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## A Policy Analysis of the Driving Factors Behind Carbon Capture and Storage Facilities

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# A Policy Analysis of the Driving Factors Behind Carbon Capture and Storage Facilities

## INTRODUCTION

It is a cold and quiet day in Morgan Country, Illinois. A day that was destined to be full of promise has now turned into a day of disappointment. Millions of dollars are wasted, the possibility of job creation is frustrated, and the prospect of a bolstered economy is gone. In a heroic attempt to further the fight against climate change, this city has left it all out on the field. Morgan Country was destined to be the site of the first successful carbon capture and storage facility in the United States. Nevertheless, the city's dream of contributing to the fight against climate change remains unrealized.

The casualties are numerous. Schools and local municipalities will continue to be underfunded; the economy will continue to be stagnant; and—the worst part—countless children will continue to grow up in a world negatively affected by climate change. In light of the negative repercussions, one can only wonder what went wrong. Far too often, this is how the story of carbon capture and storage facilities ends. As with all sad endings, this is the type of story society wants to avoid.

Right now, the world is facing a threat. Excessive carbon dioxide is currently altering the atmosphere, causing more of the sun's rays to permeate the environment.<sup>1</sup> As a result, the world is increasingly getting warmer.<sup>2</sup> This increase in temperature is not without consequence. If this trend continues, ecosystems will remain threatened; sea levels will continue to rise; and natural disasters will likely increase in number.<sup>3</sup> These are the risks of climate change. What can be done to stop this trend? To answer this question, one must look deep down: miles beneath the earth's surface.

One of the proposed solutions to climate change is Carbon Capture and Storage facilities (CCS). These facilities capture carbon dioxide (CO<sub>2</sub>) emitted into the air and safely sequester it deep into the ground. CCS facilities reduce the adverse effects of CO<sub>2</sub> emissions and serve as another

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1. *Effects of Changing the Carbon Cycle*, EARTH OBSERVATORY, <https://perma.cc/P8DV-QJPV> (last visited Jan. 21, 2017).

2. Michael Carlowicz, *Global Temperatures*, NASA, <https://perma.cc/4N-AK-2F4V> (last visited Jan. 21, 2017).

3. *The Consequences of Climate Change*, NASA, <https://perma.cc/Z8LP-SXQN> (last visited Jan. 21, 2017).

useful mechanism for the U.S. in its attempt to combat climate change.<sup>4</sup> Notwithstanding their potential benefits, CCS facilities have struggled to take hold in the U.S. Yet, many investors are hesitant to commit to these facilities. Storing high amounts of CO<sub>2</sub> underneath the ground can be very costly.<sup>5</sup> Additionally, the federal government has recently backed out of several CCS projects.<sup>6</sup> Therefore, it is unlikely that the government will continue to invest billions of dollars into these facilities. If CCS facilities are to succeed in the U.S., their financial backing must come from elsewhere.

Part I of this paper will assess the United States' current energy consumption and its need for cleaner air. Part II will examine the recent pitfalls of the CCS movement, including the lack of incentives for developers to enter the CCS market and the Department of Energy's (DOE) recent decision to halt funding for CCS facilities. Part III will focus on Canada's recent CCS success and how the U.S. can learn from it. Part IV will look to the future of CCS in the U.S., including potential projects in Louisiana. Part V will examine how the U.S. can incentivize foreign investors to sponsor CCS projects through international agreements governing climate change.

## I. BACKGROUND

### A. U.S. Reliance on Coal

Coal is a leading resource for energy consumption in the United States.<sup>7</sup> Because it is inexpensive, coal can produce low-cost energy; available low-cost energy will, in turn, have a substantial effect on the

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4. 'Clean Coal' Technologies, Carbon Capture & Sequestration, WORLD NUCLEAR ASS'N, <https://perma.cc/YY47-WJBF> (last updated Jan. 2017).

5. One of the most recent facilities in Saskatchewan has a reported total cost of 1.35 billion Canadian dollars. See e.g., *How Much Does CCS Cost*, GLOBAL CCS INST., <https://perma.cc/BA77-25WZ> (last visited Jan. 22, 2017). While not completed, the recent Texas Clean Energy Project had an estimated cost of \$2 billion. See also Jim Malewitz, *Former Mayor's "Clean Coal" Effort Struggles*, TEX. TRIBUNE (June 9, 2016, 6:00 AM), <https://perma.cc/4KDZ-ESBE>.

6. Bob Berwyn, *Energy Department Suspends Funding for Texas Carbon Capture Project, Igniting Debate*, INSIDE CLIMATE NEWS (May 13, 2016), <https://perma.cc/4PK9-QZEH>.

7. Arnold W. Reitz, Jr., *Carbon Capture and Storage Program's NEPA Compliance*, 42 ENVTL. L. REP. NEWS & ANALYSIS 10853 (2012).

economy.<sup>8</sup> Today, coal usage in the electric power sector accounts for ninety percent of the total U.S. coal consumption.<sup>9</sup> Due to the heavy reliance on coal, the U.S.'s supply of coal is not going away anytime soon. Based on U.S. coal production in 2014, the estimated recoverable coal reserves in the U.S. should last over 250 years.<sup>10</sup> Accordingly, coal remains a vital resource for the U.S. going forward. Yet, in spite of its availability, coal consumption presents unique risks. In 2015, the U.S. electric power sector was responsible for thirty-seven percent of U.S. energy-related CO<sub>2</sub> emissions.<sup>11</sup> Seventy-one percent of the electric power sector was coal-based.<sup>12</sup> These emissions present negative consequences, which can affect the way we live our lives.

## *B. Negative Effects of CO<sub>2</sub>*

### *1. Increase in Earth's Temperature*

The most common effect of CO<sub>2</sub> is its impact on global temperatures.<sup>13</sup> Global warming occurs when air pollutants, such as excessive CO<sub>2</sub> and various greenhouse gases, collect in the Earth's atmosphere.<sup>14</sup> This thickened atmosphere traps the sun's rays, which in turn increases the temperature on Earth.<sup>15</sup> CO<sub>2</sub> makes up nearly three-quarters of global greenhouse emissions and eighty-four percent of U.S. greenhouse emissions.<sup>16</sup> Unless the U.S. drastically cuts down its CO<sub>2</sub> emissions by 2030, "the odds are slim that greenhouse-gas emissions can be held at a level that, by century's end, would limit global warming to about two

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8. *Coal=Reliable Energy*, NAT'L COAL COUNCIL, <https://perma.cc/N6PB-YDAC> (last visited Jan. 21, 2017).

9. *Short-Term Energy Outlook*, U.S. ENERGY INFO. ADMIN., <https://perma.cc/XL2U-8CEB> (last updated Jan. 10, 2017).

10. *How Much Coal is Left*, U.S. ENERGY INFO. ADMIN., <https://perma.cc/7L AU-378S> (last updated June 17, 2016).

11. *How Much of U.S. Carbon Dioxide Emissions are Associated with Electricity Generation*, U.S. ENERGY INFO. ADMIN., <https://perma.cc/8AXG-FC9R> (last visited Jan. 21, 2017) [hereinafter *Electricity Generation*].

12. *Id.*

13. Amanda MacMillan, *Global Warming 101*, NAT'L RES. DEF. COUNCIL (Mar. 11, 2016), <https://perma.cc/TZ22-UAFB>.

14. *Id.*

15. *Id.*

16. *Learn About Carbon Pollution from Power Plants*, U.S. ENVTL. PROT. AGENCY, <https://perma.cc/B39K-RPVX> (last updated July 27, 2016).

degrees Celsius above preindustrial levels.”<sup>17</sup> This elevated temperature, though seemingly small, can result in rising sea levels, changes in weather and precipitation patterns, and alterations of habitats, ecosystems, and species diversity.<sup>18</sup> These changes can lead to excessive heat waves and droughts, excess smog, and increased natural disasters such as hurricanes and extreme flooding.<sup>19</sup> Such effects also create a proliferation in populations of ticks and mosquitoes, which carry various diseases such as West Nile and Lyme Disease.<sup>20</sup>

## 2. *Effects on Field Crops*

In addition to the overall effect on global temperatures, excessive CO<sub>2</sub> emissions present other risks. A new study, the first of its kind,<sup>21</sup> demonstrated that the overwhelming amount of CO<sub>2</sub> in the air is decreasing the nutritional value in field-grown crops.<sup>22</sup> Estimates indicate that plant protein could drop as much as three percent in just a few decades.<sup>23</sup> Given that there are already 795 million undernourished people in the world, this can create problems going forward.<sup>24</sup>

## 3. *Economic Consequences*

Due to the negative effects of CO<sub>2</sub> emissions, businesses that rely on facilities producing these emissions are also struggling. A recent study examined the potential impact of carbon emissions by an S&P 500 company.<sup>25</sup> The study found that “firm value decreases, on average, by

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17. Pete Spotts, *Can We Hide Carbon Dioxide Underground? Algeria Site Offers Note of Caution*, CHRISTIAN SCIENCE MONITOR (May 27, 2014), <https://perma.cc/PWX2-ASVJ>.

18. MacMillan, *supra* note 13.

19. *Id.*

20. *Id.*

21. This was the first study to examine the effects of CO<sub>2</sub> on the nutritional value of field crops. Previous studies focused on plants. Twanna Harps, *Carbon Dioxide Has Negative Effects on Plants and Crops*, LIBERTY VOICE (Apr. 8, 2014), <https://perma.cc/H6B4-PDQN>.

22. *Id.*

23. *Id.*

24. *Hunger Notes*, WORLD HUNGER EDUC. SERV., <https://perma.cc/8QSC-H3PE> (last visited Jan. 21, 2017).

25. *Carbon Footprint Stomps on Firm Value*, GLOBAL VALUATION INST. (Dec. 2012), <https://perma.cc/3873-CBUE>. The S&P 500 Index contains most of the largest companies in the United States. *S&P Companies by Weight*, SLICK CHARTS, <https://perma.cc/RJG6-9Y84> (last visited Dec. 29, 2017).

U.S. \$212,000 for every additional thousand metric tons of carbon emissions produced by the firms.”<sup>26</sup> A joint 2013 study by the Carbon Disclosure Project and the World Wildlife Fund showed that by reducing annual greenhouse gas emission by three percent, the U.S. corporate companies sector can save up to \$190 billion by 2020.<sup>27</sup> The Carbon Disclosure Project also found that seventy-nine percent of U.S. companies earn more from investments aimed at reducing carbon emissions than from their average overall capital expenditures.<sup>28</sup> The cost savings stems from improved asset allocation and waste reduction.<sup>29</sup> As such, companies who emit excessive carbon incur unnecessary financial burdens. CCS facilities can help solve these problems by minimizing some of the negative effects of CO<sub>2</sub>.

### C. Carbon Capture and Storage Facilities

Carbon Capture and Storage is the technological process of capturing carbon dioxide emissions and sequestering these gases in physical formations in the ground for geologically significant periods of time.<sup>30</sup> The goal of CCS is to reduce the amount of carbon dioxide released into the atmosphere.<sup>31</sup> These facilities can retain ninety percent of the carbon emitted into the air.<sup>32</sup> Although commonly considered a new concept, the notions behind CCS actually date back to the early 1930s, when the oil industry utilized storage space deep beneath the ground for waste disposal.<sup>33</sup> Like these injection wells, CCS facilities utilize storage space deep beneath the earth’s surface.<sup>34</sup>

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26. *Carbon Footprint Stomps on Firm Value*, *supra* note 25, at 2.

27. Sally Paradis & Elias Wehbe, *The Smart Economics of Carbon Accounting: Developing a 2020 Vision for Your Brand’s Environmental & Financial Impact*, SUSTAINABLE BRANDS (Nov. 21, 2014), <https://perma.cc/FXC4-G5QH>.

28. *Id.*

29. *Id.*

30. Nadine R. Hoffman, *The Emergence of Carbon Sequestration: An Introduction and Annotated Bibliography of Legal Aspects for CCS*, 29 PACE ENVTL. L. REV. 218, 219 (2011).

31. *Id.*

32. *Frequently Asked Questions*, CARBON CAPTURE AND STORAGE ASSOCIATION, <https://perma.cc/4NL7-4X3H> (last visited Jan. 21, 2017).

33. Stephanie M. Haggerty, *Legal Requirements for Widespread Implementation for CO<sub>2</sub> Sequestration in Depleted Oil Reservoirs*, 21 PACE ENVTL. L. REV. 197, 205 (2003).

34. *Id.*

There are three stages to CCS: capture, transportation, and storage.<sup>35</sup> First, carbon dioxide is either removed or separated from major power plants stationed next to plants emitting CO<sub>2</sub>.<sup>36</sup> Second, once the carbon dioxide is captured, it is compressed and transported through either a pipeline or by ship.<sup>37</sup> Third, the carbon dioxide is then injected into a storage site deep below the ground.<sup>38</sup> The storage and disposal sites include: (1) depleted oil and gas reservoirs; (2) deep saline formations; (3) unmineable coal seams; and (4) salt caverns.<sup>39</sup> Because of their potential effectiveness, some describe these facilities as a “promising technology that could enable the continued use of inexpensive fossil fuels while dramatically reducing accompanying green gas emissions.”<sup>40</sup> If properly implemented, the U.S. could reduce the environmental impact of coal production.

## II. PITFALLS AND FAILED PROJECTS

### A. Failed CCS Projects

Despite the often-publicized benefits of CCS facilities, the U.S. Federal Government has become increasingly hesitant to pursue this technology. Within the last few years, the DOE has backed out of five major CCS projects.<sup>41</sup> The most recent case involves the Texas Clean Energy Project, to which the DOE committed \$450 million in funding.<sup>42</sup> Despite its hefty pledge, only \$116 million has actually been spent on the project.<sup>43</sup> According to the DOE, the decision to back out was based on many missed deadlines by the project developers.<sup>44</sup>

Such a response is likely met with much skepticism. Surely the federal government would not be willing to risk the nation’s livelihood due to a few missed deadlines. After all, when has the federal government been

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35. *Frequently Asked Questions*, *supra* note 32.

36. *Id.*

37. *Id.*

38. *Id.*

39. Nigel Bankes, Jenette Poschwatta & E. Mitchell Shier, *The Legal Framework for Carbon Capture and Storage in Alberta*, 45 ALTA. L. REV. 585, 589 (2008).

40. Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide*, 58 EMORY L.J. 103, 107 (2009).

41. Berwyn, *supra* note 6.

42. *Id.*

43. *Id.*

44. *Id.*

associated with timeliness and efficiency? There must be something more at stake.

Recent reports suggest that the DOE's reluctance is actually linked to the emergence of China as a major funder of the Texas Clean Energy Project.<sup>45</sup> Given the Chinese's history of stealing IP from competitors, the DOE is concerned that a partnership with China increases the risk of IP theft.<sup>46</sup> Like the U.S., China has a special interest in these CCS projects. Coal production drives the Chinese economy.<sup>47</sup> Yet, due to coal production's adverse effects, China has been forced to confront the realities of an economy built on coal.<sup>48</sup> Accordingly, China reduced its imports on coal by thirty percent in 2016, with hopes of transitioning to cleaner power sources, such as wind, solar, and hydro.<sup>49</sup> Some scholars dubbed this recent phenomenon the "anything but coal policy."<sup>50</sup> The new policy could place strict limits on coal production over the next five years.<sup>51</sup> One researcher close to China's economic planning commission said the country is even mulling a total ban on new coal-fired plants.<sup>52</sup> While beneficial, this will not solve the problems resulting from existing coal fire plants. Currently, China is expected to increase CO<sub>2</sub> emissions through 2030.<sup>53</sup> To compensate for these emissions, China will likely continue to invest in CCS technology.<sup>54</sup> This international tension is problematic for CCS projects in the U.S. Since China and the U.S. are

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45. Michael Bastasch, *DOE 'Clean Energy' Program Hampered By Fears China Will Steal IP*, DAILY CALLER (July 6, 2016, 10:20 AM), <https://perma.cc/9NGA-RKX8>.

46. *Id.*

47. *Beyond the Coal Rush Part 1*, SCIENCE SHOW (Aug. 27, 2016), <https://perma.cc/K52M-YDZJ>.

48. Keith Johnson, *China's Leaner and Green 5-Year Plan*, FOREIGN POLICY GROUP (Oct. 30, 2015), <https://perma.cc/BPN7-KXZJ>.

49. *Panel: Tim Buckley, Institute for Energy Economics and Financial Analysis, and Greg Evans, Minerals Council of Australia*, AUSTRALIAN BROADCAST CORPORATION (June 3, 2016), <https://perma.cc/7FB4-T2KF>.

50. Gary Ellem, *The Cloud's Looming Over Coal's Future*, WEEKEND AUSTRALIAN (Dec. 15, 2015, 10:57 PM), <http://www.theaustralian.com.au/business/business-spectator/the-clouds-looming-over-coalsfuture/newsstory/55d3219003ff041f300d352f76255775>.

51. Johnson, *supra* note 48.

52. *Id.*

53. Chelsea Harvery, *China Vowed to Peak its Carbon Emissions by 2030. It Could Be Way Ahead of Schedule*, WASH. POST (Mar. 7, 2016), <https://perma.cc/U3SB-SWNY>.

54. Naomi Mapstone, *China's Interest in Carbon Capture and Storage Scheme Grows*, FIN. TIMES (Apr. 19, 2015), <https://perma.cc/W7CL-CYFC>.



major backers of the CCS movement, organizations may be forced to accept funds from only one of these countries, as the U.S. is unwilling to partner with China.<sup>55</sup> Thus, corporations can be deprived of a large source of capital. Unfortunately, the decision to withhold funding for CCS projects often extends beyond foreign relations. This hesitation also applies to the private sector, where companies face significant financial burdens.

Two of the more recent projects, the Texas Clean Energy Project and the Future Gen Project, have had a combined cost of nearly \$5.5 billion dollars.<sup>56</sup> Although expensive, these projects had the potential to serve as an economic driver for their local economies. The Texas Clean Energy Project was intended to create 2,000 construction jobs and 150 high paying jobs.<sup>57</sup> The project was also supposed to increase local tourism.<sup>58</sup> Like the Texas Clean Energy Project, Future Gen was intended to revitalize the state economy.<sup>59</sup> A University of Illinois study suggested that this project would create over 1,600 jobs and result in a \$12 billion economic boost to Illinois over twenty years.<sup>60</sup> This would create \$243 million in taxable revenue that would have made this project one of the largest supporters of schools and municipalities in the area.<sup>61</sup> Even with the best intentions, construction of these facilities can be very difficult during a struggling economic climate.<sup>62</sup> Neither of these facilities turned out to be operational due to a lack of funding.<sup>63</sup> Despite the potential benefits, many investors

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55. This assumes the U.S. will continue their hardline stance against the Chinese with regard to significant CCS projects. *See* Bastasch, *supra* note 45.

56. Malewitz, *supra* note 5; David Talbot, *Construction Begins at a Carbon-Capture Plant, but Will It Ever Be Completed?*, MIT TECHNOLOGY REVIEW (Sept. 15, 2014), <https://perma.cc/D8M9-VH7P>.

57. Deanne Lopez, *\$2.6 Billion Energy Project Plant One Step Closer to Being Built in Ector County*, CBS 7 (Dec. 8, 2015, 11:12 PM), <https://perma.cc/8M2A-CLAC>.

58. *Id.*

59. *FutureGen 2.0 Means Hundreds of New Jobs, \$12 Billion Economic Boost to Illinois*, JACKSONVILLE REG'L DEV. CORP. (Aug. 12, 2013), <https://perma.cc/98ZE-3RXM> [hereinafter *FutureGen 2.0*].

60. *Id.*

61. *Id.*

62. Jeff Cox, *How Slow is US Economic Growth? 'Close to Zero'*, CNBC (July 29, 2016, 9:55 AM), <https://perma.cc/RSC8-6MQH>.

63. Thomas Overton, *DOE Poised to Pull Out of Texas Clean Energy Project*, POWER MAGAZINE (May 17, 2016), <https://perma.cc/32HA-JW38>.

are simply unwilling to invest in CCS facilities due to the requisite cost of constructing a facility.<sup>64</sup>

In addition to concerns over startup cost, businesses also run the risk of long-term liability over the storage space.<sup>65</sup> A recent example of this occurred when the Mississippi Department of Environmental Quality forced a Mississippi company to pay a \$662,500 fine due to a blowout resulting in loss of wildlife.<sup>66</sup> While the blowout did not arise from a CCS facility, there are concerns that CCS facilities will suffer a similar fate. Many experts believe there is no long-term guarantee that the CO<sub>2</sub> will actually stay underneath the ground.<sup>67</sup> As seen most recently in Mississippi, such a blowout can lead to numerous damages.<sup>68</sup> This problem is worsened by legal inconsistency and uncertainty because the current allocation of compensatory damages varies state by state.<sup>69</sup> Such legal uncertainty often discourages corporations and investors from pouring money into certain states.<sup>70</sup>

### *B. Lack of Federal Regulation*

Perhaps even more problematic than the DOE's wavering role in financial support and the costs facing private facilities is the lack of a true federal regulatory scheme governing CCS facilities.<sup>71</sup> Currently, states control most CCS regulation.<sup>72</sup> States may be better suited to create regulation given their regulatory flexibility and general understanding of the state's property laws, but there are also several harms resulting from state regulation.

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64. Bobby Magill, *Carbon Capture Faces Hurdles of Will, Not Technology*, CLIMATE CENTRAL (Apr. 23, 2014), <https://perma.cc/EFH8-8STJ>.

65. Craig A. Hart, *Advancing Carbon Sequestration Research in an Uncertain Legal and Regulatory Environment*, HARVARD KENNEDY SCHOOL (Jan. 2009), <https://perma.cc/U2LK-D6ZL>.

66. Megan Wright, *Denbury Paying One of Largest Fines Ever to MDEQ for Blowout*, MISS. BUS. J. (July 26, 2013), <https://perma.cc/NMV8-DQTE>.

67. Haggerty, *supra* note 33, at 216.

68. Wright, *supra* note 66.

69. Jonas J. Monast, Brooks R. Pearson & Lincoln F. Pratson, *A Cooperative Federalism Framework for CCS Regulation*, 7 ENV'T L. & ENERGY L. & POL'Y J. 1, 13 (2012).

70. *Id.*

71. Michael Faure, *Liability and Compensation for Damage Resulting from CO<sub>2</sub> Storage Sites*, 40 WM. & MARY ENVTL. L. & POL'Y REV. 387, 390 (2016).

72. Monast, *supra* note 69, at 12-13.

State regulations are inconsistent across the country.<sup>73</sup> This incongruity can result in higher operating costs for the CCS industry. For example, differentiation in subsurface property rights law increases transaction costs.<sup>74</sup> Inconsistency creates a situation where compliance in one state does not equate to compliance in another state.<sup>75</sup> There are extra hurdles for companies interested in creating multiple facilities. It also becomes more difficult to replicate facilities state-by-state as each CCS facility has to be implemented under different regulations.

Secondly, state-by-state regulation does not incentivize private corporations to enter the CCS market.<sup>76</sup> Without the availability of tax credits, financial assistance, or various other perks, the private sector in states without regulation will have little to no incentive to invest in CCS.<sup>77</sup> Accordingly, organizations may only invest in a few states. This lack of activity has a stagnating effect on the overall CCS market.

### *C. Risks of CCS*

#### *1. Earthquakes*

Investors are often discouraged from sponsoring CCS projects due to the perceived risks that come with these facilities. One of these risks is the potential threat of earthquakes that may arise from injecting CO<sub>2</sub> into the ground.<sup>78</sup> Recently, the U.S. Geological Survey reported on the increase of “human-induced” earthquakes.<sup>79</sup> This activity directly connects to the oil and gas industry due to its continual drilling deep into the ground.<sup>80</sup>

Human activity has significantly affected the overall assessment of earthquakes in the U.S.<sup>81</sup> As a result, forecasters predict that the nation faces a significantly higher chance of experiencing an earthquake within

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73. *Id.* at 12.

74. *Id.* at 27.

75. *Id.* at 13.

76. *Id.* at 11-12.

77. *Id.* at 13.

78. Max McClure, *Carbon Capture and Storage Likely to Cause Earthquakes, Say Stanford Researchers*, STAN. REPORT (June 19, 2012), <https://perma.cc/QG74-TMLJ>.

79. Jessica Fitzpatrick & Mark Peterson, *Induced Earthquakes Raise Chances of Damaging Shaking in 2016*, U.S. GEOLOGICAL SURV. (Mar. 28, 2016, 11:50 AM), <https://perma.cc/USS5-4BP8>.

80. Eric Holthaus, *USGS: Human Activity “Significantly Increases” U.S. Earthquake Risk*, SLATE (Mar. 28, 2016, 4:16 PM), <https://perma.cc/XGS3-Y9YH>.

81. *Id.*

the next year.<sup>82</sup> Nowhere else is this phenomenon more apparent than in the state of Oklahoma, where in 2015, forecasters recorded 907 earthquakes with a magnitude of 3.0 or above.<sup>83</sup> To put things into perspective, there were only two Oklahoma earthquakes of that magnitude in 2009.<sup>84</sup> The rapid increase has been attributed to hydraulic fracking, which requires injecting billions of gallons of water into the ground.<sup>85</sup>

Similar to hydraulic fracking, CCS facilities require injections of greenhouse gases deep into the ground.<sup>86</sup> Some of the same problems associated with hydraulic fracking may also extend to CCS facilities. A recent example of this problem occurred in Salah, Algeria, where one of the world's largest CCS projects was forced to shut down in 2011 due to "forming or widening vertical fractures in the rock" in which the CO<sub>2</sub> was being stored.<sup>87</sup> Due to the ever-increasing rate of human-induced earthquakes in the U.S., CCS antagonists argue that the creation of CCS facilities makes this problem worse.

## 2. CO<sub>2</sub> Leakage

Given that CCS is a relatively new technology, the problem arises: what if the CO<sub>2</sub> fails to stay underneath the ground? A group of scientists studying the seafloor of the Norwegian North Sea noticed huge fractures where much of the gas was stored and concluded that the CO<sub>2</sub> would eventually leak from the ground.<sup>88</sup> In Mississippi, carbon dioxide was once being pumped to force additional oil up out of the ground.<sup>89</sup> The pumping resulted in an oil well blowout that caused the suffocation of deer and other wildlife.<sup>90</sup> Many scientists are unsure as to how long carbon dioxide can be stored under the ground.<sup>91</sup> The results of excess CO<sub>2</sub> being released at

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82. *Id.*

83. Bill Whitaker, *Oklahoma's Rise in Quakes Linked to Man-Made Causes*, 60 MINUTES (May 8, 2016), <https://perma.cc/22TG-ARS5>.

84. *Id.*

85. *Id.*

86. Haggerty, *supra* note 33, at 216.

87. Spotts, *supra* note 17.

88. Richard Monastersky, *Seabed Scars Raise Questions Over Carbon-Storage*, NATURE INT'L WEEKLY J. OF SCIENCE (Dec. 17, 2013), <https://perma.cc/LN2X-QQFL>.

89. Wright, *supra* note 66.

90. *Id.*

91. Haggerty, *supra* note 33, at 216.

one time can be devastating, producing serious health risks.<sup>92</sup> In 1986, a volcanic eruption released large amounts of CO<sub>2</sub> in the Central African country of Cameroon.<sup>93</sup> As a result of the emissions, 17,000 people died along with thousands of cattle.<sup>94</sup>

Another potentially dangerous side effect of CO<sub>2</sub> leakage is its effect on drinking water. According to a recent study, “[l]eaks from carbon dioxide injected deep underground to help fight climate change could bubble up into drinking water aquifers near the surface, driving up levels of contaminants in the water tenfold or more in some places.”<sup>95</sup> If such a leak occurs at a CCS facility, the results could be catastrophic.

Due to these potential threats, the decision to invest in CCS facilities must be made with consideration of the potential failures that may occur over hundreds of years.<sup>96</sup> These failures include “long term stewardship of the sequestration site, including plugging and abandoning the well after injection is completed, monitoring, measuring and verifying the CO<sub>2</sub> plume, and taking corrective action to remediate any problems that arise.”<sup>97</sup> Because of these risks, investors may be hesitant to sponsor these projects since the return on their work may not be fulfilled during their lifetimes.

### 3. Cost

Many other countries are expressing concern over CCS, including in Europe, where four European Utilities (EU) recently dropped an EU-driven CCS technology project.<sup>98</sup> One of the major concerns in Europe was the cost associated with the CCS Projects.<sup>99</sup> In 2013, Norway dropped

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92. Allison Kole, *Carbon Capture and Storage: How Bad Policy is By-Passing Environmental Safeguards*, 20 J. ENVTL. & SUSTAINABILITY L. 116, 127 (2014).

93. *Id.* at 112.

94. *Id.*

95. Joe Romm, *Study: Leaks from CO<sub>2</sub> Stored Deep Underground Could Contaminate Drinking Water*, THINK PROGRESS (Nov. 12, 2010, 7:20 PM), <https://perma.cc/W8JS-UAWC>.

96. Mark D. Zoback & Steven M. Gorelick, *Earthquake Triggering and Large-Scale Geologic Storage of Carbon Dioxide*, U.S. NAT’L LIB. OF MED., NAT’L INSTITUTES OF HEALTH (Aug. 18, 2015), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3387039/>.

97. Monast, *supra* note 69, at 43.

98. Alister Doyle & Susan Thomas, *Four European Utilities Drop EU CCS Technology Project*, REUTERS AFRICA (Jan. 19, 2015, 11:47 AM), <https://perma.cc/7K89-933R>.

99. *Id.*

its plans for a full scale CCS Project.<sup>100</sup> According to Norway's auditor general, Norway severely underestimated the complexity of a full-fledged CCS facility.<sup>101</sup> The program's failure even led to political ramifications within the country.<sup>102</sup> The UK also cut its major CCS project.<sup>103</sup> As with other countries, the project was just too expensive, causing important investors to back out.<sup>104</sup> This vacuum of interest presents two different problems. First, it stifles the rate of growth for this technology because fewer financial resources worldwide are used in its development. Second, it creates problems in the U.S. because there are less foreign investors interested in U.S. CCS facilities.

### III. A GLIMMER OF HOPE: THE CANADIAN MOVEMENT

#### *A. Recent CCS Success in Canada*

Despite the negativity surrounding CCS, Canada has successfully implemented the operation of these facilities. So far, Canada has not experienced some of the initial adverse effects of CO<sub>2</sub> storage.<sup>105</sup> That does not mean that its implementation of CCS facilities was easy. As with the U.S., in 2012, there were fears that these facilities would not succeed in Canada.<sup>106</sup> One of the significant problems facing Canadian facilities was the lack of a financial incentive for the companies.<sup>107</sup> At the time, there were no significant cap and trade programs or carbon taxes.<sup>108</sup> In spite of this, Canada has successfully launched two CCS facilities.<sup>109</sup> In

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100. Mikael Holter, *Norway Drops 'Moon Landing' as Mongstad Carbon Capture Scrapped*, BLOOMBERG (Sept. 20, 2013, 9:23 AM), <https://perma.cc/WR6B-3NLM>. See also Will Nichols, *Norway Ditches 'Moon Landing' Carbon Capture Project*, BUS. GREEN (Sept. 23, 2013), <https://perma.cc/8PFM-Q8LM>.

101. Holter, *supra* note 100.

102. *Id.*

103. Damian Carrington, *UK Cancels Pioneering £1bn Carbon Capture and Storage Competition*, THE GUARDIAN (Nov. 25, 2015), <https://perma.cc/X7QJ-WMAE>.

104. *Id.*

105. These adverse effects include: contamination of drinking water, increased earthquakes, and CO<sub>2</sub> leakage. See McClure, *supra* note 78; Monastersky, *supra* note 88; Romm, *supra* note 95.

106. Wendy Gills, *Carbon Capture and Storage: An Uncertain Future in Canada*, THE STAR (June 8, 2012), <https://perma.cc/5SJJ-6G7Z>.

107. *Id.*

108. *Id.*

109. *Large Scale CCS Projects*, GLOBAL CCS INST., <https://perma.cc/H9GJ-R4LQ> (last visited Jan. 21, 2017).

2014, Canada launched the Boundary Dam in Saskatchewan.<sup>110</sup> The facility currently holds one million metric tons of CO<sub>2</sub> per year.<sup>111</sup> This accounts for emissions stemming from 250,000 cars on the road per year.<sup>112</sup> In 2015, Shell launched the “Quest” project, which captures an additional one million metric tons of CO<sub>2</sub> per year.<sup>113</sup> The facility is located in Alberta, which has a long history with this technology.<sup>114</sup> In 2014, Alberta was responsible for over thirty-seven percent of Canada’s total greenhouse gas emissions.<sup>115</sup> In spite of Alberta’s overall emissions, the project is both ahead of schedule and under budget.<sup>116</sup>

### *B. Funding of Canadian Projects*

One of the unique features of Canada’s CCS facilities is how the programs were funded. When the Boundary Dam was launched, the facility entered a ten-year contract where it agreed to sell some of the carbon it captured.<sup>117</sup> This agreement enabled the facility to operate without reliance on the Canadian government.<sup>118</sup> Without this agreement, the \$1.4 billion facility would not have been possible.<sup>119</sup>

Canada has also made development of this technology available to the public.<sup>120</sup> In doing so, the cost of starting these facilities has dropped as much as an estimated thirty percent.<sup>121</sup> The Canadian government has also taken a prominent role in financing these facilities. Although smaller than

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110. Suzanne Goldenberg, *Canada Switches on World’s First Carbon Capture Power Plant*, THE GUARDIAN (Oct. 1, 2014, 12:43 PM), <https://perma.cc/5CYP-EBV5>.

111. *Id.*

112. *Id.*

113. Jessica Lyons Hardcastle, *Shell’s Carbon Capture Project Reaches Milestone, Operating Under Budget*, ENVTL. LEADER (Sept. 16, 2016), <http://www.environmentalleader.com/2016/09/16/shells-quest-carbon-capture-reaches-milestone-operating-under-budget/>.

114. James Wilt, *After Three Decades in Canada, Is Carbon Capture Technology Doomed?*, ALBERTA OIL MAGAZINE (Feb. 9, 2016), <https://perma.cc/4X9K-AGPX>.

115. *Greenhouse Gas Emissions by Province and Territory*, ENVIRONMENT & CLIMATE CHANGE CAN., <https://perma.cc/6ZFX-6DSJ> (last visited Oct. 1, 2016).

116. Hardcastle, *supra* note 113.

117. Kiran Stacey, *High Ambitions for Emission Reduction with Carbon Capture and Storage Falter*, FIN. TIMES (July 25, 2016), <https://perma.cc/DP9P-NDJE>.

118. *Id.*

119. *Id.*

120. *Global CCS Institute Applauds Shell Quest CCS Milestone*, GLOBAL CCS INST. (Sept. 15, 2016), <https://perma.cc/Z6AR-FLE2> [hereinafter *Milestone*].

121. *Id.*

some of the subsidies offered in the U.S., the Canadian government has helped foot the bill for these projects.<sup>122</sup> The Boundary Dam program received \$240 million dollars in federal aid.<sup>123</sup> The Quest program received \$745 million from the Alberta government and an additional \$120 million from the Ottawa government.<sup>124</sup> These programs have even lowered their cost by sharing transportation facilities which transmit the captured carbon dioxide.<sup>125</sup>

### *C. Impacts of the Canadian Facilities in the U.S.*

The success of these Canadian facilities cannot be understated; Canada has not experienced the doomsday-scenarios that many Americans worry about. The U.S. can learn first-hand from the success of these facilities. Canada is currently working with the U.S. through the U.S.-Canada Clean Energy Dialogue.<sup>126</sup> This agreement allows the U.S. to obtain advancements through technical collaboration on research and development.<sup>127</sup> Such an agreement benefits prospective investors in the U.S. as increased technological advancements can accelerate their potential projects.

## IV. CCS PROSPECTS IN THE UNITED STATES

### *A. Lack of Viable Alternative Energy Options*

One of the main arguments against the use of CCS facilities in the U.S. is that cleaner air can be achieved without these facilities. Often, when confronting the prospects of climate change, many people argue that the U.S. should move away from coal and rely on other sources of energy that do not result in excessive CO<sub>2</sub> emissions. While that may work in theory, any significant movement towards alternative sources of energy will not be easy because these energy sources present various problems.

First, U.S. infrastructure does not allow for significant reliance on these energy sources. Currently, there are three major power grids in the

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122. Lauren Krugel, *Shell CEO Pushes Carbon Capture and Storage as Way to Combat Climate Change*, CANADIAN PRESS (Nov. 9, 2015, 2:02 PM), <https://perma.cc/PTX9-3R4X>.

123. *Id.*

124. *Id.*

125. Hardcastle, *supra* note 113.

126. *Carbon Capture and Storage: Canada's Technology Demonstration Leadership*, NAT. RES. CAN., <https://perma.cc/3J65-KAM4> (last visited Jan. 22, 2017).

127. *Id.*



U.S.<sup>128</sup> Their combined worth extends into the trillions of dollars range.<sup>129</sup> At this moment, these grids are not conducive to sole reliance on alternative energy sources.<sup>130</sup> Any attempt to redesign these transformers to meet the needs of a system based on alternative energy sources would prove to be very difficult and extremely costly.<sup>131</sup>

Second, other forms of alternative energy present their own issues. Wind power generally produces clean energy, but this generated power cannot be effectively stored long-term.<sup>132</sup> The inconsistency in wind production can lead to intermittent blackouts.<sup>133</sup> The same is true of solar power. Like wind power, solar energy production can be interrupted due to occasional cloud cover.<sup>134</sup> While these alternative sources of energy generate “cleaner air,” significant reliance on these sources of energy is not feasible at this time. Due to their unreliability, both solar and wind power account for only 2.8 percent of the energy consumed in the U.S. for the first six months of 2016.<sup>135</sup>

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128. Andrew Follet, *Top 11 Problems Plaguing Solar And Wind Power*, DAILY CALLER (Dec. 25, 2015, 2:07 PM), <https://perma.cc/DC4X-LY69>.

129. Carolyn Cohn & Louise Heavens, *Cyber Attack on U.S. Power Grid Could Cost Economy \$1 Trillion: Report*, REUTERS (July 8, 2015, 5:31 AM), <https://perma.cc/5C24-75ZY>.

130. Follet, *supra* note 128.

131. *Id.*

132. Giles Parkinson, *The Long-Term Energy Storage Challenge: Batteries Not Included*, GREEN TECH MEDIA (Dec. 7, 2013), <https://perma.cc/ZL8W-NBDB>.

133. See Jay Weatherill, *Report: Wind Power Caused the SA Blackout*, HERALD SUN (Oct. 20, 2016, 8:39 AM), <https://perma.cc/HA6U-DNJY>.

134. Follet, *supra* note 128. Sometimes the peak performance of solar power does not align with peak demand. An example of this is in California, where in December 2015, the peak performance time for solar power was 12:36 PM. The peak solar demand time was 6:36 PM. At 6:00 PM, the solar production was zero. See *Renewables Watch*, CAL. ISO (Dec. 7, 2015), <https://perma.cc/XQ5H-GNXU>. However, this is more of an exception to the general rule as solar power tends to fair well with daily production starting after the morning ramp. See *Today in Energy*, U.S. ENERGY INFO. ADMIN. (Apr. 6, 2011), <https://perma.cc/3U3W-2J7V>. See also Wencong Su, Jianhui Wang, Kuilin Zang & Alex Huang, *Model Predictive Control-Based Power Dispatch for Distribution System Considering Plug-in Electric Vehicle Uncertainty*, ELECTRIC POWER SYSTEMS RES. (Jan. 2014), [https://www.researchgate.net/publication/259129546\\_Model\\_predictive\\_controlbased\\_power\\_dispatch\\_f\\_or\\_distribution\\_system\\_considering\\_plugin\\_electric\\_vehicle\\_uncertainty](https://www.researchgate.net/publication/259129546_Model_predictive_controlbased_power_dispatch_f_or_distribution_system_considering_plugin_electric_vehicle_uncertainty).

135. *Table 1.3, Primary Energy Consumption by Source*, U.S. ENERGY INFO. ADMIN., <https://perma.cc/KZ9G-BJLW> (last visited Jan. 22, 2017).

Hydroelectricity is similarly problematic. Hydroelectric facilities can have negative effects on forests, wildlife habitats, and agricultural lands.<sup>136</sup> A recent example of this occurred in China where an entire community was forced to relocate due to hydroelectric reservoirs.<sup>137</sup> Hydroelectric facilities are also very costly. Large-scale dams have a tendency to encounter schedule delays and significant cost overruns.<sup>138</sup> The average cost overrun of these dams is fifty-six percent.<sup>139</sup> Thus, if a dam is predicted to cost \$2 billion, it may actually cost up to \$3.12 billion. The same is true for nuclear energy: according to the Congressional Budget Office, the failure rate for these nuclear projects is over fifty percent.<sup>140</sup>

The increase of heat waves associated with global warming can force the shutdown of power output reduction reactors.<sup>141</sup> In 2006, reactors across the U.S., along with parts of Europe, were all impacted due to an increase in heat waves.<sup>142</sup> In 2003, French engineers informed the government that they could no longer guarantee the safety of the country's fifty-eight nuclear power reactors, due to cooling problems associated with the nuclear facilities.<sup>143</sup> Because of the problems affecting the current viability of alternative energy sources, CCS facilities play a key role in the fight against global warming.

### *B. Petra Nova Project*

There is currently one successful CCS project in the U.S. The Petra Nova Carbon Capture System in Houston, Texas is the world's largest

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136. *Environmental Impacts of Hydroelectric Power*, UNION OF CONCERNED SCIENTISTS, <https://perma.cc/N8XU-76NA> (last visited Jan. 22, 2017).

137. *Id.*

138. *Dams and Development A New Work for Decision-Making*, WORLD COMM'N ON DAMS (Nov. 2000), <https://perma.cc/F8NJ-W652>.

139. *Id.*

140. *Congressional Budget Office Cost Estimate*, U.S. CONGRESS (May 7, 2003), <https://perma.cc/T4HG-GM4D>.

141. *Dirty, Dangerous and Expensive: The Truth About Nuclear Power*, PHYSICIANS FOR SOC. RESPONSIBILITY, <https://perma.cc/U5WS-FZ33> (last updated Oct. 8, 2013).

142. *Id.*

143. *Nuclear Power: No Solution to Climate Change*, NUCLEAR INFO. & RES. SERV. (Feb. 2005), <https://perma.cc/72PT-TQ8P>.

CCS facility.<sup>144</sup> The facility opened in 2017 and takes some of the CO<sub>2</sub> emitted by a neighboring coal power plant, and uses the energy generated from the captured gas to recover oil under the ground.<sup>145</sup> The plant captures roughly ninety-percent of the CO<sub>2</sub> from an existing power plant.<sup>146</sup> This level of productivity has its price. The Petra Nova project costs an estimated \$1 billion.<sup>147</sup> Startup costs aside, Petra Nova is unique compared to previous failed plants as it supplements these costs through profits obtained through neighboring oil.<sup>148</sup> There are an estimated sixty million barrels of oil on site, all of which are recoverable through enhanced oil recovery.<sup>149</sup> These profits are used to help cover the cost of the CCS facility.<sup>150</sup> In addition to the oil-based profit, the plant has also gathered both national and international support. The project has received \$300 million from Japan's largest oil producer, JX Nippon Oil & Gas Exploration Corp.<sup>151</sup> The project also received \$300 million from NRG Energy (NRG).<sup>152</sup> NRG received \$167 million from the U.S. Department of Energy's Clean Coal Power Initiative, along with another \$23 million from the DOE under Section 313 of the Consolidated Appropriations Act of 2016 for the carbon capture system.<sup>153</sup> The Japan Bank for International Cooperation and Mizhu Bank have also chipped in, extending loans up to \$250 million.<sup>154</sup>

While Petra Nova is on the right trajectory, there are still concerns for CCS facilities in the U.S. going forward. Currently, NRG is unlikely to

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144. Kenneth Dubin, *Petra Nova is One of Two Carbon Capture and Sequestration Power Plants in the World*, ENERGY INFO. ADMIN. (Oct. 31, 2017), <https://www.eia.gov/todayinenergy/detail.php?id=33552>.

145. *Id.*

146. *Id.*

147. James Osborne, *U.S., Saudis to Team Up on Carbon Capture Effort*, HOUS. CHRONICLE (Dec. 8, 2017), <https://www.houstonchronicle.com/business/article/U-S-Saudis-to-team-up-on-carbon-capture-effort-12417179.php>.

148. Penn Energy Editorial Staff, *Petra Nova Carbon Capture-Enhanced Oil Recovery Project Underway*, PENN ENERGY (Sept. 8, 2014), <http://www.powerengineeringint.com/articles/2016/10/double-boost-for-carbon-capture-and-storage.html>.

149. Diarmaid Williams, *Double Boost for Carbon Capture and Storage*, POWER ENG'G NAT'L (Oct. 6, 2016), <https://perma.cc/3LUZ-EE7D>.

150. *Id.*

151. *Id.*

152. Umair Irfan, *World's Largest Carbon-Capture Plant to Open Soon*, SCIENTIFIC AMERICAN (Oct. 4, 2016), <https://perma.cc/D8W2-ASCJ>.

153. *Id.*

154. *Id.*

build another CCS facility due to the significant cost of these projects.<sup>155</sup> Furthermore, there are concerns with the sustainability of similar facilities. Since Petra Nova is being partially paid off by enhanced oil recovery,<sup>156</sup> the facility will run into some of the same problems facing the oil industry.<sup>157</sup> Whenever the price of oil is low, the facility will lose funds—subject to the market's demand. There is reason, however, to remain optimistic: the private sector is becoming interested in these facilities.

### C. Other Possible CCS Contributors

In addition to the Petra Nova Project, other private businesses may enter the CCS market sooner than later.<sup>158</sup> Chevron is currently leading a CCS project off the coast of Western Australia.<sup>159</sup> Shell also has several pilot projects, including the world's largest CCS facility in Alberta, Canada.<sup>160</sup> Chevron and Shell can become significant contributors to the future of CCS in the U.S. due to their success with these facilities.

The CCS movement is also spreading to Louisiana. Recently, the DOE awarded a \$1.3 million federal grant to research the viability of a potential CCS project located between Baton Rouge and New Orleans.<sup>161</sup> The goal of the grant is to have an operating CCS facility by the year 2025.<sup>162</sup> The DOE has also offered a \$2 billion loan for a CCS facility in Lake Charles.<sup>163</sup> Rather than storing the carbon, the facility will pipe the CO<sub>2</sub> to oil fields in Texas, where the carbon will help accelerate oil production.<sup>164</sup> The facility is expected to create approximately 1,000 construction jobs

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155. Osborne, *supra* note 147.

156. Enhanced oil recovery refers to the process whereby a drilling party recovers unproduced oil that cannot be obtained through conventional drilling due to the physics of fluid flow. *Enhanced Oil Recovery*, NAT'L ENERGY TECH. LAB., <https://perma.cc/VBS9-9BE7> (last visited Dec. 29, 2017).

157. Irfan, *supra* note 152.

158. Mike Hower, *7 Companies to Watch in Carbon Capture and Storage*, GREEN BIZ (July 14, 2016, 1:45 AM), <https://perma.cc/N8F5-QWA5>.

159. *Id.*

160. *Id.*

161. Advocate Staff, *1.3 Million Federal Grant Awarded to Evaluate Facility to Capture Carbon Emissions in the Baton Rouge-New Orleans Industrial Corridor*, THE ADVOCATE, Nov. 18, 2016, [http://www.theadvocate.com/baton\\_rouge/news/business/article\\_6d8f847e-adc4-11e6-b8a1-7f3d81171dab.html?source=lift\\_amplify](http://www.theadvocate.com/baton_rouge/news/business/article_6d8f847e-adc4-11e6-b8a1-7f3d81171dab.html?source=lift_amplify).

162. *Id.*

163. *Id.*

164. *Id.*

and 500 permanent jobs.<sup>165</sup> These Louisiana projects are not alone. There are two other ongoing CCS projects in the U.S.: one in Mississippi and one in Illinois.<sup>166</sup> Facilities like these are essential because they can establish the precedent for successful CCS projects in the U.S.

## V. PROPOSALS GOING FORWARD

The current relationship with the federal government and CCS facilities is an interesting one. The Trump administration has voiced skepticism over climate change.<sup>167</sup> As such, it is unlikely that his administration will invest billions of dollars in these environmental projects.<sup>168</sup> At the same time, President Trump has spoken highly of “clean coal.”<sup>169</sup> Perhaps this is a sign that he would support CCS facilities. The uniqueness of his presidency complicates forecasting how his administration will address climate change. If CCS facilities are to succeed, their financial backing will likely come from elsewhere.

Foreign investors have already played a key role in this movement;<sup>170</sup> going forward, their involvement will be vital. Without the necessary mechanisms put in place to further incentivize foreign investors to fund CCS projects in the U.S., the future of CCS facilities will remain uncertain.

The current international treatise governing climate change is the Kyoto Protocol.<sup>171</sup> Signed in 1997, this agreement set out to create “internationally binding emission reductions targets.”<sup>172</sup> One means of

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165. *Id.*

166. While the Mississippi project is close to being fully operational, it has been plagued with delays and excess costs coming in at four times its original cost. See Jeff Amy, *Kemper Operation Project to Cost 4 Times Original Plan*, THE CLARION-LEDGER (Oct. 9, 2016, 10:04 PM), <https://perma.cc/XB3E-LWC8>. See also Carol J. Clouse, *Donald Trump Supports ‘Clean Coal’ – But Does It Really Have a Future?*, THE GUARDIAN (Dec. 4, 2016, 12:14 PM), <https://perma.cc/4ZC4-NB9C>.

167. Lindsay Dodgson, *The Biggest Threat to Earth has been Dismissed by Trump as a Chinese Hoax*, BUS. INSIDER (Nov. 11, 2016, 8:03 AM), <https://perma.cc/VCS3-VZCA>.

168. *Id.*

169. Clouse, *supra* note 166.

170. See Bastasch, *supra* note 45; see also Williams, *supra* note 149.

171. *FAQS About How the Paris Agreement Enters into Force*, WORLD RES. INSTITUTES, <https://perma.cc/YX9T-WKLQ> (last visited Jan. 23, 2017) [hereinafter *FAQS*].

172. *Kyoto Protocol*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, <https://perma.cc/2G8N-ALKS> (last visited Jan. 23, 2017).

compliance is through joint implementation. Through this mechanism, countries are allowed to offset their CO<sub>2</sub> emissions by investing in emission reduction projects in other countries.<sup>173</sup> Investing countries benefit under this mechanism as they are able to reduce their emission requirement in an affordable way.<sup>174</sup> The country hosting the project also benefits by receiving funds and technological development.<sup>175</sup> Although the Kyoto Protocol ends in 2020, the Paris Agreement will replace it.<sup>176</sup>

In 2017, the Trump administration shocked the environmentalist world by withdrawing from the Paris Agreement.<sup>177</sup> Despite this withdrawal, President Trump has recently stated that the U.S. could reenter the agreement.<sup>178</sup> This decision to reenter the Paris Agreement would fundamentally change the landscape of CCS facilities due to the possibility of a joint implementation program.

While not expressly detailed, it is likely that aspects of the joint implementation program will be adopted in the Paris Agreement.<sup>179</sup> Currently, the Paris Agreement is still under the signing process and has yet to be fully ratified.<sup>180</sup> Similar to the Paris Agreement, the joint implementation program was not originally listed under the Kyoto Protocol.<sup>181</sup> Instead, it was later ratified to fit within the agreement.<sup>182</sup> If implemented into the Paris Agreement, this mechanism will be vital as it can be used to further incentivize foreign investors to invest in CCS projects abroad.

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173. Lawrence H. Goulder & Brian M. Nadreau, *International Approaches to Reducing Greenhouse Gas Emissions*, STAN. UNIVERSITY 20 (Jan. 15, 2001), <https://perma.cc/RKG9-H9K2>.

174. *Id.*

175. *Id.*

176. *FAQS*, *supra* note 171.

177. Michael Shaer, *Trump Will Withdraw U.S. from Paris Climate Agreement*, N. Y. TIMES, June 1, 2017, <https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html>.

178. Mythili Sampathkumar, *Donald Trump says US Could 'Go Back' into Paris Climate Agreement*, INDEPENDENT (Jan. 10, 2018), <http://www.independent.co.uk/news/world/americas/us-politics/trump-paris-climate-deal-agreement-us-go-back-latest-a8152531.html>.

179. Mike Szabo, *Paris Rings in New Era of International Carbon Trading*, CARBON PULSE (Dec. 12, 2015), <https://perma.cc/2QYY-QQM5>.

180. *FAQS*, *supra* note 171.

181. Anthony Mansell, *What's Ahead from Carbon Markets after COP 21*, INT'L CENTRE FOR TRADE & SUSTAINABLE DEV. (Feb. 19, 2016), <https://perma.cc/TC3D-WRGC>.

182. *Id.*

While the joint implementation plan may be beneficial, it will not bring foreign investors to the U.S. on its own. Many investors are hesitant to enter the CCS market for fears of cost overruns or a failed CCS project. To capitalize with foreign investors, the U.S. needs to create a healthy climate to sponsor these projects. There are several ways for the U.S. to accomplish this goal.

First, the U.S. needs to advertise its available storage space. Many investors are concerned that there is not a sufficient volume of storage space to actually have the desired impact on climate change.<sup>183</sup> Investors are unwilling to participate if long-term storage space is an issue, especially considering the upfront costs of CCS facilities; however, that is simply not the case. As of now, there are thirty-six potential storage spaces in the U.S.<sup>184</sup> The highest concentration of available storage space exists in the Gulf Coast.<sup>185</sup> It has been estimated that up to 3,000 metric gigatons of carbon dioxide could be stored in these geological basins.<sup>186</sup> To put that into perspective, the U.S. emits 5.5 metric gigatons per year.<sup>187</sup> Thus, use of this storage space would provide storage for nearly 545 years of emissions. These levels of emissions provide numerous opportunities for other countries to offset their own emissions in the U.S.

Second, alignment and shared vision across key government bodies will help fight the negative public relations aspects typically affiliated with CCS.<sup>188</sup> Without the requisite public support, foreign investors will be unable to create these projects. Given that many of these projects are created and overseen by elected officials, the relaying of information is key to implementing construction and use of these facilities at the local level. In some instances, voters are the determining factor for whether a CCS project is launched within the community.<sup>189</sup> Rather than focusing on all the potential negative effects of CCS facilities, local communities should embrace the possibilities. Aside from environmental impacts, CCS facilities present unique benefits. One benefit is that these programs

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183. Zoback & Gorelick, *supra* note 96.

184. Jeannie Kever, *Gulf Coast Leads Nation in Potential for CO<sub>2</sub> Storage*, HOUS. CHRONICLE (June. 26, 2013), <https://perma.cc/5V78-VFTE>.

185. *Id.*

186. *Id.*

187. *Id.*

188. *Public Engagement Factors*, GLOBAL CCS INST., <https://perma.cc/Y4LV-H3TA> (last visited Jan. 22, 2017).

189. *Carbon Capture and Storage Legal and Regulatory Review*, INT'L ENERGY AGENCY (May 2012), <https://perma.cc/W5DA-9DRA> [hereinafter *Legal and Regulatory Review*].

present great economic boosts to their local communities.<sup>190</sup> A second benefit is that these facilities are likely to run more smoothly than some predecessors due to the increased availability of CCS information. This has been the case for the most recent CCS facilities, which have operated without major repercussions.<sup>191</sup> Accordingly, community leaders should be proactive with their constituents by relaying the potential benefits of these facilities.

Third, the federal government can also provide some form of tax credits or subsidies to the foreign corporations who utilize CCS facilities. Some of the earliest CCS policies in the U.S. focused on tax credits, permitting perks, or financial assistance for power plants working toward capturing and sequestering CO<sub>2</sub>.<sup>192</sup> Tax credits and subsidies provides another incentive for companies interested in CCS projects to enter the market. At the point that it becomes cheaper for countries to team up and sponsor CCS facilities than to continue their excessive emissions or pursue alternative options, these facilities will finally become more viable in the U.S. Even a skeptical Trump administration has incentive to follow through with this approach as it can lead to job growth and serve as an economic boost for local communities.

Fourth, a new body of law should govern CCS facilities. Ideally, state or federal policy makers will design a CCS regulatory structure to diminish identified risks or to avoid them altogether through risk management.<sup>193</sup> Countries are more prone to develop CCS legal and regulatory schemes once they believe that the technology can contribute significantly to CO<sub>2</sub> reductions.<sup>194</sup> This can be done at the federal level with state implementation.<sup>195</sup> The federal government can set the minimal standards, while allowing states the opportunity to provide stricter ones.<sup>196</sup> A federal regulatory scheme will produce significant benefits. Such a scheme will help lower operating costs for CCS facilities.<sup>197</sup> By creating uniform laws, companies will have less legal fees and costs and will finally be fully aware of the potential legal impacts of their actions state by state. Also, a federal regulatory regime will expand the potential number of states in which CCS facilities can be located because laws regulating these facilities will exist in every state.

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190. *FutureGen 2.0*, *supra* note 59.

191. *See supra* note 105 and accompanying text.

192. Monast, *supra* note 69, at 12.

193. *Id.* at 38.

194. *Legal and Regulatory Review*, *supra* note 189.

195. Monast, *supra* note 69, at 38.

196. *Id.*

197. *Id.* at 27.



Finally, the U.S. should capitalize on its cost-saving mechanisms. Foreign investors will make their decisions based off of their financial interests. If it is significantly more expensive to invest in CCS projects in the U.S., other countries will seek to offset their CO<sub>2</sub> emissions somewhere else. The U.S. can continue to lower the operating costs of these facilities in several ways. First, the U.S. can increase the availability of CCS technology. As exemplified by the Texas Clean Energy Project, the U.S. has already been hesitant to share this information due to the involvement of a foreign country.<sup>198</sup> At the same time, increasing the availability of this technology in Canada lowered the operation costs of their facilities by thirty percent.<sup>199</sup> The U.S. should implement a similar model, as it will create a more attractive environment for foreign investors. These costs can also be lowered through unique forms of funding. As demonstrated by other CCS facilities, this can be done by selling some of the captured CO<sub>2</sub> or by using it to power neighboring plants.<sup>200</sup> If the U.S. is able to utilize these cost-saving mechanisms, other countries will be more incentivized to sponsor CCS projects in the U.S.

#### CONCLUSION

Although the present and future impacts of climate change remain uncertain, continuing to rely on an infrastructure that allows excess CO<sub>2</sub> into the air will come at a price.<sup>201</sup> In addressing the future of climate change in the U.S., one must consider whether the repercussion of not changing the current regulatory system outweighs any potential alternative options. At this moment, CCS facilities may be the answer. The current energy structure of the U.S. relies heavily on coal.<sup>202</sup> Coal is cheaper than other sources of energy, and there are large amounts of it.<sup>203</sup> Thus, there are economic incentives to maintain a system built on coal. The biggest argument against coal is the amount of carbon emissions as a result of coal usage.<sup>204</sup> CCS facilities can help mitigate these effects, while the U.S. continues to invest and develop alternative energy sources.

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198. See Bastasch, *supra* note 45.

199. Milestone, *supra* note 120.

200. See Stacey, *supra* note 117; see also Penn Energy Editorial Staff, *supra* note 148.

201. *The Consequences of Climate Change*, *supra* note 3.

202. *Short-Term Energy Outlook*, *supra* note 9.

203. *How Much Coal is Left*, *supra* note 10.

204. *Id.* See also *Electricity Generation*, *supra* note 11.

Although it may help solve the CO<sub>2</sub> problem, CCS facilities present several risks. These risks include water contamination, earthquakes, CO<sub>2</sub> leakage, issues of long-term liability, and cost concerns.<sup>205</sup> However, considering the recent success of CCS facilities in Canada, it is possible that these concerns are overblown.<sup>206</sup> Despite these concerns, CCS facilities may be the best hope for combatting climate change. As of now, there is a lack of viable alternatives. Energy sources such as solar, hydro, nuclear, and wind power are great in theory, but they are simply unable to withstand the current energy demand of the United States.<sup>207</sup> While there may be merit in pursuit of these sources of energy long-term, they are not fully viable at this time.

If the U.S. decides to move forward with CCS facilities, certain structural changes must take place. Right now, it is unlikely that the federal government will continue to fund these projects.<sup>208</sup> If these projects are to succeed, businesses and foreign investors must have the necessary economic reinforcement to continually support these facilities. Under the Kyoto Protocol and soon-to-be Paris Agreement, numerous countries can use an investor-friendly market in the U.S. to offset their emissions.<sup>209</sup> This path is both sensible and attainable in the present day, providing concrete, forward steps to address a complex obstacle. Ultimately, when ideological rhetoric is stripped away and the focus of the U.S. shifts to progress, the solution may be at our fingertips.

*Chaz Coleman\**

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205. *See supra* Part II.C.

206. *Supra* note 105 and accompanying text.

207. Follet, *supra* note 128.

208. Dodgson, *supra* note 167.

209. Goulder & Nadreau, *supra* note 173; *see also* Szabo, *supra* note 179.

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