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It's a Soft Shell Life for ME: The Case for Expanding NPDES Permitting to Include Causes of Ocean Acidification

Natalie L. Nowatzke
University of Maine School of Law

IT'S A SOFT SHELL LIFE FOR ME: THE CASE FOR EXPANDING NPDES PERMITTING TO INCLUDE CAUSES OF OCEAN ACIDIFICATION

Natalie Nowatzke[*]

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* J.D. 2024, University of Maine School of Law; B.A. and B.S. 2021, Winona State University. The author would like to thank the editorial staff of the Ocean and Coastal Law Journal for their thoughtful edits and suggestions. She would also like to thank her family and friends, as this Comment would not be possible without their support.

ABSTRACT

Ocean acidification, a lesser-known counterpart to climate change, is primarily caused by the ocean's absorption of carbon dioxide from the atmosphere. This absorption, in turn, reduces the ocean's pH, and has detrimental effects on the health of the entire ecosystem. This Comment examines the applicability of the "functional equivalent test," coined by the Supreme Court in County of Maui v. Hawaii Wildlife Fund, to the causes of ocean acidification. Using this test, this Comment proposes expanding NPDES permitting under the Clean Water Act to cover some land-based sources emitting carbon dioxide.

INTRODUCTION

The Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) states "[i]t is unequivocal that human influence has warmed the atmosphere, ocean, and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred."[1] The ocean is deeply involved and intertwined in the Earth's climate system, as the ocean actively stores carbon dioxide, heat, and water, while also exchanging these and other substances with the atmosphere.[2] One implication of this interconnectedness is ocean acidification, which results from the ocean absorbing carbon dioxide from the atmosphere.[3] This absorption then leads to a reduction of the ocean's pH, i.e., acidification.[4] Ocean acidification is already having widespread effects on the entire ocean, including significant impacts on organisms with hard outer shells.[5] Ocean acidification also affects coastal estuaries and waterways, and food sources for billions of people.[6]

This Comment addresses the ability to mitigate ocean acidification using federal environmental statutes, specifically the Clean Water Act. Part I provides essential background information on ocean acidification and utilizes the Gulf of Maine as a case study regarding the impacts of ocean acidification. Part II discusses the difficulties with regulating carbon dioxide under the Clean Air Act. Part III then turns to a novel use of the Clean Water Act to limit carbon dioxide emissions based on the functional equivalent test from the Supreme Court in *County of Maui v. Hawaii Wildlife Fund*. Finally, Part IV explores non-litigation based approaches to combatting ocean acidification. This is essential as ocean acidification, and climate change generally, requires multi-faceted approaches to enact meaningful change.

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1. V. MASSON-DELMOTTE ET AL., IPCC, 2021: SUMMARY FOR POLICYMAKERS 4 (2021), https://www.ipcc.ch/report/ar6/wg1/chapter/summary-for-policymakers/ [https://perma.cc/RQE9-83TF].

2. Michael S. McCartney, *The Ocean's Role in Climate & Climate Change*, OCEANUS (Dec. 1, 1996), https://www.whoi.edu/oceanus/feature/oceans-climate/ [https://perma.cc/WNZ5-F6D7].

3. *See generally Ocean Acidification*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification (last visited Oct. 15, 2023) [https://perma.cc/J9S2-T22E].

4. *Id.*

5. *Id.*

6. *Id.*

I. BACKGROUND

A. Ocean Acidification Generally

Understanding ocean acidification is essential to comprehending the complexities that come with attempts to prevent, mitigate, and regulate ocean acidification and its effects. Further, ocean acidification is the lesser-known counterpart to climate change and is also known as its "evil twin."[7] Increasing general knowledge on ocean acidification is incredibly important, as its consequences have already begun and will continue to progress without serious action on a large scale.[8]

1. Chemistry of Ocean Acidification

The ocean absorbs approximately 31% of the carbon dioxide that is released into the atmosphere through the ocean's surface interactions with the atmosphere.[9] Following this absorption, "a series of chemical reactions occur resulting in the increased concentration of hydrogen ions," demonstrated as follows:[10]

$$\textbf{\textit{Step}}\ \mathbf{1}: CO_{2(aq)} + H_2O \leftrightarrow H_2CO_3$$
$$\textbf{\textit{Step}}\ \mathbf{2}: H_2CO_3 \leftrightarrow HCO_3^- + H^+$$
$$\textbf{\textit{Step}}\ \mathbf{3}: HCO_3^- \leftrightarrow CO_3^{2-} + H^+$$

Step 1 shows water (H_2O) and carbon dioxide (CO_2) forming carbonic acid (H_2CO_3), a weak acid.[11] Next, in step 2, the carbonic acid dissociates into hydrogen ions (H^+) and bicarbonate ions (HCO_3^-).[12] In step 3, the bicarbonate ions continue to dissociate, producing more hydrogen ions and

7. ARC Ctr. Of Excellence in Coral Reef Studies, *Ocean Acidification: 'Evil Twin' Threatens World's Oceans, Scientists Warn*, SCIENCE DAILY (Apr. 1, 2010), https://www.sciencedaily.com/releases/2010/03/100330092821.htm [https://perma.cc/MK3S-NTAD].

8. *See generally Ocean Acidification*, *supra* note 3.

9. Nicholas Gruber et al., *The Oceanic Sink for Anthropogenic CO_2 from 1994 to 2007*, 363 SCIENCE 1193, 1193 (2019).

10. *Ocean Acidification*, *supra* note 3.

11. *Id.*

12. *Id.*

carbonate ions (CO_3^{2-}).[13] The production of hydrogen ions lowers the pH of the ocean, as "pH is the negative logarithm of the proton concentration or activity, $-\log_{10}[H^+]$."[14] This process is most easily presented as distinct steps, but the actual process represents an equilibrium of the different species of carbon dioxide.[15] Thus, "the carbon dioxide system in seawater" represents an acid-base equilibria that is particularly complex due to it being a system of multiple equilibria.[16] Alkalinity, "the excess of bases (proton acceptors) over acids (proton donors) in a solution," also has significant implications on seawater "in buffering and in calcium carbonate precipitation and dissolution."[17] Buffering, or the ocean's buffer capacity, is the "system against increasing acidity."[18] This system is extremely complicated and not necessary to fully understand for the purpose of this Comment. However, it is essential to understand that there is a direct relationship between anthropogenic carbon releases and the acidification of the ocean.

Due to this process, the pH of the ocean has lowered from 8.2 to 8.1 in the period following the Industrial Revolution.[19] The ocean pH is expected to fall an additional 0.3 to 0.4 pH units by the end of the 21st century.[20] This process amplifies itself, as the "acidification has consequences for further ocean carbon dioxide uptake."[21] These tenths of pH units are exponentially more significant than they seem, as pH is measured on a logarithmic scale.[22]

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13. Stephen Barker & Andy Ridgwell, *Ocean Acidification,* NATURE EDUC. KNOWLEDGE (2012), https://www.nature.com/scitable/knowledge/library/ocean-acidification-25822734/ [https://perma.cc/7XYU-M9CX].

14. *Id.*

15. Jack J. Middelburg et. al., *Ocean Alkalinity, Buffering and Biogeochemical Processes*, 58 REV. GEOPHYSICS 1, 1 (2020).

16. *Id.* at 2.

17. *Id.*

18. *Surface Ocean pH and Buffer Capacity*, NOAA PMEL CARBON PROGRAM (Dec. 19, 2019), https://www.pmel.noaa.gov/co2/story/Surface+ocean+pH+and+buffer+capacity [https:/ perma.cc/J6KF-HKVJ].

19. *Ocean Acidification*, SMITHSONIAN, https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification#section_77 (last visited Oct. 15, 2023) [https://perma.cc/V6VC-NJMY].

20. *Id.*

21. Jack J. Middelburg et al., *supra* note 15, at 1.

22. *Ocean Acidification*, *supra* note 19. "A logarithmic scale is a nonlinear scale often used when analyzing a large range of quantities. Instead of increasing in equal increments, each interval is increased by a factor of the base of the logarithm." *Logarithmic Scale*, ENERGY EDUC., https://energyeducation.ca/encyclopedia/Logarithmic_scale (last visited Oct. 15, 2023) [https://perma.cc/56GT-WANP]. This concept is highlighted by the

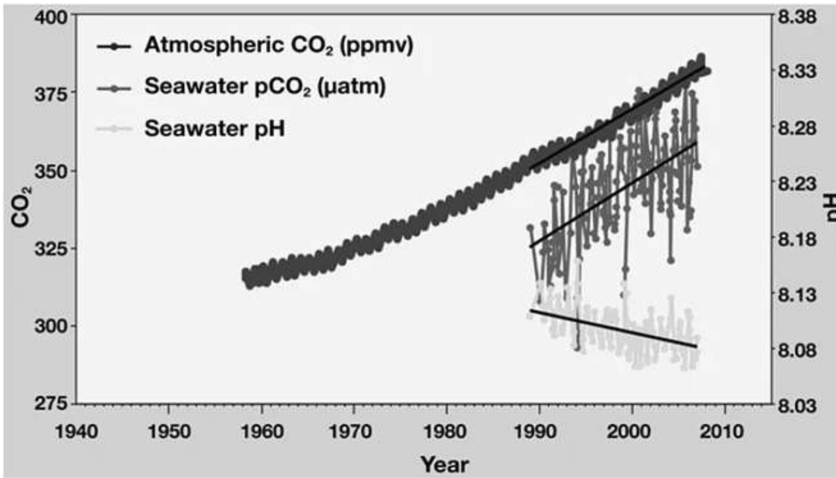

Figure 1: Atmosphere Carbon Dioxide, Seawater Carbon Dioxide, and Seawater pH Over Time Off the Coast of Hawaii[23]

As seen in Figure 1, atmospheric carbon dioxide and seawater carbon dioxide are positively correlated, meaning that as carbon dioxide in the atmosphere increases, so does the seawater carbon dioxide content.[24] Further, seawater pH is negatively correlated with both atmospheric carbon dioxide and seawater carbon dioxide, meaning as the atmospheric and seawater carbon dioxide concentrations increase, the pH of the seawater decreases.[25] These correlations, supported by the chemical reactions in the steps highlighted above, directly support the reality of ocean acidification. As the concentration of atmospheric carbon dioxide increases, the ocean continues to absorb the carbon dioxide and acidifies.

2. Biological Effects of Ocean Acidification

Rather than relying purely on pH measurements, the "[a]ragonite saturation state is commonly used to track ocean acidification because it is a measure of carbonate ion concentration."[26] As discussed, carbonate ions are the product of bicarbonate ions continuing to dissociate, producing more hydrogen ions.[27] A decrease in carbonate ion

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following example: "pH 4 is ten times more acidic than pH 5 and 100 times (10 times 10) more acidic than pH 6." *Ocean Acidification*, *supra* note 19.

23. *Id.*
24. *Id.*
25. *Id.*
26. *Id.*
27. Barker & Ridgewell, *supra* note 13.

concentration makes it difficult for species to form calcium carbonate outer shells, especially for the young.[28] This is especially problematic for organisms that rely on carbonate ions to create shells and skeletons.[29] These organisms include shellfish, such as lobsters, oysters, clams, mussels, and corals.[30]

Specifically, when the "aragonite saturation state falls below 3, these organisms [which utilize carbonate ions] become stressed, and when saturation state is less than 1, shells and other aragonite structures begin to dissolve."[31] For example, when shells of pteropods, a type of small sea snail, were tested in sea water with the projected pH and carbonate levels of 2100, the shells began to dissolve after only 45 days.[32] Further, dissolution at severe levels in pteropod shells have already been discovered in the Southern Ocean.[33] This is problematic, as it "affects animal growth, survival and behavior" and thus has implications on the industries these animals support.[34]

B. Case Study: The Gulf of Maine

Ocean acidification is a global phenomenon; however, this Comment will use the Gulf of Maine as a case study due to its increased susceptibility to ocean acidification and the elevated impacts due to the industries supported by the Gulf of Maine.[35]

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28. *Ocean Acidification: Saturation State*, SCI. ON SPHERE (Nov. 12, 2015), https://sos.noaa.gov/catalog/datasets/ocean-acidification-saturation-state/ [https://perma.cc/2HV2-ATQ3].

29. *Id.*

30. *Ocean Acidification*, INTEGRATED OCEAN OBSERVING SYSTEM, https://ioos.noaa.gov/project/ocean-acidification/ (last visited Oct. 15, 2023) [https://perma.cc/BND3-2ZAA].

31. *Ocean Acidification: Saturation State*, *supra* note 28.

32. *Ocean Acidification*, *supra* note 3.

33. *Id.* This research was published in 2012 and compared "the shell structure [of pteropod shells] with samples from aragonite-supersaturated regions elsewhere under a scanning electron microscope." N. Bednaršek et. al., *Extensive Dissolution of Live Pteropods in the Southern Ocean*, 5 NATURE GEOSCIENCES 1, 1 (2012). The researchers "found severe levels of shell dissolution in the undersaturated region alone." *Id.* The study further concluded that "deep-water upwelling and CO_2 absorption by surface waters is likely to increase as a result of human activities," and thus, "upper ocean regions where aragonite-shelled organisms are affected by dissolution are likely to expand." *Id.*

34. *Ocean Acidification: Saturation State*, *supra* note 28.

35. *See* SA Siedlecki et al., *Projecting Ocean Acidification Impacts for the Gulf of Maine to 2050: New Tools and Expectations, 9 Elementa: Science* of the Anthropocene1, 1-2 (2021).

1. The Gulf of Maine Generally, and the Fishing Industry

The Gulf of Maine is a semi-enclosed sea that borders Maine, New Hampshire, Massachusetts, Nova Scotia, and New Brunswick.[36] The Gulf of Maine is depicted below in Figure 2 to provide visual clarification of the area.

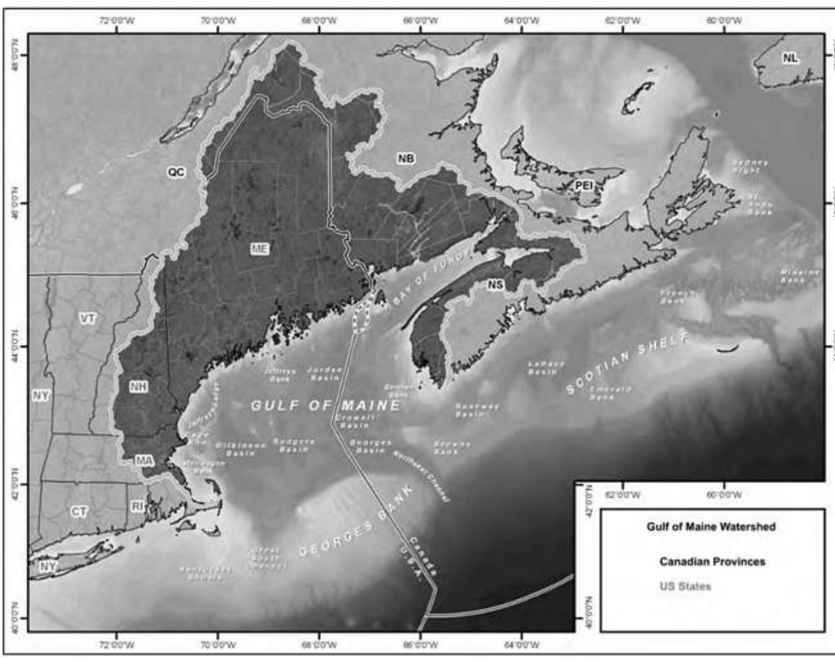

Figure 2: The Gulf of Maine and relevant watershed.[37]

The Gulf of Maine is "among[st] the most diverse, productive and complex marine temperate areas in the world."[38] The region has "unique topography and oceanographic conditions," which "combine to promote highly productive phytoplankton and zooplankton populations that support high fish populations."[39] This high fish population in turn supports

36. COLLEEN THOMPSON, THE GULF OF MAINE IN CONTEXT 3 (Jay Walmsley et al. eds., 2010).
37. *Id.*
38. *Id.* at 4.
39. *Id.*

populations of piscivorous predators[40] and pelagic species,[41] such as whales, porpoises, and seals.[42] The Gulf of Maine further supports significant benthic communities,[43] which "are largely composed of macroinvertebrates, such as annelids, mollusks, and crustaceans."[44]

The abundance of species in the Gulf of Maine has led it to support significant industry in the area.[45] Fishing has grown to play a fundamental role, both culturally and economically, in the Gulf of Maine region.[46] So much so that fishing, and the species targeted by fishing, have become deeply tied to the current identity and economy of coastal communities in the area.[47] In 2017, Gulf of Maine fisheries totaled over $1.2 billion in products, "with 74% of the total landings composed of crustaceans and bivalves."[48] As discussed, these are the same species that are most susceptible to ocean acidification.

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40. Piscivorous predators are "carnivorous animal[s] that eat[] primarily fish." *Piscivores Animals*, ANIMALIA, https://animalia.bio/piscivores (last visited Oct. 15, 2023) [https://perma.cc/DXQ2-KFZC].

41. Pelagic species "inhabit the water column (not near the bottom or the shore) of coasts, open oceans, and lakes." *What Are Pelagic Fish?*, NOAA, https://oceanservice.noaa.gov/facts/pelagic.html (last visited Oct. 15, 2023) [https://perma.cc/L2XP-EA8V]. "Oceanic pelagic fish typically inhabit waters below the continental shelf. Examples include larger fish such as swordfish, tuna, mackerel, and even sharks." *Id.*

42. THOMPSON, *supra* note 36, at 4.

43. *Id.* at 15.

44. U.S. EPA, REPORT ON THE ENVIRONMENT: COASTAL BENTHIC COMMUNITIES 1 (2012). Annelids "include earthworms, polychaete worms, and leeches. All members of the group are to some extent segmented, in other words, made up of segments that are formed by subdivisions that partially transect the body cavity." Phil Myers, *Annelida*, ANIMAL DIVERSITY WEB, https://animaldiversity.org/accounts/Annelida (last visited Oct. 15, 2023) [https://perma.cc/S4JD-B9XA]. Mollusks, or Mollusca, "have a body plan that includes a calcium carbonate shell set in a protein matrix (although some mollusks have secondarily lost their shells), mantle tissue that secretes the shell and performs a variety of other functions," C.C. Vaughn, *Mollusca*, SCIENCEDIRECT, https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/mollusca (last visited Oct. 15, 2023). Crustaceans include "crabs, lobsters, crayfish, shrimp, krill, barnacles, brine shrimp, copepods, ostracods and mantis shrimp." *Crustaceans*, MARINE EDUC. SOC'Y OF AUSTL, http://www.mesa.edu.au/crustaceans/ (last visited Oct. 15, 2023) [https://perma.cc/BHP6-KCQE]. They are defined by their "hard exoskeleton (carapace), a segmented body that is bilaterally symmetrical, more than four pairs of jointed appendages ("legs") and an open circulatory system . . . ." *Id.*

45. THOMPSON, *supra* note 36, at 23.

46. *Fisheries and Aquaculture Heritage*, GULF OF MAINE ASSOCIATION, https://www.gulfofmaine.org/public/state-of-the-gulf-of-maine/fisheries-aquaculture/ (last visited Oct. 15, 2023) [https://perma.cc/39YC-MNWA].

47. *Id.*

48. SA Siedlecki et al., *supra* note 35, at 6.

2. Susceptibility to Ocean Acidification

Ocean acidification is not distributed equally throughout the waters of all oceans and "[c]ertain coastal systems are naturally more susceptible to the effects" of ocean acidification.[49] In particular, the Northeastern United States region has been identified as an area of high risk due to "on average, lower pH and aragonite saturation state."[50] The Gulf of Maine has been identified as an area of particular concern, "as its shelf water displays the lowest mean in-situ pH, aragonite saturation state, and buffering capacity along the East Coast in summer."[51] These "conditions are consistent with the [Gulf of Maine's] relatively low temperature and thus high CO_2 solubility, inputs of fresher and low alkalinity water traceable to the rivers discharging into the Labrador Sea in the north, local inputs of low pH river water, and semi enclosed nature."[52] These conditions consequently allow for the opportunity for the accumulation of CO_2.[53] The accumulation of CO_2, as highlighted in the chemical reactions displayed as steps above, leads to the process of ocean acidification.[54]

Unfortunately, the Gulf of Maine's susceptibility to ocean acidification is not just theoretical.[55] The pH of the world's ocean has already decreased by 0.1 logarithmic units since the beginning of the 19th century, and further pH reductions are predicted.[56] Relevant to the Gulf of Maine specifically, research published in 2021 projected ocean acidification impacts for the Gulf of Maine to 2050.[57] In order to identify the impacts of ocean acidification, the researchers first "identified a critical threshold" of "the aragonite saturation state."[58] This critical threshold was identified to be 1.5 "[t]hrough a review of the sensitivity of the regional marine ecosystem inhabitants."[59] The identification of this critical threshold is important because a critical threshold value indicates where

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49. Zhaouhui Aleck Wang et al., *Seasonal Controls of Aragonite Saturation States in the Gulf of Maine*, 122 J. OF GEOPHYSICAL RSCH.: OCEANS 372, 372 (2017).
50. *Id.*
51. *Id.*
52. *Id.* at 372-73.
53. *Id.* at 373.
54. Barker & Ridgwell, *supra* note 13.
55. *See generally* SA Siedlecki et al., *supra* note 35, at 2.
56. *Id.* at 1-2.
57. *Id.* at 1.
58. *Id.*
59. *Id.*

"small changes in spatial pattern produce abrupt shifts in ecological responses."[60]

This study ultimately projects that the aragonite saturation will decline everywhere in the Gulf of Maine by 2050.[61] The most pronounced impacts are predicted in coastal areas, in subsurface waters, and in areas associated with freshening.[62] The projections were made using a "combination of regional high-resolution simulations that includes coastal processes."[63] These projections further considered various representative concentration pathways (RCPs); specifically, RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5 were inputted into the models.[64] RCPs create "a set of greenhouse gas concentration and emissions pathways,"[65] with the numerical value attached to RCP representing "the concentration of carbon that delivers global warming at an average" of that numerical value, expresses as "watts per square meter across the planet."[66] Each RCP is additionally associated with temperature increase in 2100 relative to average global temperatures before the Industrial Revolution.[67] For example, RCP 8.5 is associated with a temperature increase of approximately 4.3 ºC, whereas RCP 2.6 is associated with an increase of 1.8 ºC.[68] Importantly, RCP 8.5 represents a baseline scenario, without targeted climate action or mitigation.[69] When RCP 8.5 is inputted as the projected climate scenario, the aragonite saturation is predicted below the critical threshold of 1.5 for most of the year by 2050 throughout the entire Gulf of Maine.[70]

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60. Kimberly A. With & Thomas O. Crist, *Critical Thresholds in Species' Responses to Landscape Structure*, 76 ECOLOGY 2446, 2446 (1995).

61. SA Siedlecki et al., *supra* note 35, at 1.

62. *Id.* In the global ocean, freshening occurs "due to both floating sea ice melting (comprising Arctic Sea ice and Antarctic ice shelves) and the continental freshwater input." William Llovel et al., *Global Ocean Freshening, Ocean Mass Increase and Global Mean Sea Level Rise Over 2005—2015*, 9 SCI. REPS. (2019). Put simply, "[o]cean freshening . . . is the decrease in the ocean's salinity due to the influx of freshwater." DIANE MURPH ET AL., THE EFFECTS OF OCEAN FRESHENING ON MARINE AND ATMOSPHERIC CIRCULATION: IMPACTS AND SOLUTIONS 1 (2014).

63. SA Siedlecki et al., *supra* note 35, at 1.

64. *Id.* at 8.

65. Keywan Riahi et al., *RCP 8.5—A Scenario of Comparatively High Greenhouse Gas Emissions*, 109 CLIMATIC CHANGE 33, 33 (2011).

66. *RCP 8.5: Business-As-Usual or a Worst-Case Scenario?*, CLIMATENEXUS, https://climatenexus.org/climate-change-news/rcp-8-5-business-as-usual-or-a-worst-case-scenario/ (last visited Oct. 15, 2023) [https://perma.cc/U7CS-JEYN].

67. *Id.*

68. *Id.*

69. Keywan Riahi et al., *supra* note 65, at 33-34.

70. SA Siedlecki et al., *supra* note 35, at 1.

This modeling is extremely significant for the Gulf of Maine and surrounding communities. Outside of threats to biodiversity, ocean acidification is projected to result in global economic losses up to $100 billion annually, based on RCP 8.5.[71] New England is highly dependent on shellfisheries, and "studies show that the combination of global and local drivers of acidification of the waters off New England makes its shellfisheries, both the predominantly offshore wild harvest fisheries and predominantly nearshore aquaculture production, potentially the most vulnerable to [ocean acidification] in the United States."[72] For example, a study focused on the scallop industry in Massachusetts predicted that ocean acidification would threaten jobs at the magnitude of tens of thousands and result in economic losses in the range of hundreds of millions of dollars.[73]

Based on this case study on the Gulf of Maine, it remains clear the future of the Gulf of Maine, and other oceanic areas, depends largely on the actions taken to prevent further ocean acidification. Failure to mitigate future emissions of carbon dioxide will result in dramatic and highly detrimental effects to the water quality, biodiversity, and important industries. These impacts will certainly require less work to mitigate, as opposed to attempting to reverse or adapt to these detrimental impacts.[74] According to the Union of Concerned Scientists, "[t]he most effective way to limit ocean acidification is to act on climate change."[75] Further, the Fourth National Climate Assessment projected that taking significant action now related to ocean acidification will allow for the avoidance of abrupt decline in fish catch potential.[76]

II. APPLICABILITY OF THE CLEAN AIR ACT

Ocean acidification is a significant issue and one that requires actions to mitigate its effects. Failure to mitigate these effects will certainly result in detrimental effects inside and outside of the ocean.[77] Ocean acidification is caused by excess carbon dioxide in the atmosphere due to human

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71. *Id.* at 3.
72. *Id.* at 4.
73. *Id.* at 5.
74. *See CO2 and Ocean Acidification: Causes, Impacts, Solutions*, UNION OF CONCERNED SCIENTISTS (Feb. 6, 2019), https://www.ucsusa.org/resources/co2-and-ocean-acidification [https://perma.cc/K4SK-UYTM].
75. *Id.*
76. U.S. GLOBAL CHANGE RESEARCH PROGRAM, IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES: FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II 361 (2018).
77. *See supra* Part I.

activity, so it follows that limiting carbon dioxide emissions under the Clean Air Act could work as an avenue to limit ocean acidification. However, the Environmental Protection Agency (EPA) unfortunately has a long and largely unsuccessful history of attempting to regulate greenhouse gas emissions.[78]

In *Massachusetts v. EPA*, the Supreme Court of the United States recognized that greenhouse gases are air pollutants under the Clean Air Act.[79] However, carbon dioxide is not listed as a criteria air pollutant, which leaves it out of regulation under the National Ambient Air Quality Standards (NAAQS).[80] This is problematic because the NAAQS is "an overarching, comprehensive program for the reduction of" criteria air pollutants and "allows states to use their broad regulatory powers over sectors not subject to federal legislation to optimally attain the NAAQS through State Implementation Plans (SIPs)."[81]

In May 2010, the EPA issued the Greenhouse Gas (GHG) Tailoring Rule, which "established a common sense approach to permitting GHG emissions under [Prevention of Significant Deterioration (PSD)] and Title V" of the Clean Air Act.[82] The GHG Tailoring Rule set carbon dioxide equivalent emission thresholds, which were different than the limitations set in the Clean Air Act.[83] The EPA, acutely aware that greenhouse gases are emitted on a much larger scale than other pollutants, desired to change the threshold permitting requirements.[84] Thus, the GHG Tailoring Rule was created, further reasoning that applying the threshold requirements in the Clean Air Act would have rendered the permitting scheme unworkable.[85] Concurrently, the EPA issued the Triggering Rule and the Tailpipe Rule.[86] The Tailpipe Rule set greenhouse gas emissions standards, which would take effect on January 2, 2011, for passenger cars,

78. *See generally* Howard M. Crystal et al., *Returning to Clean Air Act Fundamentals: A Renewed Call to Regulate Greenhouse Gases Under the National Ambient Air Quality Standards (NAAQS) Program*, 31 GEO. ENVTL. L. REV. 233 (2019).

79. Massachusetts v. EPA, 549 U.S. 497, 528 (2007).

80. *See generally* Howard M. Crystal et al., *supra* note 78.

81. *Id.* at 235.

82. *Clean Air Act Permitting for Greenhouse Gases*, EPA, https://www.epa.gov/nsr/clean-air-act-permitting-greenhouse-gases (last visited Oct. 15, 2023) [https://perma.cc/8AVE-G7XY].

83. *Id.*

84. Howard M. Crystal et al., *supra* note 78, at 267; *see generally* Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31514 (2010).

85. Howard M. Crystal et al., *supra* note 78, at 265-67.

86. Util. Air Regul. Grp. v. EPA, 573 U.S. 302, 311-12 (2014).

light-duty trucks, and medium-duty passenger vehicles.[87] The Triggering Rule made stationary source permitting for greenhouse gases effective on the same date as the Tailpipe Rule.[88]

Yet, in *Utility Air Regulatory Group v. EPA*, the Supreme Court held the GHG Tailoring Rule was impermissible.[89] However, the applicability of the best available control technology (BACT) standard to "anyway" sources was found permissible.[90] "Anyway" sources are "those that would need permits based on their emissions of more conventional pollutants."[91] Thus, "EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or title V permit,"[92] but sources that are already subject to another Clean Air Act permit will have BACT applied for all pollutants, including GHGs.[93]

Specific to power plants, the EPA issued the Clean Power Plan in August 2015, which established GHG emission standards under section 111(d) of the Clean Air Act.[94] The Clean Power Plan was grounded on the following three building blocks: (1) heat-rate efficiency improvements at coal-fired power plants; (2) generation shifting from coal-fired plants; and (3) increasing renewable generating capacity.[95] This led to immediate litigation, and eventually, in 2019, the EPA repealed the Clean Power Plan by issuing the Affordable Clean Energy Rule.[96] However, further litigation led to the Affordable Clean Energy Rule being vacated, technically bringing the Clean Power Plan back.[97] The Supreme Court then granted certiorari, allowing the original lawsuits challenging the Clean Power Plan to proceed.[98] Thus, in 2022, the Supreme Court issued the *West Virginia v. EPA* opinion, which held that Congress did not give the EPA the

87. *See generally* Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 75 Fed. Reg. 25324 (2010).

88. *See generally* Reconsideration of Interpretation of Regulations That Determine Pollutants Covered by Clean Air Act Permitting Programs, 75 Fed. Reg. 17004 (2010).

89. Util. Air Regul. Grp., 573 U.S. at 315.

90. *Id.* at 220.

91. *Id.* at 329.

92. *Clean Air Act Permitting for Greenhouse Gases*, *supra* note 82.

93. Util. Air Regul. Grp., 573 U.S. at 312-13 (2014).

94. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64662, 64711 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

95. *Id.* at 64709.

96. TODD AAGAARD ET AL., PRACTICING ENVIRONMENTAL LAW 274-275 (Saul Levmore et al. eds., 2d ed. 2017).

97. West Virginia v. EPA, 142 S. Ct. 2587, 2606-07 (2022).

98. *Id.* at 2606.

authority to use a generation shifting approach with the implementation of carbon emissions caps.[99]

In conclusion, although the Clean Air Act is certainly an option for regulating greenhouse gas emissions, and thus mitigating ocean acidification, it is not the focus of this Comment because, as discussed next, the Clean Water Act also presents a viable option. The EPA has a significant history of attempting to regulate greenhouse gases under the Clean Air Act, which up until now has been largely unsuccessful. Legal scholars have already proposed other options, such as listing carbon dioxide as a criteria air pollutant.[100]

III. APPLICABILITY OF THE CLEAN WATER ACT

"The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective . . . it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved"[101]

The Clean Water Act has two "important mechanisms for protecting and improving water quality: its regulatory programs for individual polluters and its 'backstop' programs that govern ambient water quality."[102] This Comment focuses on the regulatory program, which

99. *Id.* at 2616.

100. *See generally* Howard M. Crystal et al., *supra* note 80.

101. 33 U.S.C. § 1251(a)(2).

102. Robin Kundis Craig, *Part II: Ocean Acidification and Current Law: Dealing with Ocean Acidification: The Problem, The Clean Water Act, and State and Regional Approaches*, 6 WASH. J. ENVTL. L. & POL'Y 387, 411 (2016).

prohibits the "discharge"[103] of "pollutants"[104] into "navigable waters"[105] from a "point source"[106] without a permit.[107] However, as one would imagine, each of these terms has been subject to interpretation and litigation, both from the courts and the EPA itself.[108]

Currently, because ocean acidification is largely caused by emissions of carbon dioxide into the air, the Clean Water Act's regulatory programs have not applied. This is because the EPA does not consider the pollution of greenhouse gases through the air into the water to meet the definition of a "discharge."[109] However, the Supreme Court provided further clarification and an updated test in *County of Maui v. Hawaii Wildlife Fund*.[110] In *County of Maui*, the Supreme Court was deciding "whether the [Clean Water] Act 'requires a permit when pollutants originate from a point source but are conveyed to navigable waters by a nonpoint source.'"[111] Specifically at issue was "a wastewater reclamation facility" that "collects sewage from the surrounding area, partially treats it, and pumps the treated water through four wells hundreds of feet

103. The Act defines "discharge of a pollutant" as "any addition of any pollutant to navigable waters from any point source" or "any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft." 33 U.S.C. § 1362(12).

104. "Pollutant" is defined as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." *Id.* at § 1362(6). The focus of this Comment is not whether carbon dioxide should be construed as a pollutant under the Clean Water Act, as it is the author's position that it falls within the definition. This interpretation is further supported by the policy goals of the Clean Water Act.

105. The Act defines "navigable waters" as "the waters of the United States, including the territorial seas." *Id.* at § 1362(7). The Act further defines "territorial seas" to mean "the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles." *Id.* at § 1362(8).

106. "Point source" is defined as "any discernible, confined and discrete convenance . . . from which pollutants are or may be discharged," including listed examples such as a "container," "pipe, ditch, channel, tunnel, [or] conduit." *Id.* at § 1362(14).

107. 33 U.S.C. § 1251(a).

108. *See e.g.,* Stephen Johnson, *From Protecting Water Quality to Protecting States' Rights: Fifty Years of Supreme Court Clean Water Act Statutory Interpretation*, 74 SMU L. REV. 359, 359 (2021).

109. *See* 33 U.S.C. § 1362(12); *see also Section 319: Nonpoint Source Program*, EPA WATERSHED ACADEMY WEB, https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=2788 (last visited Oct. 15, 2023) [https://perma.cc/ JLB4-VYRQ].

110. *See generally* Cnty. of Maui v. Haw. Wildlife Fund, 140 S. Ct. 1462 (2020).

111. *Id.* at 1468.

underground."[112] The partially treated water, "amounting to about 4 million gallons each day, then travels a further half mile or so, through groundwater, to the ocean."[113] Put simply, the polluted water was originally from a point source; however it only made its way to the ocean via groundwater, which is not considered a point source or a navigable water under the Clean Water Act.[114]

Prior to *County of Maui*, the applicable regulations from the Clean Water Act were not applied consistently.[115] The Ninth Circuit had adopted a "fairly traceable" test.[116] Under this test, "the permitting requirement applies so long as the pollutant is 'fairly traceable' to a point source even if it traveled long and far (through groundwater) before it reached navigable waters."[117] Contrastingly, the EPA had published an Interpretive Statement[118] on the same subject, which asserted that the Clean Water Act permitting program excludes "all releases of pollutants to groundwater . . . even where pollutants are conveyed to jurisdictional surface waters via groundwater."[119]

However, the Supreme Court chose to adopt neither of the above tests.[120] Instead, it held the Clean Water Act "requires a permit when there is a direct discharge from a point source into navigable waters or when there is the *functional equivalent of a direct discharge*."[121] The Supreme Court explained that whether a discharge is the "functional equivalent" of a direct discharge depends on the following factors:

> (1) [T]ransit time,
> (2) [D]istance traveled,
> (3) [T]he nature of the material through which the pollutant travels,

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112. *Id.* at 1469.
113. *Id.*
114. *See generally id.*; 33 U.S.C. § 1362(7), (14).
115. *See e.g.,* Cnty. of Maui, 140 S. Ct. at 1469-70.
116. *Id.* at 1469.
117. *Id.* at 1470.
118. *See generally* Interpretive Statement on Application of the Clean Water Act National Pollutant Discharge Elimination System Program to Releases of Pollutants From a Point Source to Groundwater, 84 Fed. Reg. 16810 (proposed Apr. 23, 2019) (to be codified at 40 C.F.R. pt. 122).
119. Cnty. of Maui, 140 S. Ct. at 1474; *see also* Interpretive Statement on Application of the Clean Water Act National Pollutant Discharge Elimination System Program to Releases of Pollutants From a Point Source to Groundwater, 84 Fed. Reg. at 16811.
120. Cnty. of Maui, 140 S. Ct. at 1476.
121. *Id.*

(4) [T]he extent to which the pollutant is diluted or chemically changed as it travels,
(5) [T]he amount of pollutant entering the navigable waters relative to the amount of the pollutant that leaves the point source,
(6) [T]he manner by or area in which the pollutant enters the navigable waters,
(7) [T]he degree to which the pollution (at that point) has maintained its specific identity.[122]

This is not an exhaustive list of factors, and the Supreme Court further noted that "[t]ime and distance will be the most important factors in most cases, but not necessarily every case."[123] Additionally, the Supreme Court noted the relevance and importance of the "underlying statutory objectives," stating that "[d]ecisions should not create serious risks . . . of creating loopholes that undermine the statute's basic federal regulatory objectives."[124] The Clean Water Act explicitly states that "[t]he objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[125] Further, and particularly relevant to preventing ocean acidification, the Clean Water Act also states "it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife" be achieved.[126]

After *County of Maui*, point sources of greenhouse gas emissions should be subject to the permitting process under the Clean Water Act, as they represent the functional equivalent of a direct discharge of carbon dioxide into the ocean. This tactic has never been tried as a strategy to expanding the scope of the Clean Water Act, so this Comment will address each element a successful challenge would need to meet. First, the difficulties with establishing standing will be addressed, as a challenge such as this cannot proceed without standing. Next, the current understanding of point sources will be addressed, as compared to sources that have been interpreted as non-point sources; this will particularly focus on the EPA's interpretation of smokestacks as non-point sources. Finally, each of the functional equivalent factors from *County of Maui* will be applied to smokestack emissions of carbon dioxide as it relates to ocean acidification.

122. *Id.* at 1476-77.
123. *Id.* at 1477.
124. *Id.*
125. 33 U.S.C. § 1251(a).
126. *Id.* at § 1251(a)(2).

A. Standing

Plaintiffs desiring to broaden the current interpretation of the Clean Water Act as discussed by this Comment will need to establish standing before proceeding. Article III, section 2, of the U.S. Constitution limits judicial power to "cases" and "controversies."[127] The standing doctrine was born from this case or controversy requirement.[128] As defined by caselaw, the doctrine of standing requires three elements: injury, causation, and redressability.[129] Consideration of the standing requirement is critical in environmental challenges, as it can prove to be a significant barrier.[130] In *Lujan v. Defenders of Wildlife*, Justice Scalia distinguished between plaintiffs challenging governmental action or inaction and plaintiffs challenging regulatory action.[131] In this distinction, Justice Scalia indicated that for the latter group, "much more is needed" in establishing standing.[132] Specifically, plaintiffs must ensure that the causation and redressability elements of standing are not stemming from third party actors.[133] Thus, plaintiffs using the "functional equivalent" test will need to ensure standing is clearly established, as it falls into the latter category described by Justice Scalia.

The injury element requires a plaintiff to show "invasion of a legally protected interest which is (a) concrete and particularized, and (b) actual or imminent, not conjectural or hypothetical."[134] The causation element requires a plaintiff's injury to "be fairly traceable to the challenged action of the defendant, and not the result of the independent action of some third party not before the court."[135] Finally, the redressability element requires it to "be likely, as opposed to merely speculative, that the plaintiff's injury will be redressed by a favorable decision from the court."[136]

Further, there are specific requirements when an organization is bringing the lawsuit, because "plaintiffs ordinarily cannot bring lawsuits to vindicate the rights of others."[137] These additional requirements are: (1)

127. U.S. Const. art. III, § 2, cl. 1.

128. TODD AAGAARD ET AL., *supra* note 96, at 126-27.

129. Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 (1992).

130. *See generally* Scott W. Stern, *Standing for Everyone: Sierra Club v. Morton, Supreme Court Deliberations, and a Solution to the Problem of Environmental Standing*, 30 FORDHAM ENV'T. L. REV. 21 (2019).

131. Lujan, 504 U.S. at 561.

132. *Id.* at 562.

133. *Id.*

134. TODD AAGAARD ET AL., *supra* note 96, at 127.

135. *Id.*

136. *Id.*

137. *Id.*

"[a]t least one member of the organization must have constitutional standing to sue in his or her own right;"[138] (2) "[t]he interests the organization seeks to protect through the litigation must be germane to the organization's purpose;"[139] and (3) "[p]articipation of individual members in the lawsuit must be unnecessary to resolve either the claim asserted or relief requested."[140]

Should an environmental non-governmental organization (ENGO) challenge the EPA for not requiring Clean Water Act permits, it is essential that they demonstrate standing, which can often be difficult. However, this Comment in no way cautions that establishing standing in this described case is impossible. In fact, in *Massachusetts v. EPA* the Supreme Court noted that "[w]hile it may be true that regulating motor-vehicle emissions will not by itself *reverse* global warming, it by no means follows that we lack jurisdiction to decide whether EPA has a duty to take steps to *slow* or *reduce* it."[141] This sentiment should be applied to the ENGO bringing this challenge, as the EPA regulating carbon dioxide emissions under the Clean Water Act follows the same logic as in finding standing in *Massachusetts v. EPA*. Regulating carbon dioxide emissions will not entirely solve ocean acidification, but it will certainly make meaningful steps to provide an avenue to slow it.

B. Point Sources?

The next difficulty in bringing the claim described by this Comment will involve identifying exactly what sources this type of challenge could apply to. In the United States the largest sources of greenhouse gas emissions are transportation (27% of 2020 greenhouse gas emissions), electricity production (25% of 2020 greenhouse gas emissions), industry (24% of 2020 greenhouse gas emissions), commercial and residential (13% of 2020 greenhouse gas emissions), and agriculture (11% of 2020

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138. *Id.*

139. *Id.*

140. TODD AAGAARD ET AL., *supra* note 96, at 127.

141. Massachusetts v. EPA, 549 U.S. 497, 525 (2007); *see also* Friends of the Earth v. Gaston Cooper Recycling Corp., 204 F.3d 149, 153 (2000) (holding that a plaintiff that wanted to fish and swim in a river, which was being heavily polluted by the defendant, was enough to establish an injury for standing); Larson v. Valente, 456 U.S. 228, 243 n.15 (1982) (noting "a plaintiff satisfies the redressability requirement when he shows that a favorable decision will relieve a discrete injury to himself. He need not show that a favorable decision will relieve his every injury.").

greenhouse gas emissions).[142] This is important to acknowledge, as it should guide the sources targeted. Requiring National Pollutant Discharge Elimination System (NPDES) permitting for the sources that emit the largest amounts of carbon dioxide will lead to the reduction in the rate of ocean acidification, and thus protect the integrity and biodiversity of the world's oceans.

A significant issue here is the distinction between a point source and a nonpoint source. In enacting this distinction, Congress drew a "clear and precise distinction between point sources, which [are] subject to direct Federal regulation, and nonpoint sources, control of which was specifically reserved to State governments" as they are at "the level of government closest to the sources of the problems."[143] However, the Clean Water Act did not provide a definition of nonpoint sources.[144] Instead, "they are defined by exclusion – anything not considered a 'point source' according to the act and EPA regulations" is deemed a non-point source for the purposes of the Act.[145]

In interpreting this distinction, the EPA has repeatedly maintained "that stack emissions are a form of nonpoint source pollution."[146] The EPA has noted that fossil-fueled electric generating plants could be considered point sources, but are considered nonpoint sources when viewed in the context of water pollution.[147] The key characterization noted by the EPA is "channelization,"[148] which will indicate a source is a point source.[149] The Tenth Circuit upheld this distinction in *Chemical Weapons Working Group, Inc. v. U.S. Dep't of the Army*.[150] The Court held that "common sense dictates that . . . stack emissions constitute discharges into the air—not water—and are therefore beyond the [Clean Water Act's] reach."[151]

However, this approach is entirely inconsistent with the purpose of the Clean Water Act—protecting the nation's water sources and relevant

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142. *Sources of Greenhouse Gas Emissions*, EPA, https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions (Aug. 25, 2023) [https://perma.cc/C8GB-C5PW].

143. S. Rep. No. 95-370, at 8-9 (1977).

144. *See* 33 U.S.C. § 1362; *Section 319: Nonpoint Source Program*, *supra* note 109.

145. *Section 319: Nonpoint Source Program*, *supra* note 109.

146. OFF. OF WATER, U.S. EPA, CONTROLLING NONPOINT SOURCE POLLUTION (1987).

147. *Section 319: Nonpoint Source Program*, *supra* note 109.

148. The EPA states "[c]hannelization is a key characteristic of a point source." *Id.* For example, "[d]iffuse stormwater runoff, which is not channelized, is not regulated and is a nonpoint source." *Id.*

149. *Id.*

150. Chem. Weapons Working Grp., Inc. v. U.S. Dep't of the Army, 111 F.3d 1485, 1490-91 (10th Cir. 1997).

151. *Id.* at 1490.

ecosystems.[152] Furthermore, considering the Supreme Court decision in *County of Maui*, it seems clear that this interpretation is not feasible or reconcilable. The next section will focus on why these emissions are the functional equivalent of a discharge into a navigable water. Smokestacks are directly polluting into the air, which is in a constant air-sea flux.[153] This emitted carbon dioxide is scientifically established to be causing ocean acidification.[154] It seems impossible to reconcile these sources not being covered by the Clean Water Act.

C. "Functional Equivalent" Factors

In addition to establishing standing and that these greenhouse gas emitting sources are indeed point sources under the Clean Water Act, an ENGO would need to establish that the release of greenhouse gases constitutes the functional equivalent of a direct discharge into navigable waters. For the purposes of this Comment, the regulation analyzed will be related to all point sources that emit carbon dioxide, thus acting as the functional equivalent of polluting into navigable waters of the United States.

1. Transit Time

In *County of Maui*, the United States District Court for the District of Hawaii held that a transit time of approximately eighty-four days sufficiently implicated the Clean Water Act's permitting requirements.[155] The court noted that "the Supreme Court set its extreme at 'many years,' not at 'many months,' and not even at one year or two years."[156] This guideline is consistent with the developing caselaw across the country regarding the "functional equivalent" test. For example, the court in *Conservation Law Foundation, Inc. v. Town of Barnstable* held the approximate travel time of twenty-one years did "not constitute the 'functional equivalent' of a direct discharge for the purposes of requiring an NPDES permit."[157] However, a mining company that discharged pollutants, which traveled via groundwater for approximately 1.5 to 14.6

152. *See* 33 U.S.C. § 1251(a)(2).
153. *See supra* Part I.
154. *See supra* Part I.
155. Haw. Wildlife Fund v. Cnty. of Maui, 550 F. Supp. 3d 871, 886-87 (2021).
156. *Id.* at 886.
157. Conservation L. Found., Inc. v. Town of Barnstable, 615 F. Supp. 3d 14, 19 (D. Mass. 2022).

days before reaching "navigable waters" did meet the functional equivalent test and required a NPDES permit.[158]

Looking to this proposed use of the functional equivalent test, the transit time of carbon dioxide to the ocean is dependent on a number of variables. "Air-sea gas exchange is a physio-chemical process, primarily controlled by the air-sea difference in gas concentrations and the exchange coefficient, which determines how quickly a molecule of gas can move across the ocean-atmosphere boundary."[159] Calculating this air-sea gas exchange coefficient "depends on the saturation of the gas in the water and wind speed. For example, the more saturated the water is with CO_2 and the faster the wind is blowing across the water, the higher the flux of CO_2 out of the water."[160] The "solubility of a gas in seawater" is also relevant for this calculation, which "is determined by the temperature and salinity of that water."[161] "It takes about one year to equilibrate CO_2 in the surface ocean with atmospheric CO_2, so it is not unusual to observe large air-sea difference in CO_2 concentrations."[162] This flux in carbon dioxide concentrations can be observed in Figure 3 below.

158. Black Warrior River-Keeper, Inc. v. Drummond Co., 579 F. Supp. 3d 1310, 1324 (N.D. Ala. Jan. 12, 2022).

159. PMEL CARBON GROUP, *Ocean Carbon Uptake*, NOAA https://www.pmel.noaa.gov/co2/story/Ocean+Carbon+Uptake (last visited Oct. 15, 2023) [https://perma.cc/TPZ6-BX2X].

160. *Flux of CO_2 Between Ocean and Atmosphere*, OCEAN DATA LABS, https://datalab.marine.rutgers.edu/data-nuggets/co2-flux/ (last visited Oct. 15, 2023) [https://perma.cc/5D37-H2FC].

161. *Id.*

162. *Ocean Carbon Uptake*, *supra* note 159.

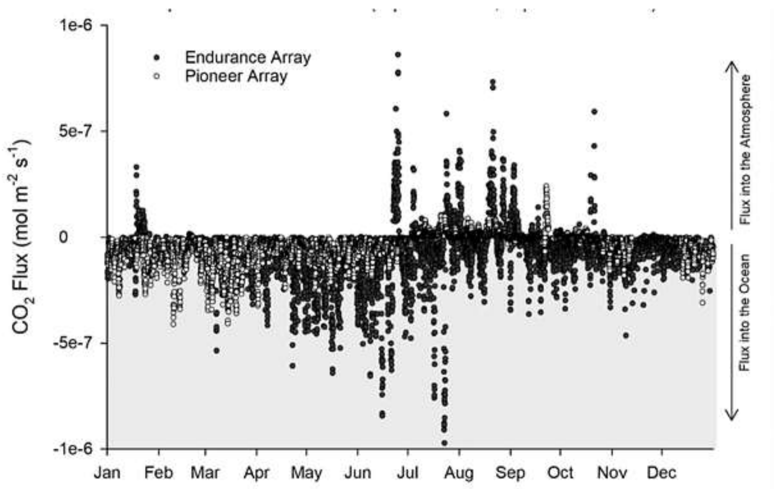

Figure 3: Coastal CO_2 Flux Between Ocean and Atmosphere[163]

Calculating transit time for carbon dioxide is not as straightforward as calculating the flow of groundwater, as has been done in other cases applying the "functional equivalent" test. However, the exchange between the ocean and the atmosphere reaches equilibrium in approximately one year.[164] This flux is displayed in Figure 3 above, which highlights the large differences that are observed, both into the atmosphere and the ocean.[165] This should be construed within the meaning of the "functional equivalent" of a direct discharge. The Supreme Court itself set the

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163. *Flux of CO_2 Between Ocean and Atmosphere*, *supra* note 160. This data collected "seasonal cycles of CO_2 air-sea gas exchange during 2017 at two coastal locations – the Endurance Array in the NE Pacific (black dots), and the Pioneer Array in the NW Atlantic (white dots). Positive data indicate a net flux of CO_2 from the ocean into the atmosphere, negative data indicate a net flux of CO_2 from the atmosphere into the ocean." *Id.* The Endurance Array, displayed in Figure 3 as the black dots, "represents a coastal upwelling area where during times of upwelling, CO_2-rich deep water reaches the surface where it is outgassed into the atmosphere. The outgassing of upwelled water is then followed by a period of net intake of CO_2 due to increase primary production from the nutrients upwelled with the CO_2." *Id.* The Pioneer Array, displayed in Figure 3 as white dots, was placed off the coast of New England, which "in contrast, is not an upwelling zone, but is an area of high productivity. As phytoplankton blooms occur, particularly in the winter/spring time period, there is a net flux of CO_2 into the ocean. During the summer months as the surface water warms, the water can no longer hold as much CO_2 and there is a small (relative to the upwelling) net outgassing." *Id.*

164. *Ocean Carbon Uptake*, *supra* note 159.

165. *Flux of CO_2 Between Ocean and Atmosphere*, *supra* note 160.

distinction at many years, not at one or two.[166] Here, the carbon dioxide reaches the ocean fairly quickly, and reached equilibrium in the air-sea gas exchange within approximately one year. Thus, construing this factor in favor of Clean Water Act regulation is consistent with the Supreme Court's "functional equivalent" test.

2. Distance Traveled

In the *County of Maui* opinion, the Supreme Court noted that fifty miles is likely too far for the permitting requirements of the Clean Water Act to apply.[167] On remand, the district court held that the "minimum distance of between 0.3 and 1.5 miles" was found sufficiently close.[168] In *Conservation Law Foundation*, however, the district court[169] found that pollutants that traveled 1.59-1.88 miles pointed against needing NPDES permitting under the distance traveled factor of the functional equivalent test.[170]

In *County of Maui*, the Supreme Court gave the following example:

> Where a pipe ends a few feet from navigable waters and the pipe emits pollutants that travel those few feet through groundwater (or over the beach), the permitting requirement clearly applies. If the pipe ends 50 miles from navigable waters and the pipe emits pollutants that travel with groundwater, mix with much other material, and end up in navigable waters only many years later, the permitting requirements likely do not apply.[171]

From this example alone, it seems that the Supreme Court set a somewhat firm line at fifty miles or less of distance traveled; however, the Supreme Court also cautioned that an interpretation that "would open a loophole allowing easy evasion of the statutory provision's basic purposes . . . is neither persuasive nor reasonable."[172] Applying the

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166. Cnty. of Maui v. Haw. Wildlife Fund, 140 S. Ct. 1462, 1476 (2020).

167. *Id.*

168. Haw. Wildlife Fund v. Cnty. of Maui, 550 F. Supp. 3d 871, 886 (2021).

169. Normally, juxtaposing a district court decision, especially one that is not on remand, with a case from Supreme Court of the United States, is not especially helpful or particularly persuasive. However, the *County of Maui* decision is only from 2020, and the Supreme Court has not provided any other guidance since that opinion. Thus, district court cases are valuable to this analysis because it is a relatively new area with limited litigation.

170. Conservation L. Found., Inc. v. Town of Barnstable, 615 F. Supp. 3d 14, 25 (D. Mass. 2022).

171. Cnty. of Maui, 140 S. Ct. at 1476.

172. *Id.* at 1474.

"functional equivalent" test only to those emitting within fifty miles of the ocean would fall squarely into the loophole described by the Supreme Court. For this reason, the distance traveled factor should hold less weight in the analysis of whether greenhouse gas emissions are the "functional equivalent" of a direct discharge into navigable waters.

3. The Nature of the Material Through Which the Pollutant Travels

In coining the "functional equivalent" test, the Supreme Court noted that the first two factors will often be the most important, but not in every situation.[173] Thus, in *Town of Barnstable*, the Court, in referring to factors other than transit time and distance traveled, noted that "relying on these factors when the approximate transit time is so substantial (over 21 years) would undermine the court's deliberate focus on time and distance when it disavowed the fairly traceable approach, which it criticized as overly broad."[174] In *Stone v. High Mt. Mining Co.*, the district court gave this factor "little weight" because of "limited evidence presented about the composition of the soil" that the pollutants traveled through.[175]

This situation, much like the examples, seems to indicate this factor should not hold much weight. The Supreme Court did not give significant guidance on this factor in *County of Maui*, resulting in district courts across the country giving this factor little weight.[176] Ascertaining the difference between factor three and four remains difficult, as it is unclear what else other than the pollutant changing could be the purpose of this factor. In sum, this factor should not be given significant weight in the analysis and not pull against the meeting of the functional equivalent test.

4. The Extent to Which the Pollutant Is Diluted or Chemically Changed as It Travels

The next factor listed by the Supreme Court is "the extent to which the pollutant is diluted or chemically changed as it travels."[177] In *Black Warrior River-Keeper, Inc. v. Drummond Co.*, the plaintiff "provided evidence that polluted groundwater travels through 'porous' GOB

173. *Id.* at 1477.
174. Conservation L. Found., Inc. v. Town of Barnstable, 615 F. Supp. 3d 14, 25 (D. Mass. 2022).
175. Stone v. High Mt. Mining Co., 2022 U.S. Dist. LEXIS 164161, at *38 (D. Colo. Sept. 12, 2022).
176. *Id.*; *accord* Conservation L. Found., Inc. v. Town of Barnstable, 615 F. Supp. 3d 14, 25 (D. Mass. 2022).
177. Cnty. of Maui, 140 S. Ct. at 1476.

[garbage of bituminous] waste that exacerbates rather than dilutes the intensity of the AMD [acid mine drainage]."[178] Additionally, the plaintiff "presented evidence that the pollution maintains its identity as AMD as the AMD-laden groundwater discharges into the Locust Fork, bolstered by the finding that concentrations of chemicals and the pH of the groundwater seeps have 'similar ranges' as the data observed for surface water."[179] Thus, the court found that this factor indicated a NPDES permit was needed, as it met the functional equivalent test.[180]

Human activities are responsible for nearly all of the increase in greenhouse gases released into the atmosphere.[181] Following the Industrial Revolution, carbon dioxide is the primary greenhouse gas emitted via human activities.[182] And, as established, "[a]s levels of atmospheric CO_2 increase from human activity such as burning fossil fuels . . . the amount of carbon dioxide absorbed by the ocean also increases. When CO_2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions."[183] Therefore, exposure to the atmosphere does not dilute or change the composition of CO_2. Instead, the CO_2 only undergoes chemical changes after it is absorbed into the seawater, and then begins the process of ocean acidification highlighted in the chemical reaction in Part I.[184] Thus, the fourth factor continues to indicate that the posed situation is the functional equivalent of a direct discharge from a point source, and thus requires permitting under the Clean Water Act.

5. The Amount of Pollutant Entering the Navigable Waters Relative to the Amount of the Pollutant that Leaves the Point Source

In the scenario discussed in this Comment, the point sources are those which are emitting anthropogenic[185] carbon dioxide. In 2019, a study

178. Black Warrior River-Keeper, Inc. v. Drummond Co., 579 F. Supp. 3d 1310, 1318 (N.D. Ala. Jan. 12, 2022).

179. *Id.*

180. *Id.* at 1323.

181. *Sources of Greenhouse Gas Emissions*, *supra* note 142.

182. *Id.*

183. *Ocean Acidification*, *supra* note 3.

184. *See supra* Part I.

185. Defined as "of, relating to, or resulting from the influence of human beings on nature." *Anthropogenic*, MERRIAM-WEBSTER DICTIONARY, https://www.merriam-webster.com/dictionary/anthropogenic (last visited Oct. 15, 2023) [https://perma.cc/WKU6-WS6E].

published by the National Oceanic and Atmospheric Administration (NOAA) and *Science*, a peer-reviewed journal, "quantif[ied] the oceanic sink for anthropogenic carbon dioxide (CO_2) over the period 1994 to 2007 by using observations from the global repeat hydrography program and contrasting them to observations from the 1990s."[186] The study then used "a linear regression-based method" to calculate the "global increase in the anthropogenic CO_2 inventory of 34 ± 4 pentagrams of carbon (Pg C) between 1994 and 2007."[187] As determined by the researchers, this "represents $31 \pm 4\%$ of the global anthropogenic CO_2 emissions over this period."[188]

The Supreme Court has not given guidance on the percentage of pollutant that enters the navigable waters that it would deem points in favor of meeting the "functional equivalent" standard. Thus, it remains difficult to ascertain the direction in which the Supreme Court would indicate the 31% of carbon absorption leans. Although this is less than a majority of carbon, that is due to absorption limitations, not any other factor. Therefore, in this case, this factor should not be dispositive.

6. The Manner by or Area in Which the Pollutant Enters the Navigable Waters

The sixth factor looks to the manner by or area in which the pollutant enters the navigable waters. The ocean absorbs carbon dioxide from the atmosphere, and is doing so at a faster rate than ever before due to the increasing atmospheric concentration of carbon dioxide.[189] As the atmospheric concentration increases, more carbon dioxide is dissolved in the surface waters of the ocean.[190] The "transfer of CO_2 out of the ocean to the atmosphere is referred to as a positive 'flux' while a negative flux means that the ocean is absorbing CO_2. The ocean has a complicated pattern of both positive and negative fluxes."[191] As with other factors, it

186. Gruber et al., *supra* note 9, at 1193.
187. *Id.*
188. *Id.*
189. Jamie Shutler & Andy Watson, *Guest Post: The Oceans Are Absorbing More Carbon Than Previously Thought*, CARBONBRIEF (Sept. 28, 2020, 1:31 PM), https://www.carbonbrief.org/guest-post-the-oceans-are-absorbing-more-carbon-than-previously-thought/ [https://perma.cc/843R-Q63Y].
190. *Id.*
191. *Ocean-Atmosphere CO2 Exchange*, SCIENCE ON A SPHERE – NOAA (Nov. 12, 2015), https://sos.noaa.gov/catalog/datasets/ocean-atmosphere-co2-exchange/ [https://perma.cc/9FSL-LP35].

remains unclear the intended effect that this factor has on the outcome of the functional equivalent test; however as discussed throughout multiple factors, it remains clear that the carbon dioxide enters the ocean directly from the air.

7. The Degree to Which the Pollution (at That Point) Has Maintained Its Specific Identity

As demonstrated by the fourth factor above, exposure to the atmosphere does not dilute or change the composition of CO_2; instead, the CO_2 only undergoes chemical changes after it is absorbed into the seawater.[192] Further, no other part of the process from the initial emission to the start of the acidification process, highlighted in Figure 1 above, results in the carbon dioxide changing its specific identity. Therefore, it has maintained its specific identity throughout its travel into the ocean and this factor indicates the functional equivalent test is met.

D. National Pollutant Discharge Elimination System Permitting

As described earlier, the Clean Water Act requires a NPDES permit for any discharge of a pollutant from a point source into navigable waters.[193] In issuing the *County of Maui* opinion, the Supreme Court expanded this by including discharges that constitute the "functional equivalent" of a direct discharge into the NPDES regulatory scheme.[194] A facility must also be directly discharging into the navigable waters, or be the "functional equivalent" of a direct discharge.[195]

After examining each of the seven factors of the functional equivalent test, it appears that the factors indicate the functional equivalent test is met. Most factors lean towards needing a NPDES permit under the Clean Water Act. Carbon dioxide emissions, which ultimately end up polluting the ocean, fall exactly into the category of pollutants that the functional equivalent test was created for: pollutants that do not fall into the ideal formulation of discharged directly into waters of the United States. The functional equivalent test was created because the Supreme Court recognized that some pollutants were escaping regulation, even though the purpose and intent with the Clean Water Act was to regulate them under the NPDES permitting program.

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192. *Ocean Acidification*, *supra* note 3.
193. *See* 33 U.S.C. § 1342.
194. *See generally* Cnty. of Maui v. Haw. Wildlife Fund, 140 S. Ct. 1462 (2020).
195. *See* 33 U.S.C. § 1342; Cnty. of Maui, 140 S. Ct. at 1477.

Additionally, the stated goals of the Clean Water Act should be heavily weighted when answering this question. As stated in its first section, the Clean Water Act aims to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[196] Clearly, allowing emissions of carbon dioxide to continue to significantly harm the ocean and its wildlife is not at all consistent with these stated purposes. Therefore, requiring permitting of these carbon dioxide sources is consistent with both the functional equivalent test and the legislative intent behind the Clean Water Act.

All discussed facilities emitting greenhouse gases meet the functional equivalent standard, and consequently require NPDES permitting. This will lead to a dramatic increase in the amount of NPDES permits required across the United States. The NPDES program is implemented directly by the EPA or by "state, tribal, and territorial governments" authorized to do so by the EPA.[197] Assuming the facilities emitting carbon dioxide discussed in this Comment require a NPDES permit, it will certainly require a reform within the EPA and states administering the NPDES permitting program. However, the complexities of what this new system will look like is beyond the scope of this Comment.

Further, although this enlargement of NPDES permitting will inevitably lead to a significant amount of work on the part of the EPA, it is not dispositive on whether these sources should be permitted. The potential issues created have nothing to do with whether this is a point source, or whether the emissions constitute the functional equivalent of a discharge into navigable waters. As established by this Comment, both are true. Thus, NPDES permits must be required pursuant to the Clean Water Act.

This implementation will further require "permitted discharges to comply with other provisions of the Clean Water Act."[198] In combination, the other sections of the Clean Water Act "direct EPA to establish, and periodically review, effluent limitations specifying the amount of pollutants that can be present in discharges."[199] These effluent limitations are approached by the EPA on an industry-by-industry standard and are technology-based standards.[200] These standards do not mandate specific technologies, but instead "identify specific maximum pollutant levels that

196. 33 U.S.C. § 1251(a).

197. *About NPDES*, U.S ENV'T PROT. AGENCY, https://www.epa.gov/npdes/about-npdes (last visited Oct. 15, 2023) [https://perma.cc/6VGP-J2D6].

198. TODD AAGAARD ET AL., *supra* note 96, at 342.

199. *Id.*

200. *Id.*

are permitted in the sources" discharges.[201] Existing sources in the industry would become subject to the Best Practicable Control Technology (BPT), which the EPA bases "on the best performing existing sources within the industry."[202] However, new sources are subject to more stringent standards, known as New Source Performance Standards (NSPS), which are based on the best available demonstrated control technology (BACT).[203] This Comment will not predict these standards, but it remains clear that technology standards would certainly result in a reduction of carbon dioxide emissions.

E. CWA Conclusion

As the "functional equivalent" test was coined by the Supreme Court only in 2020, some factors lack meaningful precedent. These factors, as mentioned through the factor-by-factor analysis, were also given little attention by the Supreme Court. Factors such as time and distance traveled were given guidelines and even examples; but this is not true for the remainder of the listed factors. This makes it difficult to understand the Supreme Court's intent with the factors but should not indicate that this result is at odds with the Clean Water Act. The intent behind the Clean Water Act, as well as the relevancy of the other factors, indicates that permitting these sources of emissions is the only consistent and efficient result available.

The appropriate finding that the sources emitting greenhouse gases are point sources and the functional equivalent of a discharge into navigable waters would force the EPA to require a NPDES permit for each of these sources. This finding is required by the EPA, as the Clean Water Act does not contain provisions allowing for no regulation of these sources because of an increase in permit applications, or other potential issues.[204] This

201. *Id.*

202. *Id.* at 343; 33 U.S.C. § 1314(b)(1).

203. 33 U.S.C. § 1314(b)(1).

204. The Supreme Court, in *Utility Air Regulatory Group v. EPA* (UARG), rejected the EPA's Tailpipe and Triggering Rules. *See supra* Part II; Util. Air Regul. Grp. v. EPA, 573 U.S. 302, 315 (2014). In doing so, the Court noted "[t]he fact that EPA's greenhouse-gas-inclusive interpretation of PSD and Title V triggers would place plainly excessive demands on limited governmental resources is alone a good reason for rejecting it." Util. Air Regul. Grp. 573 U.S. at 323-24. Further, the Court stated, "EPA's interpretation is also unreasonable because it would bring about an enormous and transformative expansion in EPA's regulatory authority without clear congressional authorization." *Id.* at 324. However, this reasoning should not be applied to the described scenario of expanding the scope of the Clean Water Act to smokestacks, which are the functional equivalent of a direct discharge of carbon dioxide into the ocean. The Clean Water Act contains no

finding is additionally consistent with the stated goals and purpose of the Clean Water Act.[205] Finally, this finding is essential for mitigating the effects of ocean acidification.

IV. Alternative Approaches

This Comment has addressed a regulatory focused approach and solution to ocean acidification because it provides a long-term mechanism for regulating carbon dioxide emissions in a manner that has not previously been pursued; however, litigation efforts such as these can last incredibly long and come with no guaranteed result. Therefore, it is important to recognize that regulation under the Clean Water Act is not the only option that should be pursued. Local communities can use other strategies to begin to mitigate ocean acidification and its effects. For the purposes of this Comment, I will briefly address other approaches because it is essential to act now in order to prevent the further devastating effects of ocean acidification. Additionally, the momentous issues of ocean acidification and climate change need significantly more than just one solution, and more than one regulatory program.

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provisions that indicate the regulatory burden on the EPA is a factor, let alone a dispositive factor, in determining whether or not a source of pollution must be regulated.

205. Another anticipated challenge to the proposed use of the Clean Water Act in this comment is the major questions doctrine. Should the EPA adopt this interpretation of the Clean Water Act and begin requiring NPDES permits for smokestacks and other related industries, it is highly likely that those industries will challenge that interpretation in court. The Supreme Court relied on the major questions doctrine in its decision in *West Virginia v. EPA*. West Virginia v. EPA, 142 S. Ct. at 2595. The Court noted that "EPA claimed to discover an unheralded power representing a transformative expansion of its regulatory authority in the vague language of a long-extant, but rarely used, statute designed as a gap filler" and that those facts made this a "major questions case." *Id.* The major questions framework has been suggested to "ask whether the agency action (a) is 'unheralded' and (b) represents a 'transformative' change in the agency's authority." Natasha Brunstein & Donald R. Goodson, *Unheralded and Transformative: The Test for Major Questions After West Virginia*, 47 WM. & MARY ENV'T. L. & POL'Y REV. 47, 47 (2022). If the major question doctrine applies, "the reviewing court should greet the agency's assertion of authority with 'skepticism,' but the agency can overcome that skepticism by identifying 'clear congressional authorization' for its action." *Id.* Regarding the EPA interpretation urged by this comment, the major question doctrine should not apply because it does not represent a "transformative" change in the EPA's authority. The new permitting would occur under the same regulatory scheme (NPDES permitting). Further, even if a reviewing court decided the major question doctrine does apply, the discussed stated goals of the Clean Water Act, along with the definitions within the Act itself, should indicate "clear congressional authorization." This is even further supported by the Supreme Court's own functional equivalent test.

The severity of the state of our climate is highlighted in the thirteenth edition of the United Nation's Emissions Gap Report.[206] The report, *The Closing Window: Climate crisis calls for rapid transformation of societies*, is self-described as a "testimony to inadequate action on the global climate crisis, and is a call for the rapid transformation of societies."[207] The report notes that global greenhouse gas emissions were on pace to continue to be the highest ever in 2021, even with the reduction in global emissions from the COVID-19 pandemic.[208] The report's main contribution is the emissions gap for 2030, which is "the difference between the estimated total GHG emissions resulting from the full implementation of the [nationally determined contributions (NDCs[209])], and the total global GHG emissions from least-cost scenarios that keep global warming to 2 °C, 1.8 °C or 1.5 °C."[210] The current emission gap for 2°C increase is between 12 – 15 $GtCO_2e$ (Gigatons of Carbon Dioxide Equivalent), and between 20 – 23 $GtCO_2e$ for an increase of 1.5 °C.[211] This is substantial, as this is a massive magnitude of difference from the amount of global warming scientists have warned we must stay below.[212] Further, this report notes that at the current level of action to reduce greenhouse gas emissions, "current policies lead to global warming of 2.8 °C over this century."[213]

206. U.N. Environmental Programme, *Closing the Window,* https://wedocs.unep.org/bitstream/handle/20.500.11822/40932/EGR2022_ESEN.pdf?sequence=8 [https://perma.cc/QNV5-XNBD].

207. *Id.* at IV.

208. *Id.*

209. NDCs represent countries' commitments to reducing greenhouse gasses. *Id.* These have been recently updated, as "part of the Paris Agreement's five-year ambition-raising cycle, countries were requested to submit new or updated NDCs in time for" the twenty-sixth United Nations Climate Change Conference of the Parties (COP 26). *Id.* at VI. Thus, between January 1, 2020, and September 23, 2022, "166 parties representing around 91 percent of global GHG emissions had submitted new or updates NDCs." *Id.* However, unfortunately, since COP 26, "there has been very limited progress in reducing the immense emissions gap for 2030. U.N. Environment Programme, *supra* note 206 at IV.

210. *Id.* at VII.

211. *Id.* at VIII. The Paris Agreement, adopted in 2015, "is a legally binding international treaty on climate change." It maintains the goals of holding "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels." *The Paris Agreement*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process-and-meetings/the-paris-agreement (last visited Oct. 15, 2023) [https://perma.cc/W7D2-3T5R]. However, the United Nation's Intergovernmental Panel on Climate Change has warned that global warming of more than 1.5°C "risks unleashing far more severe climate change impacts, including more frequent and sever e droughts, heatwaves and rainfall." *Id.*

212. U.N. Environment Progreamme, *supra* note 206, at VII.

213. *Id* at IX.

This, again, reiterates the need for much more than one regulatory scheme to combat ocean acidification, and climate change as a whole.

Clearly, significant steps need to be taken to mitigate ocean acidification, or climate change's evil twin.[214] According to a recent report, "carbon dioxide removal is a feature of all scenarios that meet the Paris temperature goal, in addition to reducing emissions."[215] Thus, both carbon dioxide removal and an emphasis on greenhouse gas reduction are necessary to come at all close to meeting goals consistent with the Paris Agreement.[216]

Carbon dioxide removal (CDR) "involved capturing CO_2 from the atmosphere and storing it durably on land, in the ocean, in geological formation or in products."[217] However, there is currently a significant difference between the current use of CDR and the reduction necessary to meet Paris Agreement Goals, known as the CDR gap. Reducing this CDR gap will require rapid growth and investment into novel forms of CDR. The development of novel CDR in the next decade is crucial, as "the amount of CDR deployment required in the second half of the century will only be feasible if we see substantial new development in the next ten years, novel CDR's formative phase."[218] Therefore, significant investment of time, money, and resources into CDR is essential in reducing the impacts of ocean acidification.

Additionally, significant investment and focus into renewable energy can result in a predicted reduction of 5.4 $GtCO_2e$ per year. This is a significant portion of the previously discussed emission gap, at approximately 43.2% of a 2 °C increase and 25.1% of a 1.5 °C increase.[219] To "jump-start" the transition to renewable energy, the United Nations (UN) has identified the following five actions.[220] First, the UN urges that renewable energy technology must become a global public good.[221] This will require the removal of "roadblocks to knowledge sharing and

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214. Kristina Bär, *Ocean Acidification – The Evil Twin of Climate Warming*, ALFRED-WEGENER-INSTITUTE (Nov. 20, 2020) https://www.awi.de/en/focus/ocean-acidification/ocean-acidification-the-evil-twin-of-climate-warming.html [https://perma.cc/79VM-5DNV].

215. STEPHEN M SMITH ET. AL., THE STATE OF CARBON DIOXIDE REMOVAL (Roz Pidock et al. eds., 1st ed. 2022) (emphasis removed).

216. *Id.*

217. *Id.* at 8.

218. *Id.* at 11.

219. *Id.*; U.N. Environment Programme, *supra* note 206.

220. *Five ways to jump-start the renewable energy transition now*, UNITED NATIONS, https://www.un.org/en/climatechange/raising-ambition/renewable-energy-transition (last visited Oct. 15, 2023) [https://perma.cc/3LR3-CZUA].

221. *Id.*

technological transfer, including intellectual property rights barriers."[222] Next, the UN urges that we must "improve global access to components and raw materials."[223] These materials are essential to producing parts such as wind turbines, electricity transmission, and electric vehicles.[224] Subsequently, the UN urges the need to "level the playing field for renewable energy technologies."[225] This will require major forms of domestic policy reform to "reduce market risk and enable and incentivize investments–including through streamlining the planning, permitting and regulatory processes, and preventing bottlenecks and red tape."[226]

Further, the UN highlights the importance of shifting energy subsidies to renewable energy from fossil fuel industries.[227] The UN calls "[f]ossil-fuel subsidies one of the biggest financial barriers hampering the world's shift to renewable energy."[228] According to the International Monetary Fund (IMF), approximately $5.9 trillion was spent in 2020 on fossil-fuel subsidies.[229] Shifting this spending toward renewable energy sources will result in substantial emissions cuts, as well as "sustainable economic growth, job creation, better public health and more equality, particularly for the poor and most vulnerable communities around the world."[230] And finally, the UN notes that we need to triple the current level of investments into renewable energy sources.[231]

Other interesting forms of climate action include local and regional initiatives. For example, the Regional Greenhouse Gas Initiative is a market-based agreement among Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.[232] The Regional Greenhouse Gas Initiative is the first regional cap-and-invest carbon initiative implemented in the United States,[233] and has led to significant reductions in carbon

222. *Id.*
223. *Id.*
224. *Id.*
225. *Id.*
226. *Five ways to jump-start the renewable energy transition now*, *supra* note 220.
227. *Id.*
228. *Id.*
229. *Climate Change – Fossil Fuel Subsidies*, INT'L MONETARY FUND, https://www.imf.org/en/Topics/climate-change/energy-subsidies (last visited Oct. 15, 2023).
230. *Five ways to jump-start the renewable energy transition now*, *supra* note 220.
231. *Id.*
232. *The Regional Greenhouse Gas Initiative – an Initiative of Eastern States of the U.S.*, REGIONAL GREENHOUSE GAS INITIATIVE, https://www.rggi.org/ (last visited Oct. 15, 2023) [https://perma.cc/7R7E-A3S9].
233. *Id.*

dioxide emissions.[234] In just five years, "participating states reduced their power sector emissions by 40 percent."[235] This is vastly significant, and indicates a viable option for other regions throughout the United States to adopt with the Regional Greenhouse Gas Initiative as a model.

Another interesting approach includes adding a "Green Amendment" into state constitutions.[236] Green Amendments aim to "recognize[] and protect[] for all people, including future generations, the inherent right to pure water, clean air, healthy environment, and a stable climate."[237] Adding a Green Amendment does not equate to a reduction in greenhouse gas emissions, but rather provides citizens with a cause of action to litigate environmentally harmful activities.[238] These examples are by no means the only solutions, but instead serve as recommendations for other forms of climate action that may be able to enact meaningful change without the use of the Clean Water Act.

CONCLUSION

As demonstrated throughout this Comment, ocean acidification is a significant issue and a part of the larger issue of climate change—a defining problem this century. Ocean acidification has been created by the immense emissions of greenhouse gases since the Industrial Revolution, and now requires aggressive reductions in greenhouse gas emissions. As highlighted by the implications in the Gulf of Maine, a failure to reduce emissions will have permanent and disastrous effects on biodiversity, economies, and much more.[239] As with climate change in general, the ability to predict the effects is never perfect, but it remains clear that the health of the ocean is dire.

Applying the functional equivalent test to carbon dioxide emitting facilities presents a method of regulating, and thus reducing emissions, from these types of facilities. The factors provided by the Supreme Court in *County of Maui* suggest that this is a proper application of Clean Water Act permitting. The balance of the factors weighs in favor of permitting these sources under the Clean Water Act. As the "functional equivalent"

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234. *Everything You Need to Know About RGGI*, S. ENV'T L. CTR., https://www.southernenvironment.org/topic/regional-greenhouse-gas-initiative/ (last visited Oct. 15, 2023) [https://perma.cc/SP2Y-CVGK].

235. *Id.*

236. Wendy Kerner, *Making Environmental Wrongs Environmental Rights: A Constitutional Approach*, 41 STAN. ENV'T L.J. 83, 84 (2022).

237. *Id.*

238. *See id.* at 85.

239. *See supra* Part I.

test was only recently coined by the Supreme Court in 2020, some factors also lack meaningful precedent, even from district courts. Further, when taken with the goals of the Clean Water Act, it is clear that the intended purpose of the Act is to regulate these facilities.

Regulating these facilities will also require a determination that these are point sources, rather than non-point sources. Although this is not how these facilities have been regarded in the past by the EPA, this is not consistent with the definition of point sources or the goals of the Clean Water Act. Upon the proper finding that these facilities are point sources and constitute the functional equivalent of a discharge of pollutants into navigable waters, the EPA will be obligated to require these facilities to obtain NPDES permits. The Clean Water Act mandates technology-based standards, which will ultimately require technology to be adapted to these sources to reduce carbon dioxide emissions. By design, these regulatory effects will reduce the rate of ocean acidification, and thus its detrimental impacts, which is essential for the health of the world's oceans.

Additionally, this Comment should not be construed as proposing that this regulatory use of the Clean Water Act is the only action needed to be taken regarding ocean acidification. Ocean acidification, and climate change generally, requires drastic and multi-faceted solutions. Federal regulation is just one method that should be pursued. The ocean needs stricter regulation of greenhouse gases, new methods of transportation and power production, investment into clean energy, international agreements with binding agreements on limiting carbon emissions, and so much more.[240]

240. V. MASSON-DELMOTTE ET AL., *supra* note 1, at 4.