CARBON CAPTURE UTILIZATION AND STORAGE TECHNOLOGY: PROS AND CONS

Climate Change Law, Research & Writing (Spring 2023): Final Paper

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TABLE OF CONTENTS

In the United States, given the state of technological advancement, Carbon Capture Utilization and Storage ("CCUS") technology is an advantageous near-term solution to lower greenhouse gas emissions. Without crippling our fossil fuel dependent economy, CCUS technology is one of the preferred approaches to reduce GHG emissions within the current legal framework. The main reasons why CCUS will not cripple the economy is that it does not require either a new legal framework nor a new electrical grid. The cost of implementing CCUS technology is manageable for stationary source owners compared to other emissions reduction approaches, and more importantly, there are legal incentives (tax cuts) available to owners, which will greatly reduce the cost of implementing CCUS technology. Finally, some states have already begun implementing CCUS technology with encouraging success. Therefore, other states such as Pennsylvania, should adopt similar legislation.

I. Introduction

A. Carbon Capture Utilization and Storage Technology – a Brief Explanation

First, it must be noted that Carbon Dioxide ("CO2") is a greenhouse gas that has been linked to global climate change. It has been recognized that "[r]esponsible deployment of CCUS is necessary to reach established climate goals and protect vulnerable communities and wildlife."[1] CCUS is able to protect against imminent harm because the technology has the capability to capture CO2 at around a 90% rate. There are two carbon capture approaches that are capable of 90% CO2 capture: post combustion capture, pre-combustion capture.[2]

Post combustion carbon capture systems capture the CO2 from flue gasses produced after fossil fuels or other carbonaceous materials such as biomass are burned. Flue gas is a mixture of different gasses resulting from combustion and channeled into the atmosphere via a flue, which is a pipe or chamber where exhaust gasses pass through. "Combustion based power plants provide most of the world's electricity today."[3] "The hot combustion gasses exiting the boiler consist mainly of nitrogen (from air) plus smaller concentrations of water vapor and CO2 formed from the hydrogen and carbon in the fuel."[4]

Pre-Combustion Capture removes carbon dioxide from fuel prior to combustion. Carbon Dioxide must first be converted to a form amendable to capture, and for coal plants "this is accomplished by reacting coal with steam and oxygen at high temperature and pressure, a process called partial oxidation, or gasification." When an entity utilizes any one of these capture processes they can attain 90% carbon capture rates.

Currently, the United States only has "10 large-scale carbon capture and storage facilities in operation, with a combined capacity to capture 25 million metric tons of carbon dioxide per year,"[5] and globally, there are about three dozen facilities that "capture carbon dioxide from power plants and factories and lock it away

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1. *Infrastructure is Key: What's Needed for CCUS Deployment • The National Wildlife Federation Blog*, THE NATIONAL WILDLIFE FEDERATION BLOG (Feb. 17, 2022), https://blog.nwf.org/2022/02/infrastructure-is-key-whats-needed-for-ccus-deployment/.
2. Peter Folger, CONG. RSCH. SERV., R41325, Carbon Capture: A Technology Assessment (2013).
3. *Id.*
4. *Id.*
5. *Infrastructure is Key*, *supra* note 1.

underground. They store 45 megatons of carbon dioxide a year. What we need to reach net-zero carbon emissions is to store at least 1 gigaton a year by 2030."[6] Therefore, the United States is going to have to greatly scale the implementation of CCUS technology in order to reduce Greenhouse gas emissions from stationary sources because "[a]chieving net-zero goals will be virtually impossible without CCUS."

B. The United States of America's Emissions Reduction Commitments

The United Nations agreed in 2016, that the Paris Agreement's central aim is to strengthen the global response to climate change by keeping this centuries' rise in global temperature below 35.6 degrees Fahrenheit from pre-industrial levels by 2050.[7] Unfortunately, the Trump administration pulled the United States out of the Paris Agreement in 2017. Honorably, as soon as President Biden took office, the United States rejoined the Paris Agreement.[8] The World Recourses Institute among other environmental groups lobbied for the Administration to establish a nationally determined contribution ("NDC"). In response to the immediacy of the threat climate change poses to America and other Countries, the Biden Administration set a goal to cut emissions by 50%-52% below 2005 levels by 2030.[9] The World Recourses Institute stated that America set an NDC that is "an ambitious, achievable target in line with the goals of the Paris Agreement and significantly higher than the previous U.S. pledge to cut emissions 26-28% by 2025."[10]

In order for the United States to achieve its independent 2030 goal and the Paris Agreement's 2050 goal, the Clean Air Act must efficiently regulate America's largest polluters. The largest stand-alone sources of air pollution in the United States as well as a majority of other countries are produced by stationary sources, and specifically, "the power sector is by far the largest category of stationary sources of greenhouse gases in the United States."[11] Stationary sources consist of "any building,

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6. Prachi Patel, *Carbon Storage and Hydrogen: Match Made in Heaven?,* IEEE SPECTRUM (Mar. 14, 2023), https://spectrum.ieee.org/carbon-capture-and-storage.

7. *Paris Agreement,* UNFCCC (Mar. 17, 2023), https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

8. Joseph R. Biden Jr., *Paris Climate Agreement*, THE WHITE HOUSE (Jan. 21, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/20/paris-climate-agreement/.

9. Joseph R. Biden Jr., *Executive Order on Tackling the Climate Crisis at Home and Abroad*, THE WHITE HOUSE (Jan 27, 2021), https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

10. *US Government Sets Target to Reduce Emissions 50-52% by 2030*, WORLD RECOURSES INSTITUTE (Sep. 19, 2022), https://www.wri.org/outcomes/us-government-sets-target-reduce-emissions-50-52-2030.

11. *Climate Change Regulatory Actions and Initiatives*, EPA (Dec. 19, 2022), https://www.epa.gov/climate-change/climate-change-regulatory-actions-and-initiatives.

structure, facility, or installation which emits or may emit any air pollutant."[12] The EPA has declared national enforcement initiatives to reduce emissions and one initiative is to "reduce air pollution from the largest source of emissions."[13] The International Energy Agency calls carbon capture utilization and storage ("CCUS") "one of the critical technologies required to achieve net-zero emissions and the climate goals outlined in the Paris Agreement."[14]

II. Analysis

A. The Legal Framework Advantages of Carbon Capture Utilization and Storage Technology

The current legal framework pertaining to CCUS implementation provides a multitude of monetary advantages to stationary source owners who choose to implement CCUS technology; not only does the legal framework provide monetary advantages, the legal advantages of CCUS technology is highlighted in *West Virginia v. EPA*[15], where the United States Supreme Court endorsed CCUS regulation as a constitutionally valid approach to mitigating GHG emissions.

The legal framework's monetary advantages provide incentives and funds that the United States government has provided to owners of stationary sources who are thinking about installing CCUS technology at their factories.

> The Infrastructure Investment and Jobs Act (Jobs Act), will help mitigate some of the challenges associated with CCUS scale-up, like subsidizing the initial cost of facility-level retrofits that may be costly and financially unattractive to owners. Money granted to the Department of Energy (DOE) would also ease the process and financial burden of building out shared regional carbon dioxide storage hubs, which is the most efficient way of transporting CO2 to optimal underground storage locations.[16]

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12. 42 U.S.C. § 7411.

13. *Air Enforcement*, EPA (Mar. 2, 2023), https://www.epa.gov/enforcement/air-enforcement.

14. *Carbon Capture and Storage*, EXXONMOBIL (Mar. 17, 2023), https://corporate.exxonmobil.com/climate-solutions/carbon-capture-and-storage.

15. 597 U.S. 2599 (2022). For a brief analysis, see, e.g., Dana Neacsu, Applying Bentham's Theory of Fallacies to Chief Justice Robert's Reasoning in *West Virginia V. EPA* (January 23, 2023). Duquesne University Law Review, Forthcoming, Available at SSRN: https://ssrn.com/abstract=4335748.

16. *Infrastructure is Key, supra* note 1.

The availability of these benefits would hypothetically encourage owners of stationary sources to implement CCUS technology in order to put the United States on the right trajectory to achieve its emissions reduction goals. The Federal 45Q tax credit will also help mitigate the cost of CCUS implementation, which will be discussed in more detail later in the paper. However, even with all the available monetary incentives and "[d]espite the pressing need to commercialize the technologies, their large-scale deployment has been slow."[17]

This is not to say that the law disfavors CCUS technology. On the contrary, the current legal framework in the wake of *West Virginia v. EPA,*[18] endorses CCUS technology as a constitutionally permitted approach of Carbon Dioxide mitigation. To fully understand why the United States Supreme Court specifically endorsed CCUS technology as a constitutionally permitted Carbon Dioxide emissions reduction technology, this paper discusses why Carbon Dioxide is such a highly debated topic when it comes to implementing regulations in the United States of America.

1. Massachusetts v. EPA – *Established that the EPA Can Regulate Carbon Dioxide*

The first reason why Carbon dioxide is a highly debated topic is because of the seminal case *Massachusetts v. EPA*,[19] where the State of Massachusetts sued the EPA because the EPA refused to recognize that it had the authority to regulate Carbon Dioxide produced by mobile sources, specifically cars.[20] A big issue in the case was whether Massachusetts had standing to sue the EPA for its failure to regulate greenhouse gas emissions.[21] The United States Supreme Court recognized that "a litigant must demonstrate that it has suffered a concrete and particularized injury that is either actual or imminent, that the injury is fairly traceable to the defendant, and that it is likely that a favorable decision will redress that injury."[22]

In answering this question, the Supreme Court noted that States are in a "special position,"[23] and "[i]t is of considerable relevance that the party seeking review here is a sovereign State and not . . . a private individual."[24] The Supreme Court noted

17. *Carbon capture and storage in the USA: the role of US innovation leadership in climate-technology commercialization*, CLEAN ENERGY (Dec. 19, 2019), https://academic.oup.com/ce/article/4/1/2/5686277
18. W. Va. v. EPA, 597 U.S. 2599, 2602 (2022).
19. Mass. v. EPA, 549 U.S. 1446 (2007).
20. *Id.* at 1447.
21. *Id.* at 1447-48.
22. *Id.* at 1454 (2007) (citing Lujan v. Defs. of Wildlife, 504 U.S. 555, 560-61 (1992)).
23. *Id.* at 1442.
24. *Id.* at 1454.

that "[w]hen a State enters the Union, it surrenders certain sovereign prerogatives,"[25] and "[t]hese sovereign prerogatives are now lodged in the Federal Government."[26] Since a State's air pollution prerogatives are heavily influenced by the Federal Government, Congress has ordered the EPA to protect Massachusetts (among other States) from any air pollution "'which in [the Administrator's judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.'"[27] Additionally, the Supreme Court reasoned Massachusetts could have standing because Congress has recognized "a concomitant procedural right to challenge the rejection of its rulemaking petition as arbitrary and capricious."[28]

When analyzing the above criteria to have standing, the Supreme Court noted that "[t]he harms associated with Climate Change are serious and well recognized,"[29] and the "EPA's steadfast refusal to regulate greenhouse gas emissions presents a risk of harm to Massachusetts that is both 'actual' and 'imminent.'"[30] Therefore, the Supreme Court found Massachusetts had standing to sue to the EPA.

The second issue is whether Carbon Dioxide is included in the definition of pollutant under the Clean Air Act. The Supreme Court easily reasoned that "[b]ecause greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant,' we hold that EPA has authority to regulate the emissions of such gases from new motor vehicles."[31] The Court found that under the Clean Air Act's clear terms, the "EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do."[32] This analysis is called an endangerment finding, and the Court reasoned that the statutory question the EPA should have made is "whether sufficient information exists to make an endangerment finding."[33]

In sum, the Court established that the EPA has regulatory authority over greenhouse gasses because the pollutants have been universally recognized to produce actual and imminent harm; the Court also established that under the clear

25. *Id.*
26. *Id.* at 1455.
27. *Id.* at 1460 (quoting 42 U.S.C. § 7521(a)(1)).
28. *Id.* at 1454 (citing 42 U.S.C. § 7607(b)(1)).
29. *Id.* at 1455.
30. *Id.* at 1442 (quoting Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 (1992)).
31. Mass. v. EPA, 549 U.S. 1446, 1462 (2007).
32. *Id.* at 1463.
33. *Id.*

terms of the Clean Air Act an endangerment finding is necessary to determine whether to regulate certain greenhouse gas emissions such as Carbon Dioxide. [34]

After the EPA conducted all of their required endangerment findings, finally in 2015, the EPA promulgated its "final rule" as to greenhouse gas emission reduction standards for Electric Generating Units ("EGU"). Electric Generating Units are power plants that provide electricity to the previously discussed electrical grids that power the majority of the United States.[35] The EPA stated that "[a]lthough GHG emissions from EGU's have fallen since the EPA promulgated the 2015 Rule, they still remain uniquely large among stationary source categories."[36]

The amount of GHGs emitted by EGUs are so staggering that they account for approximately twenty-seven percent of total U.S. GHG emissions, forty-three percent of U.S stationary source emissions, and approximately four percent of total worldwide GHG emissions, and strikingly greater than the emissions of all but four countries.[37] The Clean Air Act was promulgated to reduce these very emissions, however, there has been little regulation that tackled the mass Carbon Dioxide Emissions in the United States of America.

2. The Clean Air Act Lacks Carbon Dioxide Regulation

The second reason why Carbon Dioxide is a highly debated topic is because the Clean Air act does not adequately regulate the harmful greenhouse gas. The Clean Air Act protects the general public's health and welfare by implementing regulations through three separate programs that regulate different categories of air pollutants. "The Act defines 'air pollutant' to include 'any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . substance or matter which is emitted into or otherwise enters the ambient air.'[38] "Welfare is also

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34. *Id.*

35. *Final Rule and Related Materials for Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards,* EPA (Jan. 25, 2023), https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-and-related-materials-control-air-pollution.

36. *Pollutant-Specific Significant Contribution Finding for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, and Process for Determining Significance of Other New Source Performance Standards Source Categories,* FEDERAL REGISTER (Jan, 13, 2021), https://www.federalregister.gov/documents/2021/01/13/2021-00389/pollutant-specific-significant-contribution-finding-for-greenhouse-gas-emissions-from-new-modified.

37. *Id.*

38. Mass. v. EPA, 549 U.S. 1446, 1448 (2007) (quoting 42 U.S.C.A. § 7602(g) (West)).

defined broadly: among other things, it includes 'effects on . . . weather . . . and climate.'"[39] Providing three individual programs to regulate different categories of air pollution maximizes the Clean Air Act's ability to improve the welfare of the general public. The first program is the National Ambient Air Quality Standards ("NAAQS") program,[40] the second is the Hazardous Air Pollutants ("HAPS") program,[41] and the third is the New Source Performance Standards program.[42]

The NAAQS program "addresses air pollutants that 'may reasonably be anticipated to endanger public health or welfare,' and 'the presence of which in the ambient air results from numerous or diverse mobile or stationary sources.'"[43] After pollutants are identified, the EPA establishes NAAQS for each. The NAAQS represents "'the maximum airborne concentration of [the] pollutant that the public health can tolerate.'"[44] As of today, the EPA only recognizes six "criteria pollutants" to qualify for NAAQS. The six pollutants are Ground-level Ozone, Particle Matter, Carbon Monoxide, Lead, Sulfur Dioxide, and Nitrogen Dioxide.[45] Notably, Carbon Dioxide is not included as a criteria pollutant under the Clean Air Act.

Although the NAAQS program seems powerful, the EPA does not have the ability under the program to choose which sources must reduce their emissions. The Clean Air Act merely requires each State to "'submit to [EPA] a plan designed to implement and maintain such standards within its boundaries.'"[46] In other words, under the NAAQS program the "EPA is generally limited to determining the maximum safe amount of covered pollutants in the air."[47]

"The second major program governing stationary sources is the HAP program."[48] The HAP program protects the public from pollutants that are not already covered by a NAAQS. The HAP program primarily targets pollutants that present "'a threat of adverse human health effects,' including substances known or anticipated to be 'carcinogenic, mutagenic, teratogenic, neurotoxic, or otherwise

39. *Id.* (quoting 42 U.S.C.A. § 7602(h) (West)).
40. 42 U.S.C.A. § 7409 (West).
41. 42 U.S.C.A. § 7412 (West).
42. 42 U.S.C.A. § 7411 (West).
43. W. Va. v. EPA., 213 U.S. 2599, 2600 (2022) *(*quoting 42 U.S.C.A. § 7408(a)(1) (West)).
44. *Id.* (quoting Whitman v. American Trucking Associations, 531 U.S. 907, 908 (2001)).
45. See *NAAQS Table*, EPA (Mar. 15, 2023), https://www.epa.gov/criteria-air-pollutants/naaqs-table.
46. W. Va. v. EPA, 213 U.S. 2599, 2600 (2022) (citing Whitman v. American Trucking Associations, 531 U.S. 457, 465 (2001)).
47. *Id.*
48. *Id.*

'acutely or chronically toxic."[49] The HAP program oversees 189 different toxic chemicals compared to the six criteria pollutants in the NAAQS program, and the HAP program requires the EPA and not each State to regulate toxic pollutants, so the EPA "must promulgate emissions standards for both new and existing major sources."[50] A major source is defined as any stationary source or group of stationary sources "located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, ten tons per year or more of any hazardous air pollutant or twenty-five tons per year or more of any combination of hazardous air pollutants."[51] Therefore, vested with regulatory authority over toxic pollutants the "EPA must directly require all covered sources to reduce their emissions to a certain level. And it chooses that level by determining the 'maximum degree of reduction' it considers 'achievable' in practice by using the best existing technologies and method."[52]

The third air pollution safeguard is the New Source Performance Standards program. "That section directs EPA to list 'categories of stationary sources' that it determines cause, or contribute significantly to, air pollution which may reasonably be anticipated to endanger public health and welfare.'"[53] The EPA must "'promulgate for each category Federal standards of performance for new sources.'"[54] A standard of performance "reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the [EPA] Administrator determines has been adequately demonstrated."[55] The EPA has discretion to weigh these various considerations, and "[o]ver the lengthy history of the NSPS program, the number of modifications that we are aware of is limited."[56] The EPA has reviewed CCUS as a potential technology for the best system of emissions reduction ("BSER") for new and modified stationary sources, and the EPA found that

> partial CCS has been adequately demonstrated and is technically feasible; it can be implemented at costs that are not unreasonable; it provides meaningful emission reductions; its implementation will

49. *Id.* (quoting 42 U.S.C.A. § 7412(b)(2) (West)).
50. *Id.* at 2600 *(*citing 42 U.S.C.A. § 7412(d)(1) (West)).
51. 42 U.S.C.A. § 7412(a)(1) (West)).
52. W. Va. v. EPA, 213 U.S. 2599, 2600 (2022) *(*quoting 42 U.S.C.A. § 7412(d)(1) (West)).
53. *Id.* at 2601 *(*quoting 42 U.S.C.A. § 7411(b)(1)(A)).
54. *Id. (*quoting 42 U.S.C.A. § 7411(b)(1)(B)).
55. 42 U.S.C.A. 7411(a)(1)), *quoted in,* W. Va. v. EPA, 213 U.S. 2599, 2601 (2022).
56. EPA. § 117, 79 Fed. Reg. 34960, 34970 (Jun. 18, 2014).

> serve to promote further development and deployment of the technology; and it would not have a significant impact on nationwide energy prices.[57]

Although the EPA determined CCUS is an advantageous BSER, it noted that it did not "have sufficient information about costs to propose that partial CCS is the BSER."[58] Consequently, CCUS has not been accepted under the Clean Air Act as a technology that must be utilized by stationary sources in the United States of America.

Therefore, although these three programs protect the public's health and welfare from pollutants, interestingly, Carbon Dioxide is not included in any of the lists of pollutants the Clean Air Act protects against, and CCUS is not included as a BSER. Consequently, as noted above, Greenhouse Gas emissions are still at an all-time high in the United States, and to combat the critical issue of Carbon Dioxide emissions the EPA attempted to impose regulations different in kind than the three previously discussed programs, in *West Virginia v. EPA*.

3. West Virginia v. EPA – *Narrowed the Scope of Permitted Carbon Dioxide Regulations, but Endorsed CCUS Implementation*

The third reason why Carbon Dioxide is a highly debated topic is because *West Virginia v. EPA* narrowed the scope of permitted Carbon Dioxide regulations. The EPA needed to impose regulations that would mitigate mass amounts of GHG emissions in the stationary source sectors to meet America's newly established 2030 emissions reduction goal and the Paris Agreement's 2050 goal. In *West Virginia v. EPA*, the United States Supreme court decided whether the EPA's regulations are constitutional under the Clean Air Act.[59]

The United States Supreme Court first stressed that for the last 50 years the "EPA has exercised this authority by setting performance standards based on measures that would reduce pollution by causing plants to operate more cleanly."[60] The Court then stated, "[t]hings changed in October 2015, when the EPA promulgated two rules addressing carbon dioxide pollution from power plants—one for new plants under Section 111(b), the other for existing plants under Section

57. EPA. § 117, 79 Fed. Reg. 34960, 34982 (Jun. 18, 2014).
58. *Id.*
59. W. Va. v. EPA, 213 U.S. 2599, 2600 (2022).
60. *Id.* at 2599.

111(d)."[61] The EPA's new 2015 rule concluded "that the 'best system of emission reduction' ("BSER") for existing coal-fired power plants included a requirement that such facilities reduce their own production of electricity, or subsidize increased generation by natural gas, wind, or solar sources."[62] West Virginia sued the EPA for the regulations and the sole question before the Supreme Court is "whether this broader conception of EPA's authority is within the power granted to it by the Clean Air Act."[63] The Court stressed that "Carbon dioxide is not subject to a NAAQS and has not been listed as a hazardous pollutant."[64] The Court then went on to note the past and current ways the EPA does in fact regulate Carbon Dioxide under the Clean Air Act.

The first way is by regulating new sources under 42 U.S.C. § 7411,[65] for example, for steam generating units the "EPA determined that the BSER was a combination of high-efficiency production processes and *carbon capture technology*."[66] The second way is by regulating existing sources through what it called the Clean Power Plan rule.[67] In the Clean Power Plan the best system of emissions reduction ("BSER") the EPA selected for existing coal-fired plants was different than that of the BSER of new sources.

The EPA included three types of standards to impose on existing plants which are called "building blocks."[68] The first block was heat rate improvements which are "essentially practices such plants could undertake to burn coal more efficiently."[69] The second block was supposed to be a "shift in electricity production from existing coal-fired power plants to natural-gas-fired plants."[70] The third building block "worked the same way, except that the shift was from both coal- and gas-fired plants to 'new low- or zero-carbon generating capacity,' mainly wind and solar."[71]

The Supreme Court noted that "[g]iven the circumstances, our precedent counsels skepticism toward EPA's claim that Section 111 empowers it to devise

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61. *Id.* at 2602.
62. *Id.* at 2599.
63. *Id.* at 2600.
64. *Id.* at 2602.
65. *See* 42 U.S.C. § 7411(d)(1)).
66. *West Virginia*, 213 U.S. at 2602 (emphasis added).
67. *West Virginia,* 213 U.S. at 2602 (citing 42 U.S.C. § 7411(d)(1)).
68. *Id.* at 2603.
69. *Id.*
70. *Id.* at 2603 (citing Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, 80 FR 64510-01).
71. *Id.*

carbon emissions caps based on a generation shifting approach. To overcome that skepticism, the Government must . . . point to "clear congressional authorization" to regulate in that manner."[72]

When searching for Congress's clear congressional authorization, the Supreme Court reasoned that "[i]t is one thing for Congress to authorize regulated sources to use trading to comply with a preset cap, or a cap that must be based on some scientific, objective criterion, such as the NAAQS."[73] However, the Court reasoned that "[i]t is quite another to simply authorize EPA to set the cap itself wherever the Agency sees fit."[74]

Furthermore, the Supreme Court compared how Congress normally goes "out of its way to amend the NAAQS statute to make absolutely clear that the 'measures, means, [and] techniques' States could use to meet the NAAQS included cap-and-trade."[75] However, when the EPA created the Clean Energy Plan, "not a peep was heard from Congress about the possibility that a trading regime could be installed under § 111."[76] Therefore, as to the "EPA's claim that Section 111 empowers it to devise carbon emissions caps based on a generation shifting approach,"[77] the Supreme Court bluntly stated, "for the reasons given, the answer is no."[78]

4. In the Wake of West Virginia v. EPA, There Are Fewer Permitted GHG Emissions Control Options

The Supreme Court's decision in *West Virginia v. EPA*, established the scope of regulations permitted by the Clean Air Act will be constrained to "the Agency's prior view of Section 111, its role was limited to ensuring the efficient pollution performance of each individual regulated source. Under that paradigm, if a source was already operating at that level, there was nothing more for EPA to do."[79]

Stated differently, the "EPA still has the authority to regulate emissions at the point source or individual power plant level-what's often referred to as "inside the fence line" of the facility, as opposed to "outside the fence line" or systems-based

72. *Id.* at 2614 (quoting Utility Air Regulatory Group v. E.P.A., 573 U.S. 2435, 2444 (2014)).
73. *Id.* at 2615.
74. *Id.*
75. *Id.*
76. *Id.*
77. *Id.* at 2614.
78. *Id.* at 2616.
79. *Id.* at 2612.

approach, which is now off-limits under the ruling."[80] The United States Supreme Court's decision in *West Virginia v. EPA* quieted the debate over Carbon Dioxide regulation and made clear that systems-based approaches to regulate GHG emissions are now off limits. Therefore, the EPA is now permitted only to regulate "inside the fence line," so the Rhodium Group noted the EPA "must go beyond heat rate improvements and the like to truly move the needle on emissions."[81]

The Rhodium Group provided some inside the fence line technologies that "go beyond heat rate improvements and the like to truly move the needle on emissions," such as *carbon* capture and hydrogen blending. [82] This goes to show why CCUS technology is so important, because in the current legal framework provided by the United States Supreme Court in *West Virginia v. EPA,* CCUS technology is now one of the only acceptable near-term approaches that can "truly move the needle on emissions,"[83] and provide the United States with the ability to achieve its 2030 and 2050 emissions reduction goals, without crippling the economy.

As noted above the Clean Air Act does not include CCUS as a BSER for new and modified stationary sources, therefore, to initiate large scale implementation of CCUS technology Congress passed legislation that incentivized corporations to incorporate CCUS technology into their operations without the help of the EPA or the Clean Air Act.

*5. **Federal 45Q Tax Credit***

In 2008, "section 45Q of the Unites States Internal Revenue Code provides a tax credit for CO2 storage. "[84] This tax credit was meant to "incentivize the deployment of carbon capture, utilization and storage, and a variety of project types are eligible. However, as highlighted above the tax credit has not incentivized corporations to utilize CCUS, so in 2022, a short time after *West Virginia v. EPA*, Congress provided a significant stimulus for CCUS investment.

> The 2022 changes to 45Q provide up to USD 85 per tonne of CO2 permanently stored and USD 60 per tonne of CO2 used for enhanced

80. *Has the Supreme Court Blocked the Path to the 2030 Climate Target?*, RHODIUM GROUP (Jul. 02, 2022), https://rhg.com/research/supreme-court-2030-climate-target/.
81. *Id.*
82. *Id.* (emphasis added).
83. *Id.*
84. 26 U.S.C.A. § 45Q (West).

> oil recovery (EOR) or other industrial uses of CO2, provided emissions reductions can be clearly demonstrated. The credit amount significantly increases for direct air capture (DAC) projects to USD 180 per tonne of CO2 permanently stored and USD 130 per tonne for used CO2.[85]

The increased amount of money the tax credit provides is substantial because "commercial carbon capture technology can capture carbon at roughly $58.30 per metric ton of CO2, according to a DOE analysis."[86] This means that corporations that utilizes the 45Q tax credit can capture carbon and be reimbursed for the whole cost of capturing the carbon and in some circumstances the corporation could even make a profit on capturing carbon based on which tax credit amount is received.

"In addition, the 2022 changes reduce the capacity requirements for eligible projects: 18,750 tonnes per year for power plants (provided at least 75% of the CO2 is captured), 12,000 tonnes per year for other facilities."[87] Prior to lowering the emissions eligibility threshold, in order to be eligible "power plants must emit more than 100,000 tons per year; and DAC facilities must capture at least 100,000 tons per year." The vast reduction to the emissions eligibility threshold "will significantly broaden the universe of projects that can economically benefit from 45Q tax credits, potentially expanding the adoption of CCUS and enhancing its prevalence. Notably, these lower thresholds will likely allow for many fossil fuel-based energy generation facilities to be eligible for 45Q tax credits by implementing CCUS."[88]

Therefore, when corporations qualify under the recently modified 45Q tax credit and deploy CCUS technology, the corporation is able to not incur detrimental expenses during the process of capturing each tonne of carbon dioxide. Consequently, not only does the current legal framework reinforce CCUS technology as a preferred

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85. *Section 45Q Credit for Carbon Oxide Sequestration – Policies*, INTERNATIONAL ENERGY AGENCY (Nov. 4, 2022), https://www.iea.org/policies/4986-section-45q-credit-for-carbon-oxide-sequestration.

86. *Cheaper Carbon Capture Is on the Way*, PACIFIC NORTHWEST NATIONAL LABORATORY (Mar. 11, 2021), https://www.pnnl.gov/news-media/cheaper-carbon-capture-way#:~:text=CO2%20is%20primarily%20released,according%20to%20a%20DOE%20analysis.

87. *Section 45Q Credit for Carbon Oxide Sequestration – Policies*, INTERNATIONAL ENERGY AGENCY (Nov. 4, 2022), https://www.iea.org/policies/4986-section-45q-credit-for-carbon-oxide-sequestration.

88. *Carbon Capture, Utilization and Sequestration Tax Benefits under the Proposed Inflation Reduction Act*, MCDERMOTT WILL & EMERY (Aug. 4, 2022), https://www.mwe.com/insights/carbon-capture-utilization-and-sequestration-tax-benefits-under-the-proposed-inflation-reduction-act/#:~:text=Under%20the%20current%2045Q%20tax,least%20100%2C000%20tons%20per%20year.

GHG emissions reduction approach, the technical advantages of CCUS technology also lends itself to show why CCUS technology is a preferred emissions reduction approach. In addition to advantages the current legal framework provides for large scale CCUS implementation, there are a multitude of technical advantages that promote CCUS as the preferred technology for mass carbon dioxide emissions reduction.

B. The Technical Advantages of Carbon Capture Utilization and Storage Technology

The overarching advantage of Carbon Capture Utilization and Storage technology and a big reason why it has gained interest recently is "because it allows for the continued use of fossil fuels at power plants and other large, industrial facilities while reducing the amount of carbon dioxide emitted to the atmosphere."[89]

Pennsylvania's own Senator Yaw recognized the economic benefits of utilizing CCUS technology and stated it could guide Pennsylvania to a "path forward to tackle greenhouse gas emissions without crippling our economy."[90] There are three main reasons why CCUS technology would not cripple Pennsylvania's economy.

First, for example, fossil fuel power plants currently power 60% of the United States' electrical grids, so the most important reason why CCUS technology would not cripple the economy is because utilization of CCUS technology would enable the United States to continue operating predominately off of fossil fuels, and at the same time strive to meet new emissions reduction goals. The International Energy Agency recognized this beneficial aspect of CCUS technology and noted that coal- and gas-fired power plants provide "benefits essential to the operation of the electricity grid, such as inertia and frequency control. CCUS allows these plants to continue provide these benefits and meet long-term flexibility requirements, such as annual seasonality."[91] Annual seasonality simply is the seasonal variance of energy consumption which shows "significant spikes in demand every summer and winter."[92] Therefore, utilization of CCUS technology would enable the United States to retain

89. WYOLEG.GOV, (Mar. 17, 2023), https://www.wyoleg.gov/.

90. *Yaw: Carbon Capture, Utilization and Storage Shows Promise in Pennsylvania*, SENATOR YAW (Sep. 19, 2022), https://www.senatorgeneyaw.com/2022/09/19/yaw-carbon-capture-utilization-and-storage-shows-promise-in-pennsylvania/.

91. *Why carbon capture technologies are important – The role of CCUS in low-carbon power systems – Analysis*, IEA (Mar. 19, 2023), https://www.iea.org/reports/the-role-of-ccus-in-low-carbon-power-systems/why-carbon-capture-technologies-are-important.

92. *Homes show greatest seasonal variation in electricity use*, HOMEPAGE - U.S. ENERGY INFORMATION ADMINISTRATION (Mar. 4 2013), https://www.eia.gov/todayinenergy/detail.php?id=10211.

all the benefits of existing electrical grids, and meet seasonal energy requirements for citizens throughout the Country.

The second reason CCUS Technology would not cripple the economy is because widespread oil and natural gas drilling operations would not be negatively affected by implementation of the technology, this benefit is especially notable in Pennsylvania because fracking is a major source of revenue for the State, the work force, the citizens that allow fracking on their land, and a plethora of corporations, including law firms.

The third reason is because a lot of existing stationary sources have existing infrastructure that could house CCUS technology. However, if a corporation does not have suitable infrastructure, a common criticism of CCUS technology is that implementing the technology is too costly. The Rhodium Group recognized the monetary issue with "inside the fence line" approaches because they are more expensive than "out of the fence line" approaches. The group stated that these "[t]hese factors may add up to bigger political challenges around the total cost of regulations and may face opposition from some stakeholders who have traditionally opposed certain control technologies like carbon capture."[93] However, the International Energy Agency stated that "to dismiss the technology on cost grounds would be to ignore its unique strengths, its competitiveness in key sectors and its potential to enter the mainstream of low-carbon solutions." [94]

The Agency went on to state that in stationary source sectors such as cement, steel, and chemical production, "CCUS is a relatively advanced and cost-competitive option for dramatically cutting the CO_2 emitted during the production of these essential materials. It can also be more cost-effective to retrofit CCUS to existing facilities than building new capacity with alternative technologies."[95] Notably, "[i]ncorporating CO2 capture raises estimated costs by less than 10%, while approaches based on electrolytic hydrogen can raise costs by 35-70%."[96]

Even in the face of political challenges, some states have passed CCUS regulations because in the current legal framework it is one of the only near-term GHG emissions control technologies that would enable each State to reduce GHG emissions while utilizing its pre-existing electrical grid. Most States are now catching

93. *Id.*
94. *Is carbon capture too expensive?,* IEA (Feb. 17, 2021), https://www.iea.org/commentaries/is-carbon-capture-too-expensive.
95. *Id.*
96. *Id.*

on to the numerous benefits CCUS technology provides and some of those States are currently deciding whether to pass legislation that would enable CCUS regulation, such as Pennsylvania.

C. The Success Encountered by Other States Implementing CCUS Technology

In 2017, the National Conference of State Legislatures conducted research on 21 states which have legislation related to CCUS. "Several states including California, Kentucky, New Mexico, Oklahoma, Pennsylvania and West Virginia have enacted legislation to conduct studies or prepare reports on CCS. Other states, including Kansas, Mississippi, Montana, New Mexico, North Dakota and Texas, have enacted legislation establishing tax incentives for CCS equipment, property and projects."[97] The conference went on to note that states have taken various approaches to CCUS regulations, but there are "several main areas addressed by legislation including liability, storage funds, pore space, unitization, carbon dioxide ownership, primacy and inter-state boundary issues."[98]

1. ***Liability***

"Liability is the amount of time the operator is responsible for the site post closure. At least six states— Illinois, Kansas, Louisiana, Montana, North Dakota and Texas—have addressed the issue of long-term liability and transfer of site ownership to the state post-injection."[99]

2. ***Storage Funds***

"Storage funds are funds established for the long-term management and monitoring of CCS storage sites. At least six states have passed legislation establishing storage funds including Kansas, Louisiana, Montana, North Dakota, Texas and Wyoming."[100]

3. ***Pore Space Ownership***

At least three states—Montana, Wyoming and North Dakota—have enacted legislation that establishes who owns the pore space into which the carbon dioxide is

97. *Carbon Capture and Sequestration - Wyoming Legislature*, NATIONAL CONFERENCE OF STATE LEGISLATURES (Apr. 14, 2017), https://www.wyoleg.gov/Interimcommittee/2017/09-0629appendixg-1.pdf.

98. *Id.*

99. *Id.*

100. *Id.*

injected. All three of these states have established that the subsurface pore space belongs to the surface owner. While Montana and Wyoming allow pore space to be transferred as a separate property from the surface, North Dakota established that pore space belongs to the owner and cannot be separated from the owners of the overlying property, although it can be leased.

4. *Carbon Dioxide Ownership*

"State legislation can define who owns and is responsible for the carbon dioxide after it is injected into the ground. At least six states have addressed carbon dioxide ownership after injection through state legislation: Louisiana, Montana, North Dakota, Oklahoma, Texas and Wyoming."[101] Recently West Virginia has also passed legislation that pertains to pore space ownership.[102]

5. *Unitization*

Unitization refers to the percentage of the landowners that is required to agree to the project before it can proceed. At least three states—Montana, North Dakota and Wyoming—have addressed this through legislation. In Montana and North Dakota, at least 60 percent of the owners of the pore space must consent to the CCS project, while in Wyoming, at least 80 percent of pore space owners must consent to the CCS project before it can proceed.

6. *Mineral Rights Primacy*

"Primacy establishes which subsurface rights are dominant. At least five states including Montana, Oklahoma, Texas, West Virginia and Wyoming have enacted legislation regarding primacy of rights with regards to CCS. All states with legislation have established that mineral rights have primacy over CCS."[103]

7. *Interstate Issues*

"At least one state, West Virginia, has enacted legislation addressing the possibility of interstate interaction in conjunction with CCS."[104]

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101. *Id.*
102. *See* W. Va. Code § 22-11B-1, *et seq.*
103. *Id.*
104. *Id.*

8. *Pennsylvania has not addressed any of the main areas of legislation*

A majority of the 21 states that have CCUS legislation has rules in place that are actually substantive, however in Pennsylvania's case all that the legislation has done is to "report on the economic opportunities related to CCUS technologies,"[105] and require "a study to investigate the feasibility of creating a state carbon dioxide sequestration network."[106] The National Conference of State Legislatures made this finding in 2017, and six years later in 2023, Pennsylvania has still yet to pass any substantive legislation that positively benefits CCUS implementation.

D. Calling for Pennsylvania to Follow Suit in Implementing CCUS Legislation Before the Damage is Done

Pennsylvania is in a unique position unlike any other state to capitalize on the numerous advantages that were previously discussed, especially because of Pennsylvania's geographic location and the amount of existing open pore space the State has from fracking over the years. The advantages of CCUS technology in Pennsylvania far exceeds the negative aspects of the technology, and Senator Gene Yaw has recognized the advantages and pushed to pass legislation that would begin to allow regulation of CCUS implementation.

On March 30, 2022, Senator Gene Yaw addressed main areas of legislation that other States have addressed and released a memorandum where he stated, "I will introduce legislation creating the Pennsylvania Geologic Storage of Carbon Dioxide Act, which will establish the legal and regulatory framework for potential carbon dioxide capture and sequestration projects in the state."[107] The proposed legislation would,

- Establish legislative intent to facilitate carbon capture in Pennsylvania;
- Designate property rights around storage sites in deep geologic formations;
- Assign state regulatory authority of CCS facilities in Pennsylvania;

105. *Id.*
106. *Id.*
107. Senator Gene Yaw, *Senate Co-Sponsorship Memoranda*, THE OFFICIAL WEBSITE FOR THE PENNSYLVANIA GENERAL ASSEMBLY (Mar. 30, 2022), https://www.legis.state.pa.us/cfdocs/Legis/CSM/showMemoPublic.cfm?chamber=S&SPick=20210&cosponId=37118.

- Specify the regulatory and permitting process within the existing federal structure; and
- Create a cash fund sustaining regulatory operations, minimizing impact to taxpayers.[108]

Unfortunately, the memo's success is predicated on co-sponsorships and cooperation by government officials. The needed support of other government officials has created a slow-moving legislative process because it is now April 10, 2023, which is an entire year's time after the memo was first proposed. [109]

Therefore, Pennsylvanian governmental officials need to stop dragging their feet on the pressing issue of GHG emissions within the Commonwealth because every day/month/year that passes by brings the United States of America closer to its deadlines from the Biden administration's 2030 emissions reduction goal and the Paris Agreement's 2050 emissions reduction goals. This is also an example of why State action falls short in certain situations, because it takes a long time to pass bills that would otherwise be codified and easily to utilize if Congress would decide to pass CCUS legislation akin to the legislation that has been passed by the previously mentioned States that have CCUS legislation.

III. Conclusion

Given the numerous advantages CCUS utilization would provide to Pennsylvania far outweighs the cons, especially given that the technology will not cripple the current economy because of its ability to use the existing energy grid, another advantage is the existing legal framework which endorses large scale implementation of CCUS technology, or the incentive advantages the federal government provides in the form of tax credits to stationary source owners who are looking to incorporate CCUS technology into their operations. This paper highlights why Pennsylvania's legislature needs to quickly pass the Pennsylvania Geologic Storage of Carbon Dioxide Act, in line with the goals in Senator gene Yaw's memo, and there also needs to be more initiative from co-sponsors and overall cooperation by government officials to enable this legislation to be passed quickly by 2024, which direly needs to happen. This paper also highlights why state action is not always the best option to regulate new technology, because if Congress had passed CCUS

108. *Id.*

109. A representative from Senator Gene Yaw's office stated that his administration is still drafting language and talking to parties within the governor's office in order to finalize and submit the bill to be voted on. Phone call at 09/28/2023, 6:05 PM.

legislation years ago more states would be able to utilize the legislation without having to struggle to gain state support like Senator Yaw is struggling with at the current moment.