Do they know that New York is the nation’s second largest wine producer, third largest organic food producer, and second largest dairy producer?

[8:22min Russian vs. Venezuelan oil cartoon] And I'll come back to this as well. But there's CO2 production, there's SOX (sulfur oxide), there's NOX (nitrous oxide) production. Most people or everyone knows that gasoline runs about \$4/4.5 in California per gallon, but there are serious scientists that would argue that it really the environmental costs if it were properly incorporated would be closer to \$8/gallon. And Lester Brown, Worldwatch Institute, argues that it's really closer to \$15/gallon because much of our military structure is put in place to protect supply lines of oil or petroleum from the middle east. And there are a lot of reasons why we don't want to be dependent upon regimes that are fairly either hostile or unstable.

Again, the full cost of natural gas via shale gas extraction has never been calculated. Energy from wind and sun is also domestic, would also make us energy secure and energy independent, and would not run out after 5-14 years. The best data available suggest that New York could be free of fossil fuels by 2030 if we invested in renewable energy production and storage and smart grids and increased efficiency by decreasing demand. We would also save the lives of 4,000 New Yorkers each year who currently die from diseases related to air emissions.

The solution to energy security is to use only the energy you already own. Everyone and no one owns the sun, the wind, the water: nobody has to fight for these sources of energy. The solution to energy independence is to use only energy that is inexhaustible. Again: sun, wind, water.

[9:13min Graph of US Primary Energy Production] You can tell I like these graphs, but you can see that renewable energy is pretty flat lined, although it started going up around 2005 or so. Nuclear power has a significant portion of energy production in the US, but look at natural gas around 2005 it begins to tip up and now it's higher than coal. Do you see this thing call Crude Oil and NGPL? Well, when these hydraulic fracturing wells are drilled, a distillate is extracted as well as the natural gas as well as the methane, and that production has

increased as well, it's one of the reasons these wells, by generating both methane **[9:55min The Fukushima Meltdown announcement]** and distillate that can be used for gasoline and other things is important.

We have never heard of gasoline created from the distillates of shale gas well production.

However, it is true that these distillates, especially ethane, are often used as the chemical feedstocks for the plastic industry. [A massive new ethylene cracker](#)—the first in Appalachia—is currently being planned for Beaver County, Pennsylvania. This plant, to be built by [Shell Oil](#), is being rolled out to solve a disposal problem for the energy industry and to create jobs. It is not being built to solve an unmet human need for plastic.

Petrochemical crackers are notorious air polluters, and the air of Beaver County, PA already exceeds legal limits for ground-level ozone, which is the very sort of pollution that crackers create.

[Depleted salt caverns](#) under Seneca Lake in the wine-growing region of upstate New York are currently being repurposed for the storage of these distillates, including butane and propane. The resulting compressor stations and flare stacks will add to local air pollution and the dangers of bringing, by rail and truck, explosive materials into a rural, agricultural, tourist-dependent area have already triggered an outbreak of civil disobedience, sending one woman—a nurse—into [jail](#) for 15 days.

I don't need to tell anyone that nuclear has its own set of issues, I think one of the biggest problems with nuclear is we're still using what I would assert to be 1950's / 1960's technology maybe more primitive than that. And siting it in places that don't make sense **[10:18min DOE Budget by Organization]** in terms of tsunamis or earthquakes etc. is its own set of challenges. I really was quite interested in how much the United States Department of Energy worries about energy efficiency and renewables and so I looked at their budget. And possibly many of the people on the line don't know that only 8% of the Department of Energy's budget goes to energy efficiency and renewables, and a third, more than a third, of the overall budget goes to nuclear security. And the United States has spent close to \$10 billion to secure a safe repository in Yucca Mountain in NV that appears to not be going forward. And we still don't have ways to satisfactorily deal nuclear or radioactive wastes in this country. So, it's a negative, a drag on the desire to have nuclear energy and to utilize this.

Hopefully this slide will come up in a second, but it is corn ethanol. Something like 98% of the state of Iowa now is under production for corn and other commodity crops, and there are actually incentives in the Federal Legislation to have this happen. Why's that a health issue? Well, #1 it's shockingly inefficient to be using just the corn starch **[11:43 Hydro Hoover Dam photos]** in the corn

kernels to make ethanol. It makes sense to have ethanol; its an oxygenate to put it in the gasoline it decreases carbon monoxide and other pollutants coming out of the tailpipe, and oxygenates are a reasonable thing, but it also means that enormous amount of land in corn-producing parts of the United States have been turned over to glyphosate-resistant crops--that means really nothing can be grown on that land besides glyphosate-resistant plants such as these special seeds, special corn. But it also means that virtually every child in the Midwest is consuming nitrates that are running off the corn fields and atrazine and the other corn herbicides that are being used as well, also is a big contributor to the fact that 6-7,000 square miles of the Gulf of Mexico dies every year because of runoff from the Mississippi River.

Nitrate fertilizer—also known as anhydrous ammonia—is indeed a ubiquitous groundwater and surface water contaminant in the Midwest, as is atrazine. It is also responsible for the dead zone in the Gulf of Mexico.

Anhydrous ammonia is made from natural gas, as are many other farm chemicals and pesticides. Indeed five percent of the world's total supply of natural gas is consumed in the manufacture of [synthetic nitrate fertilizer](#). Cheap and abundant natural gas, as provided by fracking, makes cheap and abundant anhydrous ammonia, which makes ethanol production more profitable, poisons more Midwestern wells, and further enlarges to the Gulf of Mexico dead zone.

Hydro - does it have health effects? Well, there was a time that salmon was cheap and abundant and, as everyone knows, it's very expensive and non-farm raised salmon is pretty difficult to get partly because of overfishing partly because of the damming of the rivers of many of the areas where they produce.

[13:02min Wind Turbines] Again, a technology that needs to be developed much further into the 21st century are wind turbines. There reasonable people that are concerned--about noise, bird losses and the rest--these can be fixed and it's clearly a reasonable and good source of energy and an increasing source of energy, but as you go down the Altamont Pass there's an awful lot of turbines that are small and move too fast and are probably need to be changed out for much smarter kinds of turbine production. **[13:30min Trends in Nondefense R&D by Function]** So again, if we had been doing the research back during the 1980s to develop batteries that could hold energy from whether it's solar, or wind turbines or the rest for much longer periods of time, much more efficiency in gearing of these turbines **[13:47min Renewable Electricity generation graph 2008-2012]** and other kinds of research we wouldn't be in the situation we're in.

This is from President Obama's report back in 2012 talking about renewable electricity generation; we've made real progress since 2008. Over a doubling of renewable energy production.

By making fossil fuels cheap and abundant, shale gas investment [impedes](#) the advance of clean, renewable energy.

[14:04min US CO2 emissions by major source USEIA] And I don't know what slide just would not appear so we can just skip that for now. But you can see that the important part of this slide is that it's not energy production, **it's CO2 emissions, it's greenhouse gas emissions. and you can see that natural gas is considerably lower than coal or petroleum [14:28pm US Primary Energy Production]** in how much CO2 it produces, but look how much more energy now is coming out of natural gas versus coal, crude oil, nuclear etc. So, there are a fair number of reasons environmentally why natural gas would be preferable.

Research shows the opposite is true: shale gas is more damaging to the climate than coal.

This slide does not distinguish between conventionally obtained natural gas and gas obtained via HVHF in shales. Furthermore, it considers greenhouse emissions only from combustion and not from methane leaks in the system prior to combustion. (In the Q and A that follows, Jackson acknowledges overlooking greenhouse gas emissions during shale gas extraction and delivery.)

The EPA has identified natural gas and oil production as the [largest source](#) of methane pollution in the United States, and, as [Al Gore](#) recently said in an interview,

“When methane leaks during the fracking process, each molecule of methane is more than 70 times as powerful as CO2 in trapping heat, and that means you wouldn't have to have that much of the methane leak into the atmosphere, before you completely wipe out the advantages of having less CO2.”

Global warming, as was noted earlier in this webinar review, is not caused solely by carbon dioxide but also by methane and black carbon. The unit of comparison here should be CO2 equivalents when contrasting emissions by major sources. EPA-reported emissions are calculated as CO2eq, which means the emissions of CO2 plus other emissions, such as CH4 (methane) that are also greenhouse gases, converted to equivalent amounts of CO2. The problem is that not all gases have the same effect on global warming. So, by convention, other greenhouse gases are rated according to their effect on warming relative to that of CO2. That rating is called the Global Warming Potential (GWP), which is the ratio of the heating potential of another gas relative to that of CO2.

The Code of Federal Regulations (CFR)--the law of the land that EPA and other government agencies must follow--has encoded a GWP of 21 for methane. That number is based on science completed before about 1995; GWPs are constantly evolving as more is understood about atmospheric chemistry and global

warming. That number 21 was raised to 25 according to the IPCC (Intergovernmental Panel on Climate Change) report of 2007, and is now 33 according to the very latest peer-reviewed science. In other words, federal law has not kept up with rapidly changing science by at least 18 years.

The GWP for methane depends very strongly on what period of years one wants to make the comparison with CO₂. That is a policy judgment call. The numbers 21, 25, and 33 are for a 100-year time horizon, in other words, taken over a 100 year period, how much more heating will methane cause relative to CO₂ over 100 years?

If we are, as President Obama is saying, very worried about acceleration of global warming over the next few decades, then 100 years is too long a horizon. The latest climate science estimates predict we will most likely be at 2 degrees C global warming in about 40-50 years, and really bad things will happen well before 50 years. So, we should be looking at a shorter time horizon for GWP. Over a 20-year time horizon, the latest science says that the GWP for methane is as much as 105, not 21, not 25, not 33. And certainly not 15.

Jackson's slide at 14:04 is a year out-of-date. EPA's reporting 225 million metric tons of emissions from oil and gas is a low-ball estimate (it is not an actual measurement) consisting partly of CO₂ and partly of methane, and involves converting the methane emissions to CO₂-equivalent emissions using the number 21: this is both old science and short-sighted policy judgment.

The same reasoning applies to the issue of whether the U.S. has really made progress on its own against global warming. We recently read that CO₂ emissions have decreased over the last few years in the U.S. This is true and largely attributable to the decrease in total energy use in the U.S. and a coincident increase in renewables that do not emit CO₂.

Nonetheless, CO₂eq has increased from the U.S. over those years because the U.S. is emitting more methane during those years, and most of the increase is from oil and gas development.

[14:44min Aggregate damages: 498 natural-gas-fired power plants by decile. Damages from SO_x, NO_x, and particulates. GHG not included.] And if you look at the aggregate damages--remember the other slide I showed where it was 800 million in aggregate other costs from the production--for methane or natural gas its about 8-10 million dollars. So there are benefits, many of the old coal-fired power plants are moving to natural gas, partly because they can be turned on or off **[15:10min HVHF]** and they're less expensive to build than a coal fired power plant.

This figure compares the CO2 emissions of natural gas, coal, and petroleum. Natural gas is the lowest—which is true at the point of combustion/point of use. However, this figure is not specific to natural gas obtained by high volume hydraulic fracturing and, as such, does not include the damages caused by methane leaks throughout the shale gas extraction process and delivery system. We do not understand the source of the \$8-10 million figure. Does this represent aggregate damages from all gas wells in the United States?

Here below are recent peer-reviewed papers that would make such a comparison meaningful and accurate.

Were these resources included in the materials provided by the DEC and DOH to the three outside reviewers? We do know that New York State scientists provided them to the DEC as part of public comments. Who decided what background documents would be given to the three outside reviewers to inform their analysis?

Alvarez et al (2012). Greater focus needed on methane leakage from natural gas infrastructure. *Proc. Nat. Acad. Sci.* doi: 10.1073/pnas.1202407109

Howarth et al 2011. Methane and the greenhouse gas footprint of natural gas from shale formations. *Climatic Change Letters*, doi: 10.1007/s10584-011-0061-5

Howarth et al. 2012. Methane Emissions from Natural Gas Systems. Background paper for The National Climate Assessment (NCA), reference no. 2011-0003. 25 February 2012.

Myrvelde NP and Caldiera K (2012). Greenhouse gases, climate change, and the transition from coal to low-carbon electricity. *Environ Res Lett.* doi:10.1088/1748-9326/7/1/014019

Petron G, et al. (2012). Hydrocarbon Emissions Characterization in the Colorado Front Range – A Pilot Study. *Journal of Geophysical Research.* doi:10.1029/2011JD016360.

Shindell DT, Faluvegi G, Koch DM, Schmidt GA, Unger N, and Bauer SE (2009). Improved attribution of climate forcing to emissions. *Science* 326: 716-718.

UNEP/WMO (2011). Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers. United Nations Environmental Program (UNEP), UNON/Publishing Services Section/Nairobi, ISO 14001:2004-certified

USEPA (2011). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009. April 15 2011 US Environmental Protection Agency Washington DC. <http://epa.gov/climatechange/emissions/usinventoryreport.html>

Wigley T (2011). Coal to Gas: the influence of methane leakage. *Climatic Change Lett.* doi: 10.1007/s10584-011-0217-3

Burnham A, Han J, Clark CE, Wang M, Dunn JB, and Rivera IP (2011). Lifecycle greenhouse gas emissions of shale gas, natural gas, coal, and petroleum. *Environ. Sci. Technol.*, doi:10.1021/es201942m

Howarth, RW and A Ingraffea. 2012. Should Fracking Stop? Point/Counterpoint *Nature*, doi:10.1038/477271a

Howarth RW, Santoro R, and Ingraffea A (2012). Venting and leakage of methane from shale gas development: Reply to Cathles et al. *Climatic Change*. doi:10.1007/s10584-012-0401-0

Hultman N, Rebois D, Scholten M, and Ramig C (2011). The greenhouse impact of unconventional gas for electricity. *Environ. Res. Lett.* doi:10.1088/1748-9326/6/4/044008

Jiang M., Griffin WM, Hendrickson C, Jaramillo P, van Briesen, J and Benkatesh A (2011). Life cycle greenhouse gas emissions of Marcellus shale gas. *Environ. Res. Lett.*, doi:10.1088/1748-9326/6/3/034014

Shindell D, and others (2012). Simultaneously mitigating near-term climate change and improving human health and food security. *Science* 335: 183-189.

Venkatesh A, Jamarillo P, Griffin WM, and Matthews HS (2011). Uncertainty in life cycle greenhouse gas emissions from United States natural gas enduses and its effect on policy. *Environ. Sci. Tech.* 45: 8182-8189.

So, I'm going to try not to use the word fracking, High volume hydraulic fracturing and I'll talk a little bit about the methodology. **[15:23min Map of Shale Gas Resources]** Again, this slide is not showing up, I don't remember what slide it is, but this is but this is a map of the US showing major sources of underground methane production. Up in the top left corner you can see just how much the methane is in the shale of the Northern Rockies. Texas and(?) Louisiana produced large amounts of methane, although in many ways the distillate they pulled out is often preferable, and I've seen videos of methane just being released into the atmosphere. **So, it is extraordinarily important to be capturing everything that is coming out of these wells.**

Capturing all methane from a gas well is not possible. During well drilling, methane is free to vent into the atmosphere. One to two weeks of 24/7 drilling are required to drill a HV horizontal gas well in the Marcellus Shale. During that time, methane escapes into the atmosphere.

Proposed draft regulations in NYS allow for additional open venting of methane. Section 556.2 allows methane to escape into air under five conditions: when a well is tested to see how much gas it has (24 hours of venting allow drilling); when a just-drilled well is being prepared for production (48 hours of venting allowed); when the shale is being fracked (48 hours of venting allowed); when a repair takes places (48 hours of venting allowed); and whenever the operator thinks it's necessary (another 48 hours for each "operational requirement).

Were the three outside reviewers made aware of the various conditions under which shale gas wells are allowed to freely vent methane and other volatile organic compounds into the atmosphere?

By the way when it comes out of the wells the gas is often mixed with water, it has to be separated from water, it has to then be odorized, and there are problems with each one of these steps. If the odor (?) of methyl mercaptan (?) goes out through the neighborhood it will make people feel absolutely miserable. The water has to be removed the distillates have to be recovered as well, but the

prior slide was showing worldwide shale gas reserves and **[16:40min US Shale gas Production]** when you look at it you're struck by just how immense this enterprise is. Shale gas production 14-fold increase over the last decade and so-called reserves of at least identified reserves have tripled over the last few years. You can see Texas is the big producer from this slide. Marcellus shale, which is NY, PA, OH, WV is still just coming online in this slide.

[17:04min US Clean Water Act Definition of Pollutant] A very important law change occurred back in 2005 and it was when ... the US Clean Water Act in fact has in place very stiff penalties for those who contaminate the water resources of the United States, whether it's fresh water, salt water, rivers etc. And back in 2005 there was an exemption put in the Clean Water Act that said water, gas, or other material which is injected in a well to facilitate production of oil or gas is not a pollutant. So that's good; it was a relief to know that the Federal Government no longer considers that a pollutant **[17:53min Safe Drinking Water Act Changes]** and this was called, I'll tell you the name of this in one second, because the same thing happened under the Energy Policy Act of 2005, to the Safe Drinking Water Act, that fracking fluids and propping agents, other than diesel fuels that are put in these operations are not considered pollutants under the Safe Drinking Water Act. And this is broadly called the "Halliburton Exemption". As I look at the rapid increase in hydraulic fracturing since 2005, I wonder about how much this exemption **[18:22min The Economic Impacts of the PA Marcellus Shale Natural Gas Play]** from these laws has really had an effect. Well, what's the other reason? **Here's a good source of energy, you know it isn't quite as polluting as other sources,**

This claim ignores a [large body of evidence](#). Pollution from shale gas extraction operations include--

- *surface spills that lead to both groundwater and surface water contamination;*
- *well casing/cement failures that lead to groundwater contamination;*
- *hazardous air pollution from compressors, flare stacks, and condensers;*
- *diesel exhaust from truck traffic, pumps, and generators;*
- *sedimentation of rivers and streams caused by forest clear-cutting;*
- *radionuclides in flowback water;*
- *radon releases from wellheads;*
- *discharges of fracking wastewater into surface water sources and sewage treatment plants;*
- *the permitted use of fracking wastewater for de-icing roads.*

Moreover, conductive faults are found throughout the Marcellus Shale that could allow [transport of contaminants](#) from the fractured shale beds to groundwater aquifers via both advective transport and preferential flow.

Additionally, exemptions from hazardous waste laws allow the dumping of

drilling fluids, flowback sand, and drill cuttings into municipal landfills, even though these substance are often radioactive and laced with toxic hydrocarbons and heavy metals. During the first six months of 2012 alone, more than 55,000 tons of drill cuttings and 55 tons of flowback frack sand from Pennsylvania was hauled to three upstate NY [landfills](#) (Lowman, Niagara Falls, and Painted Post).

Did NY DOH and DEC provide the outside reviewers information about these various potential pathways of exposure?

why else has it taken off? Excellent report from PennState **[18:38min Summary of Actual, Planned & Forecast Economic Impacts]** and here as they looked at Pennsylvania and the Marcellus shale, which is again the area near Pennsylvania and Pennsylvania itself, look at the millions of dollars that would be added to the economy in 2011, 10 billion dollars in a state that really are struggling, in many of the rural areas in these states, have had a hard time.

The “excellent report from Penn State” in this slide is, in fact, a discredited economic analysis that was commissioned by an industry trade group, the Marcellus Shale Coalition. This paper, “The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play,” was [retracted](#) by Penn State administrators for presenting research in misleading ways and for failing to fully disclose funding sources.

Two of the Penn State report’s authors, Timothy Considine and Robert Watson, went on, two years later, to write another fraudulent report, “Environmental Impacts During Marcellus Shale Gas Drilling: Causes, Impacts, and Remedies,” that was released by the University of Buffalo’s Shale Resources and Society Institute. This [second report](#) contained conclusions that were false, lifted entire passages from a pro-fracking source, and claimed to be peer-reviewed when it was not. The resulting scandal prompted the University of Buffalo to defund and close the Shale Resources and Society Institute in 2012.

Where did Jackson obtain the Penn State report and why does he reference and rely on this completely discredited source? Did DOH and DEC provide this report to the reviewers in the materials that they were sent?

A billion dollars in state and local taxes, you can imagine any elected official that’s looking at this is going "Oh yeah, I want to have fracking in my backyard." I remember getting off a plane in Washington DC two, three years ago and it seemed like every other huge advertising sign at Washington National Airport was telling us about how many jobs and how much energy security we would get by having broad scale energy extraction, specifically gas extraction in the United States.

Natural gas is a global commodity. Even as the US natural gas industry wraps itself in patriotic language and boasts about energy independence and energy

security, it is, at the same time, desperate to export liquefied natural gas to both Europe and Asia where prices are much higher. In 2012, permit requests to export LNG totaled over 60 percent of current domestic consumption. Exporting gas will hike domestic prices just at a time when we've finished transforming coal plants and vehicle fleets to natural gas.

Are we to turn our nation into a gas extraction colony for the energy security of other nations?

[19:34 min Institute of Medicine] Oh, my goodness, I don't know what that last slide is, but I'm going to skip it. A lot of what I've been talking about I've extracted from a wonderful session that was held by the Institute of Medicine, National Academy of Sciences, in Washington DC April of 2012. Any of you that are online can go and hear and see at least the Powerpoint from each of the presentations at that meeting, just search on health impact assessment of new energy sources Institute of Medicine 2012. It will come right up and you can find the references that you want to see **[20:12 min Well Planning]** that I will be using.

The IOM conference raised many health issues; in addition, many new, significant studies in the health and climate literatures have emerged since April 2012. Did DOH provide up-to-the-minute research to Jackson and the other reviewers?

One of the presentations was from Shell Chemical and you can imagine in this setting it was a well-honed presentation. The gentleman said, "We protect surface water" the drinkable water, usable water groundwater is usually within, is pretty shallow, certainly not more than 1,000 feet down. Any of the stuff that's below that is supposedly not potable, not very usable.

Mexico City plans to draw drinking water from a mile-deep aquifer. [The Mexican effort](#) challenges a key tenet of U.S. clean water policy: that water far underground can be intentionally polluted because it will never be used.

And apparently the fracking wells go down about 5,000 feet or more, but the collar around these wells is heavily engineered. You all know that it was a failure of a collar that led to the Gulf Deepwater Horizon event. So the collar and the construction of these wells is extremely important and needs to be done under very tight engineering controls. And I will assert as I look at this more and more, there doesn't seem to be very much governmental oversight for the people that are putting these in place. And I'll tell you if I had to do a change in the wiring in my house, I'd have more governmental oversight than these plants, these drilling facilities, that can run millions of dollars. The casement is tested to make sure it meets drilling specifications and once the pipe goes down it goes off in different directions, at about 5-10,000 feet it will then, it can go out in multiple different

directions in a web underground. Explosives are then put into the tip of the pipe [21:49min Pictures of HF in a Lab] and the fracturing of the stone and the shale occurs. The cracks themselves can be in micron range to about a half an inch and go on about a half mile or so. What begins to seep out of these cracks is the methane and, for that matter, the distillates that people want to identify, and the crack can go up and down as much as 400 yards from these sites.

The danger here is well cement and casing failures, methane migration, and uncontrollable and unpredictable contamination via deep fractures intersecting with aquifers over time. These [problems](#) are fundamental to HVHF and very difficult, if not impossible, to mitigate. Cement is not an immortal material. It degrades over time and, while able to withstand compressive forces well, is vulnerable to cracking and debonding from steel casing with vibrations, as caused by repeated fracking or nearby drilling and fracking activities.

I won't get into and I have not researched the issue of earthquakes related to [22:20min Economic & Community Impacts of Gas Shale in PA] this and I just don't know enough about it,

Here Jackson admits he has not looked at risk of earthquakes associated with fracking, yet certainly someone with knowledge in this area should conduct such research before New York is opened up to HVHF gas development. A growing body of evidence implicates fracking itself, and not just the reinjection of fracking waste, with [observed seismicity](#).

This evidence is critical for any report about public health risks from drilling and fracking operations if only because three nuclear power plants are operational in western upstate New York and because all of Manhattan's water is carried into the city via two, antiquated, leaking [tunnels](#) that lie directly on top of the Marcellus Shale, which is, itself, cracked and fissured. While the Catskill watershed of NYC's drinking water is off-limits to HV-fracking, the proposed draft regulations provide no protection for the 100-mile-long aqueducts. Some natural [fractures and fault lines near the NYC watershed](#) extend for up to [seven miles](#).

Vibrations, pressure, and small-scale seismic activity could bring catastrophic public health consequences to NYC via structural failure of its subterranean water-delivery infrastructure.

Were these issues part of the DOH and DEC public health review?

but here was a presentation that Tim Kelsey did from Penn State and I just was impressed by this picture here. Here's a small pretty Pennsylvania town rural road through the center of town and you can see truck after truck after truck hauling in water and there are other trucks hauling in sand and other trucks

hauling in the drilling equipment into these small towns. It brings people, often times young men and large work crews that will be onsite for the months that it takes to build it. The crews then reduce in numbers

What are the public health effects of the exposure to the resulting diesel exhaust?

What are the public health effects from increased vehicular accidents, increased commuting times, increased stress levels, and increased exposure to traffic-related noise?

What are the socioeconomic consequences of large influxes of non-resident employees?

Socioeconomic impacts have public health consequences. Were the outside reviewers asked to consider these issues?

[22:57 Sand Mining USGS] once it's put in place. The quantities of sand are just staggering, and so in Wisconsin and Minnesota the amount of sand that's mined, and, by the way, after the cracks occur under pressure, under huge pressure of water, the sand is put in place, and its called a proppant, it keeps the cracks open so the methane can then seep past, but look at this: 12 million tons of sand **[23:25]**

What are the consequences to public health of the people living near sand mine operations or frack sand processing, storage, and transport centers? No data have been published on this topic. However, the people of Horseheads, NY are already living next to frack sand processing and transportation operations. It is apparent from videotaped documentation in Pennsylvania that clouds of crystalline silica dust fills the air in communities where it is being off-loaded. Potentially exposed individuals include children in adjacent daycare centers, as is evident in this [short documentary](#).

Did NY DOH ask the three reviewers to consider this pathway of exposure? How will sand be contained at fracking sites? Are workers and those living or traveling nearby protected from silica dust exposure?

23:23-28:21

[23:23] 12 million tons of sand being put on trains put on trucks and hauled into these rural areas where it goes. **[23:30 Infrastructure Footprint -pipelines and storage facilities- USGS]** Once the drill pad is put in place, I think that's the picture that when you show the gas is then uh put in actually it's dewatered, odorized and uh theoretic or put in pipes to then go to the sites. **The opportunities for failure in this kind of thing are dramatic but the potential for revenue for these**

communities, jobs and the rest, are genuine as well.

As documented by [Elected Officials to Protect New York](#), the promise of revenues and jobs in the NYS SGEIS is based on outdated and vastly overstated shale gas reserve estimates. Meanwhile, jobs numbers and production data from other states including neighboring Pennsylvania have not lived up to promises, and an influx of out-of-state workers and heavy industry can be a heavy burden on municipalities.

Elected Officials to Protect New York has been calling on NYS to study the socioeconomic impacts of HV-fracking. In December 2011, DEC Commissioner Martens admitted that the state's economic review—conducted by the consulting firm Ecology & Environment, Inc—was inadequate. That review projected only benefits, and no costs, from HV-fracking although it acknowledged that there would be increased expenditures for local governments, including road repair, emergency services, education, housing, and solid waste management. These costs were not quantified in the SGEIS.

Were reviewers invited to consider the public health impacts of these socioeconomic consequences? Were they provided adequate resources to do so?

[23:50 The Local Footprints of Marcellus Shale Gas Well Sites-USGS] Here is a USGS before and after photo of drilling pads and the pipelines being put in place to then carry it to a central compression or other kind of site where they would use it for transport.

Compressor stations for natural gas transport represent point sources for both noise pollution and methane, along with formaldehyde. There are no proposed setback requirements from compressor stations for homes, schools, or hospitals.

Were the outside reviewers invited to consider air pollution from compressor stations as a potential route of exposure? Were they told how many compressor stations might be built in NYS to support HVHF operations? Were they provided with adequate resources to do so?

[24:04 Permit Locations as Indicators of Potential Geographic Footprint-USGS] USGS map showing where these permits been put in place and one things that struck me during the Academy of Sciences meeting was this is, you know, this is more energy production than anything else in the United States. And the US government's really not been on top of this. And the state governments very much want the revenue and are a bit overwhelmed by it and the localities have really no capacity, most of them, to provide regulatory or health oversight for what's going on. **[24:36 Drilling Down Series- NYT article-"Regulation Lax as Gas Wells Tainted Water Hits River"]** I've certainly heard

horror stories about water contamination, you've seen movies and the rest on both surface water contamination, ground water contamination from this. I've heard industry folks say well those are badly done wells or this is stuff from that was from an old oil well from 50 years ago that's causing this. I'm not in a position to debate whether that's true or not

More than one month after turning in his comments to the DOH on the health effects of fracking, Jackson states that he does not know if accounts of surface or groundwater contamination from shale gas fracking are true or not.

Why not? Well casing and cement failures can and have been [quantified](#) and those numbers have been verified. Deep contamination has been predicted, modeled, and documented. Why would anyone accept industry's excuses without challenge?

Must crucially: how can New York move forward with HV-fracking if the hired experts claim not to know the answer to this fundamental question?

but I've certainly heard stories of the drilling waters being put into local rivers and creeks--that doesn't go on any longer I'm told--then putting it into municipal treatment plants and these plants are really not equipped for handling the extraction fluids that are coming out of these wells.

Who told this to Dr. Jackson? A DOH or DEC official?

In fact, dumping of liquid frack waste in rivers and streams via sewage treatment plants not only still goes on, it will be codified as part of the permitting process in New York State. Draft proposed regulations in Section 560.7 explain how drillers may apply for such a permit.

In his Feb. 4 testimony at the budget hearing, DEC Commissioner Joe Martens said "the SGEIS...talks about the possibility of waste going to publicly owned treatment works anywhere in the state, but none—there is not a single POTW permitted to take HVH wastewater today. If a driller wanted to dispose in a POTW, that POTW would have to get an approved pre-treatment process permitted by the EPA because that's not a delegated program in NY and they would also need to update the permit with DEC."

Worse, the incentives are structured in such a way as to encourage illegal dumping: taking waste to a treatment plant costs money where dumping in a surface stream or sewer costs nothing unless discovered and, if discovered, only a cost-of-doing-business fine. Unless regulations restructure this system, dumping will predictably take place and must be considered in a valid health impacts assessment.

Just last week, 40,000 gallons of fracking waste were illegally [poured into a creek](#) in Youngstown, Ohio.

According to a [New York Times](#) investigation,

“The documents reveal that the wastewater, which is sometimes hauled to sewage plants not designed to treat it and then discharged into rivers that supply drinking water, contains radioactivity at levels higher than previously known, and far higher than the level that federal regulators say is safe for these treatment plants to handle. Other documents and interviews show that many E.P.A. scientists are alarmed, warning that the drilling waste is a threat to drinking water in Pennsylvania. Their concern is based partly on a 2009 study, never made public, written by an E.P.A. consultant who concluded that some sewage treatment plants were incapable of removing certain drilling waste contaminants and were probably violating the law.”

What materials did DEC and DOH provide the three reviewers on the topic of fracking waste disposal if at least one of them claims that he “was told” that “drilling waters” are no longer put into local rivers and streams?

[25:18 Article- "Diesel in Water Near Fracking Confirm EPA Tests Wyoming Disputes"] but fluids that are put in have to have 1-2% chemicals mixed in that are bactericides that prevent scaling and do other effects but every time these have gone in the community becomes more and more concerned and is less aware of what is going in.

Bactericides are not used to prevent scaling. They are used to kill life forms that live in the frack fluid and in the shale. Deep, briny, carbon-rich shales are living ecosystems that serve as habitats for extremophilic organisms that will proliferate inside of well casings and interfere with the flow of gas.

To exterminate these living organisms, biocides, including bactericides

, are added to fracking fluid. In this respect, fracking is like subterranean crop dusting. Biocides are just one category of many highly toxic ingredients in frack fluid.

To counteract scaling, anti-scaling chemicals are added to frack fluid. To counteract casing and piping corrosion, anti-corrosive chemicals are added to frack fluid. Acids and lubricants are also used as additives.

The confusion here—on the part of professional public health expert—about the chemicals used in fracking fluid make us wonder what materials were provided to him by the NY DOH and DEC.

[25:36 NIOSH Oil & Gas Extraction Safety and Health Research- "Chemicals" (NIOSH & CDC)] That slide gave credit to Eric...?.. who was the fellow from NIOSH that did these slides and was a terrific presentation on what are the chemicals that are being put in these wells -here's an industrial biocide- and I'm just going to say from a policy standpoint, **I don't think that anyone should be using chemicals near where people live without full disclosure to the community**, to the doctors that might end up treating the workers or even treating affected or nearby community members. There's no business trade secret when we're talking about human well being in this situation.

Does this mean that Jackson has recommended full chemical disclosure as a precondition for opening New York State for HV-fracking?

The current draft regulations that would govern HV-fracking in New York State allow chemical identities to be withheld from the public.

[26:09 NIOSH Oil & Gas Extraction- "Potential Chemical Exposures" (NIOSH & CDC)] These are some of the chemical exposures that he looked at and there's not been a whole lot of occupational health and industrial hygiene looks by at least governmental agencies, perhaps the industry's done a lot of the worksite exposures. Silica, all that sand is crushed up and put under pressure and is becomes ? Diesel generators, if the well, if gas is evanescent or escaping from the wellhead or other organic compounds, people are exposed to that. Hydrogen Sulfide has been an ongoing problem at other drilling sites, for example, the geysers in north California, um metals, etc.

Before opening New York up to HV-fracking, should we not quantitatively evaluate risks of these exposures using HIA protocols?

[26:50 "Diesel Particulate (DPM)"- (NIOSH & CDC)] These are big industrial operations and it doesn't look to me like to me like those workers are being exposed, are being protected from diesel particulates, perhaps they are, I can't tell in the picture **[27:06 Diesel particulate, daytime vs. early morning- (NIOSH & CDC)]** but you can see with the early morning tyndall effect just how much diesel particulates are in the air around the sites where this work is going on. **[27:13 "Sand Use" (NIOSH & CDC)]** This is an amazing number, up to 4 million pounds of sand are pounded down these wells to prop open the cracks and keep them open. Its virtually 100% silica and when its put under pressure its coming out of these trucks, being put into a blender hopper and then being forced down the well under substantial pressure and silica gets into the atmosphere around where in the air where the workers are where this procedure is going. **[27:48 Silica (Quartz) (NIOSH & CDC)]** We've known for a long time that breathing, especially fine silica, is a health threat. It is regulated by OSHA

(Occupational Safety and Health Administration).

Silica dust is not well regulated for workers, and improvements are [long delayed](#). No one is regulating community exposures.

It puts you at a risk of a lung disease called silicosis and of lung cancer and we have several hundred deaths a year from silicosis in the United States. **[28:06 "Why is silica an occupational health hazard?" (NIOSH & CDC)]** Its a ?. Besides is carcinogenic effects its an occupational carcinogen, its not reversible, its progressive, its a difficult and horrible way to die.

Why do we want to open New York State up to an industry that provides toxic, dangerous jobs that will fill up our hospitals and ratchet up medical costs, as has occurred in [other states](#) where HV-fracking is ongoing?

Can we presume that the NYS health review undertaken by DOH provides an analysis of health costs associated with direct and indirect medical costs associated with HV-fracking, including costs to communities and county public health departments?

Is an evaluation of occupational health and safety to workers part of the health review?

28:19- 34:05

[28:19 "Hot Loading" (NIOSH)] Here's the hot loading cuz it's heated up, it's under pressure. **[28:27 Hot loading, sand transfer operations (NIOSH/CDC)]** Look at the size of these trucks that are pushing the sand into the wells and the workers desc..and you can see it coming out of the pipes at the side of the truck... I don't know if in fact that's silica itself ..**[28:41 Sand transfer operations-silica (NIOSH)]** I was said it was silica that was coming out of the truck but the workers describe being in this work setting as working on the beach, there's that much sand around them and silica around them in these exposures so I would assert that worker exposures are substantial, nearby exposures. And there are some of these well pads that have been put in place in between private home and the barn or near a school, at least I'm told this is gone on in Texas and other parts of Pennsylvania where these operations put in place.

Hot loading does not mean that the sand is heated up. It means that the [sand is being moved](#) while the fracking or transportation machinery is in operation.

[29:11 Blueprints for a Secure Energy Future-federal doc] The federal government and president put forward his blueprint for a secure energy future back in 2011 and he says the administration is calling on industry to be more transparent about the use of fracking chemicals. Seems pretty permissive to me.

And said we're going to do more research, that's good, and we're going to set the bar for safety and responsibility and he appointed a subcommittee to the secretary of energy to report back on steps to improve the safety and environmental performance of fracking and to develop within 6 months recommended advice to agencies on practice for shale to protect public health and environment.

[29:58 "Concerns raised by opponents of Marcellus Shale Drilling..." - federal doc-]..(?).. At the first public meeting people were given 2 minutes a piece to address each of these issues and if you go down the list, yes, its environmental concerns and I'm not focused on environmental concerns right now, I'm really talking about human health. People were worried about how the industry is being regulated, they're very much worried about their water, their general health concerns, their air. They're worried about bias and conflict of interest. There was a professor who was giving a lot of information on this recently, it turned out he was an executive, an appointed person in one of the major companies that had a vested interest in the drilling, in fact I've heard the term 'frackademics' being used.

Jackson earlier praised the Considine et al. report as "excellent." In fact, Considine is a leading "fracademic" whose work is funded by the gas industry and who has falsely claimed that it is peer-reviewed when, in fact, it is not.

Jackson "has heard" about conflicts of interest in academic research on shale gas but ignores independent and peer-reviewed research on the economic impact of shale gas development that show job losses and economic costs from shale gas extraction. The DEC also ignores this research. Comments that economist, Jannette M. Barth, PhD, submitted to the DEC in response to revised regulations, address this omission, provide citations, and also list many of the costs that are ignored in studies such as Considine's.

Why is Jackson unaware of Barth's research? Did DEC not incorporate Barth's findings into the final iteration of the SGEIS that was made available to the three outside reviewers? This question is a crucial one because socioeconomic changes to a community is an important variable in predicting public health outcomes. Increased homelessness, for example, among low-income families in communities impacted by drilling and fracking operations have direct consequences for the public health status of that community—as does job creation and job destruction.

Here is an excerpt from a Frackonomics lecture from April 2012 in which Dr. Barth discusses the ways in which industry misrepresents the jobs creation data:

Let's look at a few different, but somewhat related examples of industry claims: I'm sure that many of you have heard about the Ethylene Cracker plant that Shell Oil is going to build in Beaver County, PA. A cracker plant separates wet gas and produces ethylene that is in turn used in

plastics and other chemical industries. There was competition among West Virginia, Ohio and PA, each state hoping that Shell would decide to locate there. There are concerns about the quality of air emissions near the cracker plant, but beyond the air emissions issue, it's interesting to consider the economics.

Each state offered tax incentives to entice Shell – in fact, I saw a report that PA created a Keystone Opportunity Zone whereby the plant will pay virtually no taxes to the state for 15 years. So, I've seen reports that this plant would create 10,000 construction jobs (you all know that the construction jobs are just during the construction phase – they go away) AND then the plant would create another 10,000 permanent jobs. Note that the facility will be built on 300 acres.

So, I looked into another ethylene cracker plant owned by Shell but located in Norco, Louisiana. The Shell website states that this plant is on 1,000 acres and has only about 600 full-time employees. In other words, the Norco cracker plant is on more than three times as much acreage, but has only 6% the number of jobs. Does this make sense? I don't know BUT this is an example of a claim that should be questioned.

[30:38 Pennsylvania] The Governor of Pennsylvania, newly elected at the time, said Marcellus shale is very important and he appointed a 31 member committee to an advisory committee, divided up into work groups and said please report on public health, safety and environmental protection. **[30:54 Maryland HVHF]** The Governor of Maryland did the same thing and said we want to make sure there are no unacceptable risks or adverse effects on public health, safety and the environment.

[31:03 - Paper - "Missing From the Table: Role of the Environmental Public Health Community in Governmental Advisory Commissions Related to Marcellus Shale Drilling"- Bernard D. Goldstein, Jill Kriesky, Barbara Pavliakova] So Berney Goldstein, former dean at Pittsburgh did this paper in *Environmental Health Perspectives* which I want to thank Bernie for and he's been such an important leader on all these issues and they looked at what kind of public health oversight had been provided on hydraulic fracturing. **[31:26]** Quote unquote "Our review of the background of the 51 members of the federal, Pennsylvania and Maryland advisory committees provided no evidence that any member had expertise in the human health aspects of environmental health or experience in health or health care." Not dentists, not nurses, no one with a health background. And I'm going to blame both the agencies that have pulled these advisory committees together and in a way I'm going to blame the public health community because this is not easy stuff and we needed we need to step up and be much more visible and present and **we need to assure that there is a health impact assessment on any proposed hydraulic fracturing or drilling processes just as there would be an environmental impact assessment.**

Can we therefore conclude that New York State will not proceed with HV-fracking until a comprehensive health impact assessment is conducted? Medical health professionals in New York State have been making this demand for two years and to no avail.

[32:08 -Socialism and Capitalism - Quotes from Oystan Dahle, Former VP, Exxon of Norway] So I'm going to wrap up in a minute and come to solutions. But truly, an economic structure that doesn't tell the truth about the ecologic and not just the ecologic harms but the human health harms and how do we assure that as we put a process in place, every kind of energy source has human health impacts, that we want to maximize the benefits and minimize the negatives and people that are bearing the risks are reaping benefits, not someone at a distance in Houston or New York or somewhere else are reaping the benefits.

[32:48 Solutions] So one is I feel very strongly that "Right to Know" is very important. People need to have data on what's coming out of that site, what's getting into the air, what's getting into the water, what are the chemicals that are being used. There needs to be a central clearinghouse in each of the states, in my opinion, as well as that would provide real-time data. I remember reading one Environmental Impact Statement that said "well, we'll provide information to the public." You know, basically it would take months and months for that information to be provided whether it was a spill, a chemical, or a health impact or a release, and in this era of computers, why isn't it being provided in real time? We've learned from Richmond, California that when the public demanded to know what was being released in real time, it had benefits to the oversight of that site. We'd have good disease surveillance, especially of the workers because these exposures are very substantial, and I don't think it's been adequate to this time and of community exposures at the same time. It sounds like I'm endorsing hydraulic fracturing, I'm not necessarily endorsing it, I'm just saying if it's going to be done it has to be done in ways that maximize benefits.

[34:05 National Environmental Policy Act -NEPA Decision Making Process] This looks like a pretty boring slide but everyone's heard of environmental impact assessments or environmental impact statements. These are mandated under the National Environmental Policy Act and was put in place in 1970, and if you go through the typical environmental impact assessment and statement--and they can go on for thousands of pages and it deals with many regulatory, engineering and legal issues--the coverage of human health issues is notoriously inadequate. And so suddenly in a small town if you have a thousand young men looking for housing, looking for meals, looking for entertainment, it has a social impact and this boom town mentality that occurs in many of these communities, clearly the localities wants to have the revenue, people want to have jobs, they're often depressed communities, people want to have in a financial source in these communities, but we've got to make sure there are long term benefits and its not the typical boom/bust cycle that we see with every other gold rush. And in fact

that's exactly what's going on with hydraulic fracturing is it's a gold rush.

[35:16 Improving Health in the United States] It's a poor slide I'm sorry. This is the Health Impact Assessment report came out in 2011 from the National Academy of Sciences. It says Improving Health in the United States. Jonathan Fielding, the Health Officer of Los Angeles. was on that committee. I had the opportunity to chair the committee. Rajiv Bhatia-(?) from San Francisco was on it, Aaron Wernham from the PEW Trusts, and one of the findings was we need to incorporate robust and rigorous Health Impact Assessment into the assessment process. And one of the people on the committee was Dinah Bear, and Dinah was on the Council of Environmental Quality in the White House for over 25 years, she's actually a staffer to it, very seasoned lawyer who said there was never, never any intention that health impact would be excluded, human health impact would be excluded from the environmental impact assessment. It's partly because it not necessarily easy, and it requires a lot of community input that many ways the responsible parties avoided doing it and the health community wasn't stepping up and really addressing it. When you do oversight, and you do apply pressure on a process, you can see big changes.

[36:33 Per Capita Electricity Sales] This is a graph of per capita electricity sales after 1974 when we had the gas shocks in the United States that California put in place energy efficiency requirements for refrigerators, industrial processes, eventually for cars, well, for other domestic and industrial sources and at this point California did about half of the per capita energy use as the rest of the United States. So even handed regulation across the board has been effective and in many ways if we want to reduce the health impacts of energy production, one of the best ways we can do it is with efficiency. ..remember that loss (?)

[37:14 More Solar Roofs in California] I talked a little bit about solar earlier where I was speaking about wind. I would argue that our current photovoltaic panels are ugly, they're too costly, they're not robust enough, they contain rare earths, they're um and if we had really developed the technology adequately through the 1980s and 1990s I would argue that virtually every home in the United States very quickly would have shingles **[37:48 Distributed Solar has \$ Value Beyond its Energy Value ASRC]** that were photovoltaic and generating energy anytime the sun shone and in fact often times we need the most amount of electrical energy is when the sun is brightest and when its hot. It would require less demand on the grid, less wear and tear on ... and you know we're going to need much more than just solar, but the combination of much more efficiency **[38:07 Trends in Nondefense R&D by Function AAAS]** and local generation of energy makes sense. So big take away, I do think that research into safer and healthier energy sources and research into the health impacts of these sources and doing all cost accounting and full health impact assessment of our energy sources is what we need in the United States. And in that

portfolio, perhaps fracking or hydraulic fracturing, is in there, I'm not arguing for or against it but I am saying it certainly up until now has in my opinion been under regulated.

[38:39 Energy is a Public Health Issue] And with that I will stop and thank you all for your attention, I'm sorry I was silent there for the first few minutes.

Q & A- BEGIN

[Moderator] Thank you Dr. Jackson. If anyone has a question, please type it in the field at the bottom of the chat window in the bottom left hand corner of your screen. We have a question from Brenna, she says "Hi Dr. Jackson, from your comments on the needed public health impact studies and following the precautionary principal, it seems you would support a moratorium in California until such studies on public health impacts were provided. And recommendations to minimize such impacts? " Do you have a ... she also goes on to say, sorry, "Following your theme of the precautionary principal, you also did not mention what we do know about fracking and health. The University of Colorado peer reviewed study showing severe...air quality problems near fracking cities and that those living near cities were at a much greater risk of acute and chronic health conditions." Dr. Jackson would you like to answer that?

[40:05] Dr. Jackson: No, I'm not going to comment on the Colorado work, in fact the committee or the group I work with, John Adgate, and **by the way what I've told you is not necessarily incorporated into the comments I've provided to New York State, these are my opinions offered in the noon seminar.** Dr. Adgate's the expert on this and I've decided not to dive in to local air quality issues and I've been focused on the Marcellus Shale in particular with the report. The precautionary principal sounds great, most Americans argue for it, it is not the law of the land in the United States. The National Environmental Policy Act is right now the law of the land and we need to require adequate looking at the health impact in that process. **You can do health impact assessments briefly or you can do them in great depth. I think we need a national one in great depth, and its just absurd that we're 5 - 7 years into this vast enterprise of doing hydraulic fracturing and there's not been a full-blown, national health impact assessment, number one.**

We need in New York State what Dr. Jackson calls for nationally. Concerned

Health Professionals of New York have begged for such a study. Here is the opening of our position paper released last fall, “The Case for Comprehensive Health Impact Assessment:

“Four years of study and four thousand sGEIS pages have still not answered the three most fundamental questions about hydraulic fracturing in New York State: Will fracking sicken and kill more New Yorkers than it employs? Will the sick and dying have any recourse—other than fleeing their homes and jobs—to protect themselves? And what is the economic cost of that morbidity and mortality?”

“Case studies and individual reports from other states provide credible evidence of public health risks in communities located near drilling and fracking operations. Although these risks have been acknowledged, no comprehensive assessment has yet been conducted. How many illnesses and deaths are we willing to ignore? Many of the areas currently being drilled are not as densely settled as New York, which is the nation’s third most populous state. Small increases in mortality and disease rates in a state with 19.5 million inhabitants would have much more wide-spread consequences and carry much bigger costs than equivalent effects in, for example, western Wyoming or eastern Utah. Must we see these consequences played out before we take action?”

I won't argue whether fracturing is going on or hasn't been going on. It's often in old oil wells that are being reopened to extract both natural gas and distillate at the same time. I think scrutiny for that needs to go on but I'm reluctant to dive into the air quality issues, it's not something I'm conversant in.

[41:05] It's just absurd that we are 5-7 years into this vast enterprise of doing hydraulic fracturing and there has not been a full blown national health impact assessment, number one. I won't argue whether fracturing is going on or hasn't been going on. It's often in old oil wells that are being reopened to extract both natural gas and distalate at the same time. I think scrutiny for that needs to go on but I'm reluctant to dive into the air quality issues, it's not something I'm conversing in.

[41:50] Thank you Dr. Jackson, I have a quick question or um The LA county public health water has a question for you, they say: “what issues would we need to know as far as dealing with waste's? i.e chemicals, waste water, drilling solids produced by the fracturing process?”

[42:04]

Dr. Jackson: You do this for a living so you probably know it by you, I mean the water district know it better than I. One, you need to know what are the chemicals are being added to the water and being pushed down the wells and as I said there are bactericides etc two- when these things then return to the surface the fluid and the tailings return to the surface they can contain certain amount of natural occurring radioactive materials. That needs to be scrutinized. There has been discussion about storage in sealed and lined facilities. There are concerns about that since they fail over time. I have heard concerns about radon and other chemicals being present in the gas itself once it's been pulled from the shale or below ground. The oil sources in California are actually or fracking sources in California are different, it's my understanding is that they are more maritime sediments and they are different from the shale in the Marcellus area. I think probably the water board and water resources control board need to set up a proper regulatory process and hearing process to decide exactly how to handle it in our state. This is what they do for a living.

[43:27] Thank you, we have another question from Dr. Susan DeVenidictus-(?). How adequate is the WHO health impact assessment?

Dr. Jackson: Is the WHO? I don't understanding? You mean the World Health Organization?

Moderator: Yes, the World Health Organization health impact assessment.

Dr. Jackson: You know, I'm guilty. I'm not aware that World Health Organization had done an in depth impact assessment of hydraulic fracturing. So I claim ignorance on that.

[44:05]Gina Natoli asks: "Can local jurisdictions regulate the use of these chemicals at the well site or does the state or federal government have supremacy?"

[44:18]

Dr. Jackson: It varies by locality. My understanding when I was in Pennsylvania recently is the state has preemptive, folks from Pennsylvania may want to correct me on this, has preemptive local jurisdiction and control. It does appear that the, depending on who's doing it, they want it both ways. They want the state to regulate it, the locals look like there going to do something. If they want locals to regulate it then the state is going to do something. But it does vary from locality to locality.

[44:56] During your talk you said how High Volume Hydraulic Fracturing is being employed in many regions of the United States. How many impact assessments have been completed at the national level and do we know how many impact assessments have been done at the state or regional levels?

[45:14]

Dr. Jackson: I did not do a survey of that. I know New York State is in the process of doing quite an in depth one. I've read that one closely.

We are not aware of any health impact assessment of HVHF in New York State. We have asked for one repeatedly. We were denied.

Is Dr. Jackson referring here to the health review? If so, does it employ recognized HIA methodologies? Does it aggressively seek out information on health problems reported in communities in regions where HV-fracking is already underway? Does it use quantitative analytic methods to estimate exposures and project health impacts? Does it describe risks faced by the general public, as well as those faced by vulnerable sub-populations?

I'm not aware of the some of the impact assessments elsewhere. I don't believe there has been a full blown impact assessment at the national level. I think we desperately need it given the breadth of this activity.

[45:45] We have another question from, I'm sorry if I mispronounce the name, Seth Shonkoff, Dr. Jackson you spoke about carbon dioxide emissions from natural gas and compared them to coal, yet you failed to include emissions of methane during the production of shale gas. Most recently NOAA asserted in the scientific journal Nature that 9% of total methane production is vented into the atmosphere, putting it above coal in its climate impact. Methane is not only a strong GHG but is also a precursor to background tropospheric ozone levels, a driver of poor respiratory health. Could you please comment on the implications of these data in terms of your comments today?

[46:35] **Dr. Jackson:** You are absolutely right and I did not remember to include it. I actually didn't talk about extraction of methane from landfills and other sources. There are releases of methane from these sources. I watched a video of using a certain kind of isotope camera of methane being released from fracking sites in Texas. Large amounts of it were being released and it is extraordinarily important to be capturing. The reason they are doing these wells is to capture methane but it is often being released in the atmosphere. The person that raised this issue is exactly

correct. Methane is far more effective a green house gas than is carbon dioxide and is a major contributor to local air quality problems. It has its own set of risks as well. I really feel very strongly, I want to come back to this, that all energy sources have health impacts and as we pick what we are going to work on we need to minimize the negatives on the ones that we're using. I do think that moving coal power plants to methane is a big improvement.

[47:50] We have a follow up question from Dr. Susan Devenidictus. Clarifying my earlier question, the world health organization has an assessment tool. How can we get LA county to do this for the 300,000 residents living around the Baldwin hills Inglewood oil field. What do you recommend citizens do to get adequate health assessments as soon as possible?

[48:27] Dr. Jackson: I believe this is a pretty local issue and I don't want to dive in it too deeply. There was an item on the ballot recently in Los Angeles that would surtax oil and gas production in the Los Angeles region. That lost. Clearly if something is generating this kind of wealth or at least this kind of revenue, that some of that money should be used for a health impact assessment. I know. I had been a state health official in California and I know the pressures that they're under, it is very difficult to take on a very costly and laborious impact assessment without additional and directed appropriation. I was very concerned in other states. I won't name the state right now, that enormous amounts of resources go into the environmental impact assessment, it's done within the environmental agency; the health questions come up and then they say, "here, health department, you deal with it," and the health department is inadequately staffed, it doesn't have the health physicists, it doesn't have the epidemiologist, it doesn't have the staff to deal with these specific issues, and it needs to be part of the revenue stream that comes out of these wells that supporting the health functions as well as the environmental regulatory functions. So, ya know, get a bill or something on the ballot measure and require them to do it but make sure you are paying for it cuz its not going to happen unless it is. As we used to say at CDC, "Don't give me an authorization; give me an appropriation if you want me to do something."

[50:00] I think we have time for one or two more questions. If people want to go ahead and type a question in the bottom of the chat window in the bottom left corner of your screen. Dr Jackson, you said that water is an integral component of the hydraulic fracturing process. Can you elaborate a little more on why HVHF is exempt from the Clean Air and Water Acts?

Dr. Jackson: Why, I can't even figure out why it's called the Halliburton exemption in the year 2005. I think it's pretty obvious why it's exempt. I don't mean to be flippant with that answer. Actually, what I mean to say is that it's big politics and any time there is this much money it's very big politics.

[51:00] ..wrap up..