Free markets. Real solutions.

R STREET POLICY STUDY NO. 174
June 2019

REDUCING REGULATORY BARRIERS TO CARBON CAPTURE INVESTMENT

By William Murray

CONTENTS

INTRODUCTION

Carbon dioxide is the fourth-most common chemical in the Earth's atmosphere and is integral to life. However, if concentrations become too high, the climate can become overwarm and cause severe damage to ecosystems. For this reason, ways to capture carbon in order to prevent such negative environmental effects have increasingly become a topic of debate among those who wish to address the problem of global warming.

There are many natural ways to capture carbon, such as by afforestation and through soil carbon sequestration. However, the focus of the present study is the mechanical capture and underground storage of gaseous carbon dioxide that is the byproduct of fossil fuel use—known as carbon capture and sequestration or CCS.[1] Like all major engineering efforts, knowledge about such technology must be gained iteratively over decades through trial and error until best practices are developed and thus the technology exists but is still being perfected.

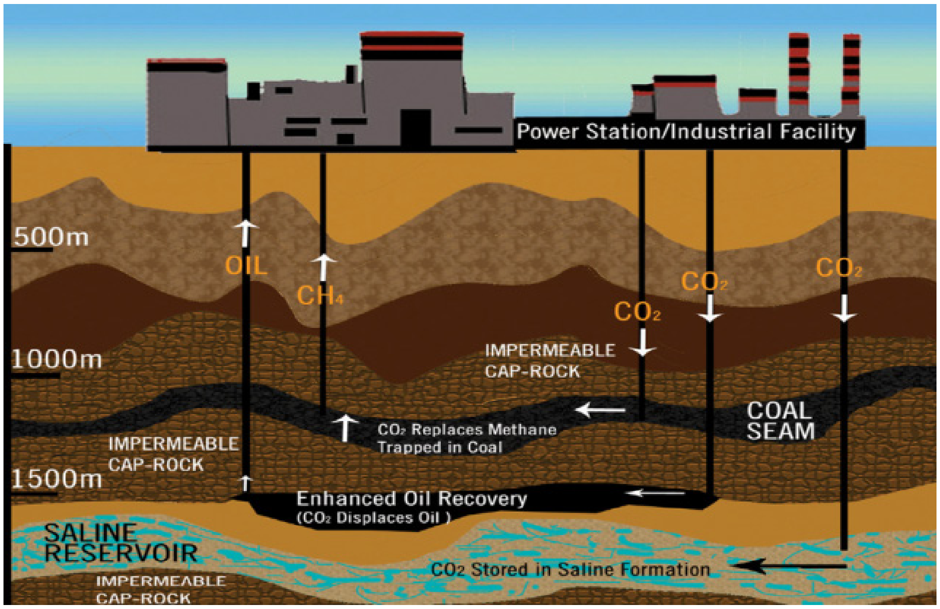
Currently, the U.S. Dept. of Energy has adopted a goal to economically deploy carbon capture projects by 2030. However, concerns about the increasingly dire risks of global warming have necessitated that this deployment schedule be expedited. In fact, if the pronouncements from the United Nations' Intergovernmental Panel on Climate Change (IPCC) are taken seriously, the world is in desperate need of a solution within the next decade. The maturation of carbon capture and sequestration (CCS) technology in the next several years is an important missing piece to the puzzle of how to constrain carbon without undermining economic growth. Therefore, in order to meet the requirements of the 2015 Paris Accords, which stipulate that worldwide temperatures must be kept from increasing more than 2 Degrees Celsius above pre-industrial times, CCS must play a significant role.

However, current Environmental Protection Agency (EPA) regulation is stifling the development of this key technology—to the detriment of the environment and the nation's clean energy industry. Of paramount concern in this regard is the negative influence of EPA oversight of the well-drilling that is the necessary pre-requisite for storage of CO_2 underground. As things stand, overregulation of drilling rules has created a chilling effect on investment and in light of this, a regulatory exemption regarding a specific portion of the Safe Drinking Water Act's Underground Injection Control (UIC) rules would likely *guarantee* new demand for drilling permits as investors see a near future in which industry emissions—which come from a wide range of sectors at the frontlines of the industrial economy—can be seriously curtailed through technical innovation.[2]

1. Specifically, for the purposes of this paper, CCS is defined as the combination of chemistry and engineering that takes gaseous CO_2 emissions produced by combustion or industrial production and injects them permanently underground.

2. Emitters include electric power plants, natural gas processing facilities, petroleum refiners, steel and iron foundries, chemical plants, hydrogen plants, ammonia refineries, ethanol plants and cement kilns.

CHART I: CARBON CAPTURE AND SEQUESTRATION



Source: World Resource Institute.
https://www.wri.org/resources/charts-graphs/carbon-capture-sequestration-flow-chart.

CURRENT STATE OF CCS DEVELOPMENT

To store carbon underground, well-holes must be drilled several thousand feet below the surface into geologic areas that can store and hold the CO2. The majority of global storage capacity is found in deep saline water aquifers that are already tainted with natural toxins, making the water undrinkable for humans. The carbon dioxide is absorbed into the saline, which traps it for an indefinite period of time. Currently, CCS injects about 0.1 percent of global emissions into permanent storage. However, in order to constrain carbon emission enough to forestall climate change, this number must be significantly higher.

Initially, there were five separate classes of wells covering different types of waste disposal, however, in December 2010, a sixth class of drilling regulation was created specifically for geologic storage of carbon and the "Class VI" rule established the minimum technical standards to protect underground sources of drinking water from the long-term underground storage of carbon dioxide.[3]

TABLE I: UIC WELL INVENTORY THROUGH 2016

Classification	# Permitted	Definition/Type of Well
Class I	832	Industrial and Municipal Waste Disposal Wells
Class II	184,095	Oil and Gas-Related Injection Wells
Class III	24,669	Injection Wells for Solution Mining
Class IV	20	Shallow Hazardous and Radioactive Injection Wells
Class V	489,190	Non-Hazardous Fluid Wells Near Drinking Water Sources
Class VI	7	Geologic Sequestration of Carbon Dioxide Wells

SOURCE: Environmental Protection Agency.https://www.epa.gov/uic/underground-injection-well-inventory.

However, as demonstrated in the table above, in the nine years since the Class VI program was established, only seven permits have been issued and only two wells have been drilled. As a point of comparison, during that same time period, thousands of wells have been drilled under the Class II program that handles oil-industry-related wells.[4] By the end of 2018, there were 23 large-scale CCS facilities in operation or under construction, and another 28 pilot and demonstration projects in operation or planned. To properly restrict global emissions, Royal Dutch Shell, for example,

3. "Rule Summary: Federal Requirements under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells Final Rule," U.S. Environmental Protection Agency, accessed May 14, 2019. https://www.epa.gov/uic/federal-requirements-under-underground-injection-control-uic-program-carbon-dioxide-co2-geologic.

4. Molly Bayer and Brian Graves, "Geologic Sequestration of CO2 and Class VI Wells," U.S. Environmental Protection Agency, June 2018, p. 10 https://www.epa.gov/sites/production/files/2018-06/documents/class_vi_wells_2018_-_brian_graves.pdf. It should be noted that an additional Class VI application was filed and then withdrawn in Kansas. See: http://www.kgs.ku.edu/PRS/Ozark/SmallScale/2017/Class_VI_Permit_Req_and_Exp_TBirdie.pdf.

has estimated that 10,000 large-scale carbon capture plants will be needed by 2070.[5]

In light of this and to encourage the deployment and testing of new CCS technology, in February 2018, Congress more than doubled the value of CCS tax credits from $10-20 to $35-50 a metric ton. However, unresolved legal and regulatory questions regarding federal agency oversight of drilling practices means that the risk to capital is still too high for many companies to consider making such an investment.

REGULATORY BARRIERS TO NEW INVESTMENT

CCS technology was first used in 1972 in Texas to support enhanced oil recovery (EOR) drilling and much of the way it is now regulated has to do with that history. Accordingly, the Underground Injection Control (UIC) system is primarily regulated at the federal level under the 1974 Safe Drinking Water Act (SDWA), which regulates the construction, operation, permitting and closure of underground storage areas. But, like most other environmental regulation, it is a combination of state and federal oversight, and although the SDWA is the primary law that protects the country's 151,000 public water systems,[6] with EPA permission, individual states are able to handle the management of several classes of wells.[7] However, the resultant legal issues caused by such overlapping oversight are indeterminate and are one of the main drivers of indecision for companies interested in CCS activity.[8]

State Handling of Liability Issues

For starters, at the state level, a primary issue related to CCS is leakage liability. Most leakage issues tend to occur within the first several years of operation and thus companies are reluctant to invest in new drilling operations because the time it takes to get them off the ground carries a much higher initial risk than potential benefit. And, although the societal benefits amass outward over time, the liability is not shared initially.

In order to mitigate this situation, liability is eventually transferred over to the state in which the well is drilled, however, the amount of time before such transfers occur varies from state to state—and often the periods of time are quite lengthy. For example, five states (Illinois, Louisiana, Montana, North Dakota and Texas) have passed legislation that transfers liability from industry to the state after a period of 10 to 30 years. However, operators must still monitor the site and track any potential leakage of CO2 until it is transferred. To offset some of the related costs, states including Kansas, Louisiana, Montana, North Dakota, Wyoming and Texas charge user fees to those who inject CO2 underground and use the funds to pay for the long-term management and monitoring of carbon storage sites after liability has transferred to them.[9] But the amount of time and expense—and variation in both—is disconcerting at best to potential investors.

EPA Disincentives

In addition to navigating such nebulous state regulations, at the federal level, the Environmental Protection Agency's broad role in regulating CCS drilling causes the following issues that make investing in the technology a hard sell.

Overly Prescriptive Rules—Despite constant technological development in drilling, the EPA's overly prescriptive regulation is largely static, speculative and broadly attempts to cover the entire industry somewhat arbitrarily. For example, its Class VI regulation prescribes specific technologies and techniques for well casing, cementing and the specific use of acid-resistant/corrosion-resistant cement. The type of regulation is viewed by many as a "command-and-control" method of oversight that transfers risk away from the builder in a way that may increase overall risk in that it can be inflexible and result in costly action that defies common sense. Industrial policy increasingly prefers the setting of performance goals, rather than specifying behavior, an idea that harkens as far back as Hammurabi's Code.[10]

An example of this prescriptive regulation occurred with the Big Sky Carbon Sequestration Project that began in 2003 in Toole County, Montana near the Canadian border. For all UIC permits, a water source qualifies for public use if it has less than 10,000 parts per million (PPM) of total dissolved solids. An exemption process allows the EPA to exempt aquifers that are not plausibly potable and since its aquifer was already undrinkable, the Kevin Dome area had near-perfect geological conditions for long-term storage. Despite this and for reasons that can only be viewed as overly precautionary, instead the EPA dramatically expanded the definition

5. "Sky Scenario: Meeting the Goals of Paris," Shell, 2018, https://www.shell.com/energy-and-innovation/the-energy-future/scenarios/shell-scenario-sky.html.

6. "Protection of Underground Sources of Drinking Water From Underground Injection (UIC)," U.S. Environmental Protection Agency, Sept. 6, 2016. https://www.epa.gov/uic/general-information-about-injection-wells.

7. Currently, North Dakota is the only state with primary enforcement authority for Class VI wells after a five-year application process. See: "Primary Enforcement Authority for the Underground Injection Control Program," U.S. Environmental Protection Agency, accessed May 28, 2019. https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program.

8. Civil liability involves damage caused by storage operations on third parties; administrative liability obligates the operator to make remediation in the case of leakage.

9. Megan Cleveland, "Carbon Capture and Sequestration," National Conference of State Legislatures, April 15, 2017. https://www.wyoleg.gov/Interimcommittee/2017/09-0629appendixg-1.pdf.

10. Code of Hammurabi 233, 235 (L.W. King trans.) available at http://avalon.law.yale.edu/ancient/hamframe.asp. Among other things, the Code specifies only that a builder of a house "must make the walls solid" or of a ship must "make it tight" rather than stipulating specific building instructions.

of drinking water and development was halted. These new rules regarding Class VI wells—written after the Big Sky project had begun—effectively banned the EPA from its normal exemption process and thus the project was cancelled.[11]

Even when the initial rule was released for comment in 2010, responders pointed out that many of its mandates were "excessive" and costly to implement.[12] Neither industry opinion nor the rule itself have changed in the decade that has followed.

Additional Liability Issues—Given the litigiousness of U.S. environmental policy, companies and industry stakeholders often ask for, and sometimes receive, explicit limits on the ability of environmental litigation to stop or impinge project operations.[13] This was the case in the exemption of hydraulic fracturing from the EPA in 2005, but it took an act of Congress to exempt the technique from federal oversight. Under the rubric of federal environmental law, the EPA is subject to citizen lawsuits that can overturn permits on procedural rather than substantive grounds, and can freeze the issuance of permits for years even when licenses are found to be legally processed.[14]

Onerous Reporting Requirements—Reporting requirements for Class VI wells under the EPA's greenhouse gas reporting rule (called Subpart RR) are more onerous than they need to be. For example, unlike with other well classes, which require mechanical integrity testing every five years, Class VI wells must be tested annually. As a result, the estimated average cost of reporting at facilities that inject carbon underground for sequestration is expected to run $320,000, while facilities that inject carbon underground for any other purpose other than sequestration is expected to cost only $4,000.[15]

Not only is this a time-consuming and costly process, but there is no evidence that such frequent testing is any more warranted for this particular class, as compared to others. Further, any Monitoring, Verification and Reporting (MVP) plan must be approved by the EPA's chief administrator, which leaves another administrative avenue open to citizen lawsuits by environmental groups.

In addition to these excessive testing requirements, monitoring regulations are cumbersome. Current interpretations of regulatory rules dictate that monitoring activity can only be determined by the EPA's chief administrator.[16] The language in the regulations says Class VI monitoring should take place for 50 years, although there are examples of permits being negotiated for much less time.[17] Given the political divisions that have grown over environmental policy in the past decade, this kind of open-ended administrative "flexibility" by an agency merely increases the risk profile for investors of CCS technology.

Lag Times in Permissions—Compounding the issues above, a major problem with respect to the development of new CCS technology is the unnecessary delay in permitting new Class VI wells. For example, in July 2011, the Archer Daniels Midland (ADM) carbon capture project in Decatur, Illinois applied for a test-well permit. It took more than three years to finalize, however, and because the EPA intervened to halt the project with information-gathering requests during the test drill, completion was postponed until early 2017, which delayed the deployment of technology that could store 1 million tons of carbon per year permanently underground.[18] Such a test case not only discourages the future use of Class VI drilling classifications but it is also counterproductive to environmental goals.

RAMIFICATIONS OF THE STATUS QUO

If the disincentives caused by EPA oversight are not improved upon, another decade of progress could be lost. And, put simply, if emissions are not captured, global warming will not be curtailed.

In order to try to spur interest in CCS investment, in 2018, Congress revised and extended "45Q" legislation (named after Section 45Q of the Internal Revenue Code), more than doubling the tax credit for storing CO2 below ground. This effort reduces the cost of investing in CCS for some industries and improves the general investment climate for all CCS projects. But, because enhanced oil recovery has an established successful history, it is likely that almost all new CCS investment in the next several years as a result of these credits will involve EOR projects.[19] However, the industrial

11. "Kevin Dome Carbon Storage Project," Big Sky Carbon Sequestration Project, accessed June 5, 2019. https://www.bigskyco2.org/research/geologic/kevinstorage.

12. Federal Register, Vol. 75, No. 237, Dec. 10, 2010, pp. 77251. https://www.govinfo.gov/content/pkg/FR-2010-12-10/pdf/2010-29954.pdf.

13. Federal environmental laws in which the EPA has primary regulatory authority include: Safe Drinking Water Act (SDWA), Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act, and the Toxic Substances Control Act https://www.gao.gov/assets/680/671846.pdf.

14. The EPA permit application process involves providing a draft permit for the public to comment upon before the agency issues or denies a final permit. Final permit decisions, including the process, may be challenged in federal court.

15. "Fact Sheet for Geologic Sequestration and Injection of Carbon Dioxide: Subparts RR and UU," U.S. Environmental Protection Agency, accessed June 4, 2019. https://www.epa.gov/sites/production/files/2015-07/documents/subpart-rr-uu-factsheet.pdf.

16. Interview with National Manufactures Association Staffer, May 2019.

17. For example, ADM negotiated a 10-year monitoring plan with the EPA for its Illinois project.

18. Scott MacDonald, "ADM CCS Project Lessons Learned," *CSLF Technical Workshop*, June 17, 2015, p. 29. https://www.cslforum.org/cslf/sites/default/files/documents/regina2015/McDonald-Workshop-Regina0615.pdf.

19. Interview with Senate Environment and Public Works Committee Staff, February 2019.

sectors most at risk of carbon regulation—coal-fired power plants, ethanol and fertilizer makers—are often located far away from CO2-enhanced oil fields. These are the industries most in need of CCS growth but until pipeline infrastructure is built between coal-fired power plants and ethanol plants in the Midwest and to meet existing demand in the oil patch, the only available option for utilities and industries is to use geologic storage of CO2.

There is already some obvious room for investment within some industries, particularly for those that create emissions as part of their production. For example, while the estimated cost of carbon capture for power plants can be between $60 per metric ton for coal-fired plants and $70 a metric ton for natural gas ones (with an additional $11 a metric ton going toward transportation and storage),[20] within production industries (like ethylene and oil refining), the cost is only between $9-30 a metric ton.[21] Given this level of cost, it is possible for these industries to invest in CCS with the chance of making a profit via the 45Q tax credit. And perhaps they would do so if they had more confidence that drilling permits could be reasonably processed and received.

However, a year after the 2018 tax credits were increased for CCS, *no additional* CCS projects have been finalized in the United States.[22] And the ADM and Big Sky projects serve as the *only* examples of the Class VI drilling rules being used for geologic storage of carbon capture in the regulation's lifespan.

WAYS FORWARD

While it is difficult to prove that regulatory disincentives are directly to blame for the chill in CCS investment, lessons learned from another similarly situated industry can be instructive here. In the summer of 2005, Congress passed major energy legislation that included a provision that banned the EPA from regulating hydraulic fracturing under the UIC program. The exemption explicitly devolved drinking-water-related oversight to states, and thus dramatically eased red tape and litigation risk to oil and gas firms that would otherwise have been under direct scrutiny by the EPA; scrutiny that likely would have undermined the shale revolution in its infancy.[23]

In the 13-year-period after passage of the fracking exemption, U.S. oil production has increased 140 percent from 5 million to more than 12 million barrels, while natural gas production has increased more than 30 percent.[24] In 2016, roughly two-thirds of producing oil and gas wells were hydraulically fractured and horizontally drilled, up from five percent a decade or so before.[25] The additional value of fracking technology to U.S. consumers is estimated to be at least $200 billion a year in energy savings.[26] The total economic benefits to the U.S. stock market and general U.S. economy is estimated to be well in excess of $3 trillion and growing larger each day.[27]

There is debate over the degree to which the explosion in domestic oil and gas production is related to the 2005 EPA exemption, in part because the regulatory chilling effect on private investment and the opportunity costs of non-investment in breakthrough technology is one of the hardest economic influences to identify. This is because the outcome must rely entirely upon counter-factual analysis. However, there is little debate the exemption lowered the risk of government intervention. After all, with the arrival of a more environmentally conscious administration in 2009, it is certainly possible that absent the exemption, the EPA would have used precautionary principles to slow or even issue a moratorium on fracking until the environmental impacts were better known.

Luckily, this preemption did not take place, and since then, the fracking revolution has not only added growth to the U.S. economy, but is also the main cause of the 12 percent drop in U.S. carbon emissions between 2007 and 2017, as low-priced, cleaner-burning natural gas has displaced coal-generated electricity.[28] Further, the net-benefit of the investment in hydraulic fracturing was the development of a world-changing drilling technique that calmed fears of runaway global energy prices and "peak oil" for many decades.[29] It is also important to note that the environmental hazards expected by critics of the fracking exemption never materialized,

20. "Carbon Capture, Utilization and Storage: Climate Change, Economic Competitiveness, and Energy Security," U.S. Dept. of Energy, August 2016. https://www.scribd.com/document/385292530/Carbon-Capture-Utilization-And-Storage-Climate-Change-Economic-Competitiveness-And-Energy-Security-0.

21. James Temple, "The carbon-capture era may finally be starting," *MIT Technology Review*, Feb. 20, 2018. https://www.technologyreview.com/s/610296/the-carbon-capture-era-may-finally-be-starting.

22. Emma Foehringer Merchant, "With 43 Carbon Capture Projects Lined Up Worldwide, Supporters Cheer Industry Momentum, *GreenTech Media*, Dec. 11, 2018. https://www.greentechmedia.com/articles/read/carbon-capture-gains-momentum.

23. Mike Soraghan, "The fracking 'loophole' that just keeps growing," *E&E News*, Aug. 18, 2015. https://www.eenews.net/stories/1060023558.

24. Patti Domm, "Oil shale boom will keep rocking world crude prices as US moves closer to becoming net exporter," *CNBC*, Mar. 10, 2019. https://www.cnbc.com/2019/03/10/oil-shale-booms-seismic-event-us-to-become-net-exporter-of-crude.html.

25. Troy Cook et al., "Hydraulically fractured horizontal wells account for most new oil and natural gas wells," Energy Information Administration, Dec. 20, 2018. https://www.eia.gov/todayinenergy/detail.php?id=37815.

26. Robert Rapier, "Fracking Saves Americans $180 Billion on Gasoline Annually," *Forbes*, June 2, 2017. https://www.forbes.com/sites/rrapier/2017/06/02/fracking-saves-consumers-180-billion-annually-on-gasoline/#f74a4b312ddc.

27. Erik Gilje et al., "Fracking, Drilling and Asset Pricing: Estimating the Economic Benefits of the Shale Revolution," *The National Bureau of Economic Statistics Working Paper* No. 22914, December 2016. https://www.nber.org/papers/w22914.

28. "Preliminary U.S. Emissions Estimates for 2018," Rhodium Group, Jan. 8, 2019. https://rhg.com/research/preliminary-us-emissions-estimates-for-2018.

29. "Peak Oil" was the neo-Malthusian belief in the late 2000s that permanent scarcity of fossil fuels had arrived and no amount of human ingenuity could counteract such a scientific certainty.

largely because the Safe Drinking Water Act's other provisions were so strongly enforced that best practices had long been developed before the invention of the hydraulic fracking technique itself.

And, while it is true that if the fracking exemption had occurred during a time of low energy prices, less investment would have taken place, the 2005 exemption came at a time of record natural gas prices in the United States. This timing meant both the regulatory and investment risk for the activity was significantly lowered, which in turn turbocharged new capital spending in shale fields in western Pennsylvania and Texas.

Under the right circumstances, a similar step change can occur in carbon capture and storage, but the regulatory circumstance, in particular, must stop inhibiting industries most interested in capturing carbon for storage underground. After all, CCS is the only clean technology that can decarbonize major industry. Accordingly, a blanket exemption from federal oversight and delegation of Class VI well authority to state-level environmental regulators is likely the only way to reach the necessary national and international goals for carbon sequestration by 2030 and 2040, respectively. However, given the technical advances (and public attention) to well regulation in the past several decades, state-level authorities are well able to manage the particular technical and political issues around siting, building and operating sequestration and storage sites for CO2.

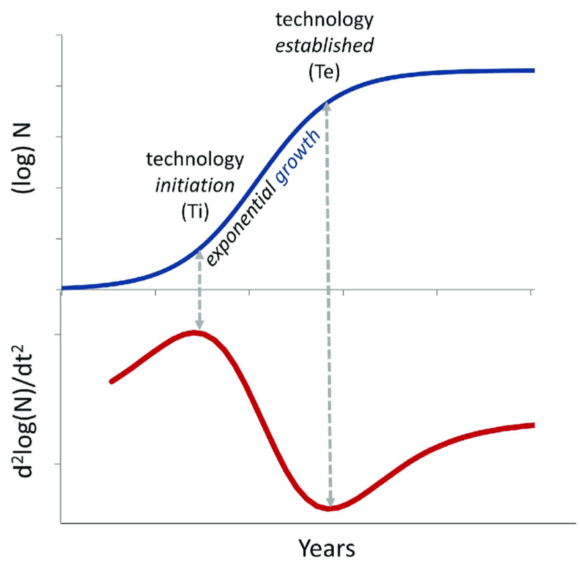
But time of is of the essence, as there are physical limits to the rate at which new energy technologies can be deployed. A landmark study pushed in *Nature* in 2009 found that the uptake in breakthrough energy technology consistently shows an 'S Curve," in which technology starts slowly in experimental use after invention and then grows at an exponential rate from the first commercial use as the technology matures.[30] The technology then moderates into a more linear growth rate.[31]

These well-established rules show that it can take a generation (25-30 years) for energy technology to go from initial deployment to material impact on an economy or ecosystem. The reasons for this length of time are many and include a combination of market forces and regulatory policies. What is clear is that private capital investment is key to successful deployment of any energy technology, which means investment risk must be reduced as much as possible early in the development cycle. As such, for CCS technology to advance, at least some exemptions to rules concerning the drilling and operation of wells associated with geologic capture must be written into law.

30. Gert Jan Kramer and Martin Haigh, "No Quick Switch to Low-Carbon Energy," *Nature 462*, December 2009, pp. 568-69. https://www.nature.com/articles/462568a.

31. Ibid.

CHART 2: TECHNOLOGY GROWTH CURVE



SOURCE: Creative Commons

CONCLUSION

If we are to reach the necessary climate goals, we must act now, and the best way to do so is to remove the regulatory barriers that create prohibitive risk for those wishing to invest in the development of CCS technology. The 2005 Energy Act's exemption of federal oversight for fracking provides a demonstrated success story that legislators can follow in this regard. As the risks of climate change continue to increase globally and within the United States, it is of key importance that we must lower the barriers for innovation for carbon storage and exempting UIC Class VI wells from federal oversight is likely the fastest, best way to get there.

ABOUT THE AUTHOR

William Murray is the energy policy manager at the R Street Institute, where he helps coordinate advancement of free-market solutions to solve difficult problems regarding energy and the environment. These issues include fuel-choice diversity, climate change and conflicts over public lands.