Extracting natural gas from shale can be done safely, says researcher

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A gas well in central California with the Sutter Buttes in the distance.

Natural gas currently provides more than a quarter of the energy used in the United States and that fraction is likely to continue growing. New technologies are making it easier and more economical to produce natural gas from where it lies in shale formations deep underground. But as gas plays a bigger role in meeting our energy demands, safety and environmental concerns about the extraction process have mounted.

Earlier this year, President Obama instructed Secretary of Energy Steven Chu to put together a panel to address the safety and environmental

aspects of shale gas production. Mark Zoback, a professor of geophysics at Stanford University, was asked to be part of that panel, which recently released its first report; He spoke with *Stanford Report* about shale gas as an energy source and the recommendations in the report.

Why has natural gas from shale become such a major energy source in the United States?

Fundamentally, it is due to several technological breakthroughs. We have known about these organic-rich shale formations for 100 years, but getting the natural gas out of these extremely impermeable rocks was essentially impossible.

Over the last five to 10 years, however, it has been demonstrated that by carefully controlled hydraulic fracturing in a well drilled horizontally into the shale, you can enhance the permeability of the shale to produce commercial quantities of gas.

According to the Energy Information Agency, natural gas deposits, both in the United States and the world, are absolutely enormous. According to some estimates, at current consumption rates there is enough gas to last for 100 years.

Is burning natural gas any better than burning coal or oil when it comes to global warming?

Burning coal currently provides about 50 percent of the electricity used in the United States and it accounts for about 40 percent of all U.S. carbon dioxide emissions, as well as a number of other pollutants. Generating electricity with natural gas reduces carbon emissions by about half. In a new study I've carried out with Prof. Steve Gorelick, we

argue there is more than enough gas from shale in the U.S. to completely replace coal for generating electricity in the next 20-30 years. Countries such as China, India and Australia also use large quantities of coal for electrical power generation and switching to natural gas would dramatically reduce their emissions.

Natural gas is also a cleaner fuel for running cars and trucks than gasoline or diesel fuel. Estimates are that switching to natural gas would reduce carbon dioxide emissions from gasoline- and diesel-powered vehicles by about 25 percent. Using domestic natural gas for transportation could significantly lessen our dependence on imported oil.

Natural gas is also an ideal back-up for renewable energy sources such as solar and wind because gas-fired power plants start up quickly and are much more efficient and clean than coal-burning plants.

Speaking of renewables, wouldn't we be better off directing our efforts toward renewable resources such as solar, wind and water?

Absolutely. I see natural gas as a transition fuel to an energy future that is far less dependent on fossil fuels. But the global energy system is so huge that even if we move as quickly as possible to develop renewable energy sources such as wind, water and solar, we will need to continue using fossil fuels until mid-century.

Remember too that over this same period the demand for energy will continue going up dramatically because of increasing standards of living in China, India and the rest of the developing world. We have to address the many issues associated with energy and the environment on many fronts – we need to save energy through improved efficiency; more fully utilize renewables; and develop new clean energy sources.

To me, enhanced utilization of shale gas resources provides an opportunity to transition to clean and renewable sources over the next few decades while helping to meet current and growing global energy needs. Our study addressed some of the things that could be done to accomplish this while reducing the environmental impact of shale gas production.

The hydraulic fracturing or "fracking" of gas shale has raised concerns about potential damage to the environment and to human health. How serious are those concerns?

It is somewhat ironic that nearly all of the reported problems associated with shale gas development have been attributed to hydraulic fracturing, when in fact the exact opposite is the case. Most problems associated with shale gas wells have arisen from poor well construction – it is critically important to drill properly and to line the wells with steel casing that is properly cemented in place. Nonetheless, identifying measures to reduce the environmental impact and improve the safety of shale gas production are precisely the issues the subcommittee was asked to address in our report.

There are three main aspects of hydraulic fracturing that have caused concern: the chemicals in the fracturing fluid; fear of the fracturing fluid interacting with drinking water aquifers; and the disposal of the fracturing fluid coming out of the well after it has been in contact with the shale formations.

So what about the chemicals in the fracturing fluid?

Hydraulic fracturing fluid is mainly water, with small amounts of thickening agent added – usually guar, the same thickening agent used in

making ice cream. There is also some biocide, to kill bacteria in the water, as well as a little bit of a friction reducer.

Unfortunately, an act of Congress exempted the gas companies from having to reveal the chemicals in the fluid. I say unfortunate because it has led to unnecessary suspicion and paranoia. Our report recommends that the contents of fracturing fluid be fully disclosed.

Has hydraulic fracturing caused drinking water contamination?

There have been fears that hydraulic fracturing fluid injected at depth could reach up into drinking water aquifers. But, the injection is typically done at depths of around 6,000 to 7,000 feet and drinking water is usually pumped from shallow aquifers, no more than one or two hundred feet below the surface. Fracturing fluids have not contaminated any water supply and with that much distance to an aquifer, it is very unlikely they could.

This said, there are instances where natural gas has been found in drinking water supplies, which is one of the problems that can be caused by poor well construction. If the steel well casing is not fully cemented, gas can leak up around the outside of the casing and contaminate shallow aquifers. In fact, a related problem is that there are a number of aquifers contaminated with natural gas that can be traced to leaking casings of very old wells that predate recent drilling for natural gas by 40 or 50 years.

What about disposing of the water that flows out of the well after hydraulic fracturing?

This can be a serious issue. When that water comes back up the well, it

has picked up chemicals present in the shale that aren't good for human health or the environment. The water that comes back can be very saline and can contain chemicals such as selenium, arsenic and iron.

That water has to be disposed of properly, which can mean injecting it into a storage well that has been permitted and licensed by the Environmental Protection Agency to standards that will prevent leakage.

Alternatively, it can be treated and reused, which is the preferable solution. More and more, that is what is being done in the northeastern U.S. So the water goes right back into the shale from which it came.

The subcommittee report made a number of recommendations. What would you say is the most critical thing for people to bear in mind regarding developing our natural gas resources?

Our most important recommendations were for more transparency and dissemination of information about shale gas operations, including full disclosure of chemicals and additives that are being used during drilling and hydraulic fracturing. We also recommend a number of steps to better protect air and water quality. We call for more and better data collection before, during and after drilling, so that if problems are encountered, the causes can be established and remedies more easily identified.

There have been a lot of misconceptions and ill-informed debate regarding shale gas development. To quote our report: The public deserves assurance that the full economic, environmental and energy security benefits of shale gas development will be realized without sacrificing public health, environmental protection and safety. We hope to have taken a step in this direction.

Provided by Stanford University