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A Tale of Two Technologies: Hydraulic Fracturing and Geologic Carbon Sequestration

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Recent innovations have given us the opportunity to tap large reserves—perhaps a century's worth of reserves ... in the shale under our feet.

President Barack Obama, March 2011

Two technologies, hydraulic fracturing and geologic carbon sequestration, may fundamentally change the United States' ability to use domestic energy sources while reducing greenhouse gas emissions. Shale gas production, made possible by hydraulic fracturing and advances in directional drilling, unlocks large reserves of natural gas, a lower carbon alternative to coal or other fossil fuels. Geologic sequestration of carbon dioxide (CO_2) could enable use of vast domestic coal reserves without the attendant greenhouse gas emissions. Both hydraulic fracturing and geologic sequestration are 21st Century technologies with promise to transform energy, climate, and subsurface landscapes, and for both, effective risk management will be crucial. Potential environmental impacts, particularly to groundwater, are key concerns for both activities, because both inject large volumes of fluids into the subsurface. Unless environmental issues and public concerns are actively addressed, public opposition could stall deployment of these two important technologies.

In the United States, shale gas production increased 8-fold in the past decade, and it is projected to comprise roughly half of domestic production in 2035.[1] Between 2010 and 2011, the U.S. Energy Information Agency (EIA) doubled the estimate of technically recoverable unproven shale gas reserves.[1] U.S. energy supply projections have been fundamentally and strategically altered. Hydraulic fracturing, which makes this bounty possible, injects a mix of water, propping agents, and proprietary chemicals at high pressure to create millions of small fractures in low-permeability shale and liberate trapped natural gas. At each well, 2 to 4 million gallons of water are injected and 30 to 70% remains underground.[2]

Geologic sequestration could keep CO_2 out of the atmosphere by capturing it at coal burning power plants or other industrial facilities and injecting it into deep geologic formations.[3] The U.S. Department of Energy, in the 2010 Carbon Sequestration Atlas, estimated that the nation has the capacity to store all CO_2 emissions from large domestic stationary sources for at least 500 years (at 2009 emission rates). Geologic sequestration has great promise, but its role in the U.S. energy future is uncertain; there is no economic driver to do it unless society decides to substantively reduce GHG emissions. A few demonstration projects are underway, scheduled to inject a total of about 10 million tons of CO_2 in the United States. Another 12 million tons of captured CO_2 was used for enhanced oil recovery in 2010, but currently, geologic sequestration is a minor player on the U.S. energy stage.

Although hydraulic fracturing and geologic carbon sequestration are distinct technologies, they pose some similar environmental risks. Groundwater contamination could occur if injected or mobilized fluids escape from the target formation and migrate upward into drinking water along faults, fractures, abandoned wells, or poorly constructed injection wells. Both technologies can protect groundwater by carefully studying site geology so only appropriate sites are chosen, using best practices for well construction, monitoring site performance, and developing emergency and remedial response plans so all parties are prepared if problems arise.

Despite similarities in their environmental risks, regulations for geologic carbon sequestration and hydraulic fracturing are drastically different; the result is that similar risks are managed quite differently. Ironically, nascent geologic sequestration technology has state-of-the art regulations that were crafted during a decade of federal notice-and-comment rulemaking. The environmental risks of geologic sequestration will be managed by the EPA UIC program, under new Class VI well rules adopted in 2010. As the first injection well class added since 1983, Class VI rules incorporate advances in subsurface technology and modeling, regulatory philosophy, and environmental expectations that have transpired in the intervening quarter century.

In contrast, the Energy Policy Act of 2005 officially exempted hydraulic fracturing from regulation under the UIC program. The environmental risks of shale gas production are managed

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through rules established by state oil and gas agencies. These rules reflect historical practices that emphasize production of hydrocarbons for maximum economic gain. These values are so entrenched that federal environmental regulation has grown up around them, often in the form of exemptions. Beyond the UIC exemption, hydraulic fracturing is also effectively exempt from reporting the composition of the hydraulic fracturing fluid to the EPA Toxics Release Inventory and from obtaining stormwater permits that would regulate how hydraulic fracturing fluid is handled at the surface.[2,4] These exemptions are significant because surface activities associated with hydraulic fracturing can also threaten drinking water. In light of increasing reports of groundwater contamination, some communities are moving to block shale gas projects[5] and bills to remove environmental exemptions have been introduced in Congress. While states struggle to address the environmental risks of hydraulic fracturing, public trust in industry's ability to self-regulate remains low—particularly in the shadow of the 2010 Gulf Oil Spill.

Emerging energy technologies are often held to regulatory standards that incorporate technological advances in management and monitoring, while fossil energy technologies are often exempted from environmental regulation. This double standard can impede the deployment of new technologies and damage the prospects for important energy resources. Overly stringent regulation can damage the business case for important new technologies like geologic sequestration, while environmental exemptions can compromise public acceptance. Further, discussions of regulation, seen recently in the furor over hydraulic fracturing, provoke deeply embedded reactions from both industry and environmental groups. Industry often opposes environmental regulation while environmental groups often decry regulation that falls short of banning particular activities. Neither of these positions is helpful to further the development of valuable and strategic energy technologies. Within this context, appropriate regulation can be seen as a fulcrum to balance community and industry interests.

A shift toward a 21st Century vision of regulation is required. Hydraulic fracturing and geologic sequestration are both technologies that could reduce greenhouse gas emissions, enhance domestic energy security, and fundamentally change trajectories of energy supply and use, not just in the United States but across the world. While both present risks to the environment, appropriate regulatory approaches that equitably and consistently balance risks and benefits can aid in public acceptance and responsible deployment.

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