BLUE CARBON LAW

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This Article explores the emerging law of blue carbon, defined as rules governing human interventions into Earth's marine carbon cycles. Blue carbon law is of growing importance today as pressure mounts to incorporate coastal conservation and restoration activities into market-based carbon sequestration schemes, and as the planet's deep oceans are evaluated for their carbon sequestration potential. The Article conceptualizes two broad trends in blue carbon law: the international law of carbon credit markets creating incentives to commodify and monetize blue carbon resources; and the responsive integration of commodification concepts into existing laws that already manage and influence blue carbon systems, with attendant risks and opportunities. In the United States, the rise of blue carbon appears to be posing a fundamental challenge to long-established international norms and rules for carbon crediting, as U.S. state actors are increasingly pushing to qualify for carbon finance for existing conservation activities. These developments, in turn, raise questions about the valuation of mandated conservation and the potential for the carbon market system to compensate the maintenance and protection of ecosystem services.

I. INTRODUCTION

Following the first Blue Carbon Law Symposium hosted at the University of Georgia in May 2023,[2] this Article seeks to characterize an emerging "law of blue carbon," with specific emphasis on the ongoing development of market-based systems to incentivize marine carbon sequestration, integration of carbon

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[2] The Blue Carbon Law Symposium was a collaboration between the South Carolina Sea Grant Consortium, Georgia Sea Grant, and the University of Georgia School of Law. *See* https://www.scseagrant.org/blue-carbon-law-symposium/.

sequestration concepts into existing legal regimes, guardrails on activities that affect blue carbon sequestration, and recently proposed legislation.

The study reveals a growing interest in creating legal systems that commodify, monetize, maximize, and merchandise the marine environment's carbon sequestration services, as well as a justified growing concern over these proposals. Measurement systems to allow for the management of blue carbon resources; qualification rules for marketable credits that increase confidence in their real-world value; and markets to buy and sell carbon sequestration services to the highest bidder, are offered up as underutilized tools for climate change response that also benefit aquatic ecosystem conservation, and are simultaneously accused of servicing the greenwashing purposes of polluting industry.[3] Whether coming to the topic optimistically, cautiously, or skeptically, it is hoped that this Article will prove useful to anyone seeking to understand and improve emerging laws governing marine carbon sequestration.

In this spirit, Part I of this article endeavors to offer a comprehensive definition of "blue carbon law," arguing that it ultimately encompasses the rules of human intervention into Earth's marine carbon cycles, which are increasingly understood as potential tools in efforts to respond to climate change. Part II reviews the development of carbon credit markets for terrestrial carbon management activities, which have formed the basis for commodification initiatives in the blue carbon realm. Part III then seeks to identify existing laws and legal frameworks that meet the definition of blue carbon law, and to determine how emerging efforts at blue carbon commodification might drive change in these regimes. Part IV, finally, provides a brief conclusion that reviews recent proposed federal legislation and flags the most pressing questions that blue carbon law will need to address in the near future. At the end of the analysis, such questions are less likely to relate to whether blue carbon sequestration will be commodified and traded, than with how it will be, and to whose benefit.

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[3] *E.g.*, *see* Patrick Greenfield, *Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier are Worthless, Analysis Shows*, THE GUARDIAN (Jan. 18, 2023); *and see Verra Response to Guardian Article on Carbon Offsets*, VERRA (Jan. 18, 2023).

II. DEFINING BLUE CARBON LAW

Definitions hold extraordinary power.[4] It is appropriate, therefore, to begin a law review article of this type with a definitional inquiry: "what is blue carbon law"? It is a difficult question, and so the following sections in this Part break it into pieces. The first begins with the noun: what is *carbon*? With that in hand, the next proceeds to consider which of the carbon is *blue*. With those terms clarified, the last section discusses what the *law* of any such thing might be. The Part as a whole defines blue carbon as rules governing human interventions into marine carbon cycles.

A. "Carbon": Life, Energy, and Climate Change

What is carbon? Physicists tell us that it is any atom with six protons in its nucleus.[5] Notwithstanding some details about isotopes, that's all there is to it.[6] Almost all of the carbon in existence today was created in stars over the last

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[4] By defining, for example, what is or is not a "renewable" energy technology, financing is driven toward or away from entire industries. 26 U.S.C. § 45(c) (defining qualifying energy resources for purposes of the clean energy production tax credit). By defining what is or is not a "pollutant," the United States federal government's powers to regulate greenhouse gases causing climate change are restricted or preserved. *Massachusetts v. EPA*, 549 U.S. 497 (2007) (interpreting whether the words "air pollutant" in Clean Air Act § 202 may encompass greenhouse gases causing climate change). By defining what is or is not the "waters of the United States," so is the scope of federal protection for millions of acres of wetlands. Sackett v. EPA, 598 U.S. 651 (2023) (interpreting the term "waters of the United States" under the Clean Water Act for purposes of federal wetlands jurisdiction).

[5] *Carbon*, ENCYCLOPEDIA BRITANNICA (online ed. 2023); *Atom*, ENCYCLOPEDIA BRITANNICA (online ed. 2023). *See generally* INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY (IUPAC), IUPAC PERIODIC TABLE OF THE ELEMENTS AND ISOTOPES.

[6] In 99% of cases, atoms with six protons also have six neutrons, a form of matter called carbon-12. Almost all of the rest of the six-proton group has only one extra neutron, and is called carbon-13. A radioactive isotope, carbon-14, also exists in trace amounts, as it is constantly being created in Earth's atmosphere when cosmic rays transform protons in nitrogen into neutrons. Setting aside lab-made isotopes, these three arrangements of protons and neutrons "are" carbon as found in nature. Many other carbon isotopes have been created in physics labs but are highly unstable and do not occur in nature. IUPAC, CARBON FACT SHEET.

approximately fourteen billion years.[7] There is a great deal of it, in various forms, throughout the known universe, including on Earth.[8]

Carbon's physical structure is uniquely conducive to bonding with other elements to create more complex molecules.[9] Many abundant minerals contain carbon, and Earth's molten mantle and the rocks of its solid crust (the lithosphere) contain a huge amount of it.[10] Earth's other major carbon "reservoirs"[11] include its oceans and other aquatic environments (the hydrosphere); its air (the atmosphere); all of the life upon it (the biosphere), and the relatively near-surface sediments and deeper sedimentary rock layers containing gigantic masses of dead biomass (lacking a catchy -sphere name, but crucial to distinguish). Carbon in its many forms permeates all of Earth's systems.

The reservoirs, however, are only half of the carbon story. The other half is "flux," meaning the aggregate movement of any material between any reservoirs. Billions of tons of nitrogen, oxygen, sulfur, and, yes, carbon, are constantly moving between the oceans, atmosphere, soils, rocks, and life on earth. Together, these reservoirs and fluxes constitute Earth's "biogeochemical cycles," meaning "the natural pathways by which essential elements of living matter are circulated" between earth systems.[12] In the same way that a reservoir behind a dam is actually always emptying over the dam and refilling from its stream

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[7] Jennifer A. Johnson, *Populating the Periodic Table: Nucleosynthesis of the Elements*, 363 SCI. 474, 475 (2019).
[8] Jie Li et al., *Carbon versus Other Light Elements in Earth's Core*, *in* DEEP CARBON: PAST TO PRESENT [hereinafter DCPP] 40, 57 (Beth N. Orcutt et al. eds. 2020) (approximately 1% mass fraction carbon in earth's core); Cin-Ty A. Lee et al., *A Framework for Understanding Whole-Earth Carbon Cycling*, *in* DCPP, 313, 316 Fig. 11.3 (excluding earth's core, earth's carbon reservoirs total about $1.75*10^{18}$ (1.75 quintillion) tons).
[9] *Carbon Bonding*, ENCYCLOPEDIA BRITANNICA (online ed. 2023) ("The carbon atom is unique among elements in its tendency to form extensive networks of covalent bonds not only with other elements but also with itself.").
[10] Maria Temming, *Here's Where Earth Stores Its Carbon*, SCI. NEWS (Oct. 1, 2019).
[11] In earth sciences, a "reservoir" is "an amount of material defined by certain physical, chemical, or biological characteristics that, for the purposes of analysis we consider to be reasonably homogenous. Examples: oxygen in the atmosphere…" Michael C. Jacobson et al., *Introduction: Biogeochemical Cycles as Fundamental Constructs for Studying Earth System Science and Global Change*, *in* EARTH SYSTEM SCIENCE: FROM BIOGEOCHEMICAL CYCLES TO GLOBAL CHANGES (Jacobson ed., 2d ed. 2000).
[12] *Biogeochemical Cycle*, ENCYCLOPEDIA BRITANNICA (online ed. 2023) (emphasis added).

source, seemingly static accumulations of the elements of nature are constantly being depleted and replenished in reservoirs as these materials circulate via biological, chemical, and physical processes. In the "deep" (or "slow") carbon cycle, vast amounts of carbon flow between Earth's mantle and its atmosphere and vice versa, outward via volcanic activity, and inward along numerous pathways, from CO_2 absorption by the world's oceans, to incorporation of carbon into marine life forms, to sedimentation of the carbon in those life forms after they have died, to the movement of the carbon-bearing sediments into the mantle via mineralization and plate tectonics.[13] Each of these subprocesses is also itself a cycle, also occurring constantly.[14] At all times, the growth or diminution of any given reservoir is attributable to the difference between total fluxes – additions and subtractions – via these movement processes.

Understanding carbon in terms of biogeochemical cycling, it is possible to appreciate the amazing role that carbon plays in three separate but interrelated processes: life, energy, and climate change. Again, carbon's unique structure results in its propensity to form chemical compounds, and one special class of these are the organic molecules, essential to life. "Carbon-based life-forms" are called that because carbon makes up something like half (by dry weight) of all the biomass on Earth,[15] and all known life is built on and requires carbon to function. Yet this is only the beginning of carbon's import to humanity. Millions of years of sedimentation of organic carbon compounds has resulted in the formation of massive reservoirs of fossil hydrocarbons – materials we call coal, and oil, and natural gas, or "fossil fuels"[16] – which have a special property all their own: in the presence of oxygen, and with sufficient activation energy, they burn.[17]

Humanity's modern energy potential was unlocked with the discovery, extraction, beneficiation, and combustion of fossil fuels.[18] And yet the same

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[13] *See* Lee et al., *supra* note 8.
[14] Holli Riebeek *The Carbon Cycle*, NASA EARTH OBSERVATORY (Jun. 16, 2011).
[15] Yinon Bar-On et al., *The Biomass Distribution of Earth*, 115 PNAS 6506 (2018) ("All of our reported values can be transformed to dry weight to a good approximation by multiplying by 2, the characteristic conversion factor between carbon and total dry mass").
[16] Bob Strauss, *Does Oil Come from Dinosaurs?*, THOUGHTCO (Aug. 15, 2019).
[17] *Combustion*, ENCYCLOPEDIA BRITANNICA (online ed. 2023).
[18] *See generally*, DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER (2008); TIMOTHY MITCHELL, CARBON DEMOCRACY: POLITICAL POWER IN THE AGE OF OIL (2011).

unique attributes that give rise to carbon's usefulness also have produced its third and final role: as existential threat to the modernity it has helped create. Hydrocarbon combustion releases energy, true, but elemental matter cannot be created or destroyed, only converted. In the process of hydrocarbon combustion, the carbon atoms in fossil fuels are recombined with oxygen to form carbon dioxide. Those sedimented reservoirs of ancient life that would, undisturbed, eventually have been reabsorbed into Earth's mantle, have instead been blasted by the megaton into the atmosphere for the last two hundred years. Prior to the industrial revolution, Earth's atmosphere contained about 270-280 ppm CO_2, while today that concentration has increased to about 420 ppm, and is rising steadily.[19] This new human-caused fossil-atmospheric flux, far in excess of earth's natural countervailing removal fluxes, has increased the atmospheric carbon stock and thus the thermodynamic properties of the atmosphere itself, resulting in a gradual increase in Earth's global mean surface temperature, and all of the climatic disruptions and catastrophes, past, present, and future, that this entails.[20]

Carbon, the sixth element, is fundamental to life, to energy, and to climate change. This latter threat has driven the development of the sciences discussed above, as humanity has realized that its intervention into the planet's deep carbon cycle now threatens us all, and has asked what might be done to slow or even reverse the coming change.

B. "Blue Carbon": Location, Destination, and Convention

In this context, what is blue carbon? To be clear, to the extent that carbon has any color, none of it is blue. Rather, the term "blue carbon" comes from a need to distinguish important parts of the carbon cycle from each other, and it is the fashion of the day to identify subcategorizations and taxonomies of climate-

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[19] *Keeling Curve*, UNIV. OF CAL., SAN DIEGO (last visited Feb. 14, 2024) (continuous atmospheric CO_2 sampling data since 1958); Tom M.L. Wigley, *The Pre-Industrial Carbon Dioxide Level*, 5 CLIMATIC CHANGE 315 (1983) (260-290 ppm).

[20] For the current state of climate science, *see* CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (Masson-Delmotte et al., eds.) (2021).

and energy-related systems using colors.[21] The so-called "colors of carbon" distill some of the complexity of carbon cycles by "moving past traditional, broad classifications … to more nuanced definitions based on carbon function, attribute, or location."[22] But what this means in practice is that "blue carbon" is whatever people say it is, and what they say it is, is – mostly – marine carbon, with a great deal of debate around the edges.

The term "blue carbon" entered into the literature in substantially its present form in a 2009 United Nations Environment Programme report titled *Blue Carbon: The Role of Healthy Oceans in Binding Carbon*,[23] which argued for increased consideration of ocean carbon cycles in climate policy. Although the report was not overly concerned with definitions, it defined blue carbon in passing as "the carbon captured by the world's oceans," meaning the carbon absorbed and ultimately "sequestered" (stored for some duration, ideally permanently) in all marine ecosystems and sediments, which the report argued was a potentially important component both of emissions reduction and future atmospheric carbon removal efforts. Despite its focus on deep ocean sequestration potential, however, the report mostly examined coastal vegetated ecosystems such as mangroves, seagrasses, and salt marshes, which the report described as responsible for about half of the ocean's annual carbon intake flux.[24] Thus, the first use of the term "blue carbon" introduced some fundamental ambiguity, as it seemed to focus mostly on the location of the carbon stock (coastal, deep, etc.), while closer consideration reveals that it was truly concerned with destination: the report told us that blue carbon was not just carbon in marine ecosystems, but also carbon ultimately bound to be sequestered in them.

This ambiguity matters because "blue carbon" is often discussed today as if it was a locational delineation only, even though locational boundaries by

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[21] Natalie Marchant, *Grey, Blue, Green – Why Are There So Many Colours of Hydrogen?*, WORLD ECON. FOR. AGENDA (Jul. 27, 2021).
[22] Laura Zinke, *The Colours of Carbon*, 1 NATURE REV. EARTH & ENV'T 141 (2020).
[23] United Nations Environment Programme Rapid Response Assessment, BLUE CARBON: THE ROLE OF HEALTHY OCEANS IN BINDING CARBON (Christian Nellemann et al., eds. 2009) ["UNEP Blue Carbon Report"]. The report used a taxonomy of brown, black, blue, and green carbon that has not caught on. *Id.* at 15-19. *See also* Google Ngram Viewer for term "blue carbon," ("blue carbon" usage begins climbing in 2010, immediately after UNEP report published).
[24] UNEP Blue Carbon Report, *supra* note 23, at 37, 39; Appendix 1.

themselves create more confusion than clarity (as was discussed in the Symposium[25]). For example, "coastal blue carbon" could be understood as just the carbon currently bound up in coastal ecosystems. But it could also be understood as all the carbon in coastal ecosystems that is destined to be sequestered, or even all the carbon destined to be bound up in coastal ecosystems (meaning even, perhaps, some amount of carbon currently in the atmosphere), whether or not destined to be sequestered later; or something else entirely. Similar problems arise when considering the carbon bound up in ocean waters and life. Does the portion of carbon currently bound up in marine biomass but destined to be re-released into the atmosphere count? What about inorganic carbon dissolved in ocean water? Again, the destination-based distinction helps – it is clearer if blue carbon is only the carbon that ends up sequestered in or under the ocean, although it is still a little vague how long it has to stay there to qualify as "sequestered."

The locational focus also gives rise to debate about whether other watery ecologies should qualify. Should terrestrial wetlands, peatlands, or sediments under rivers and lakes be discussed as blue carbon? These are also aquatic ecosystems, and if "blue carbon" means aquatic carbon, then why exclude them? Furthermore, if the focus is on destination, and the goal is sequestration, then shouldn't sequestration in aquatic environments all be considered and counted, regardless of the distinctions between upland, coastal, or marine environments? On the other hand, distinct ecological characteristics do justify divisions and distinctions – peatland, for example, produces more methane than does, say, marine shell formation. Instead, the terms "green carbon" (for terrestrial forests and peatlands) and "teal carbon" (for freshwater ecosystems) have begun to be used. This gives rise to its own confusion, however, as, for example, carbon that begins in terrestrial ecosystems can be washed via rivers into the oceans.[26] Is this green, or teal, or blue carbon, or all three? And if destination is part of the definition, is this blue carbon from beginning to end, or only at the moment it enters the ocean? This ambiguity suggests the need for a cutoff rule – a moment at

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[25] There was debate about whether, for example, peatlands and carbon in freshwater rivers and lakes should "count" as blue carbon.

[26] Terry Plank & Craig E. Manning, *Subducting Carbon*, 574 NATURE 343 (2019) ("Terrestrial organic carbon is also washed onto the seafloor by large rivers.").

which some other kind of theoretical blue carbon (e.g., carbon that might get drawn into the ocean from the atmosphere) actually becomes blue carbon.

With these concerns noted, this Article will follow the weight of current convention and use the term "blue carbon" hereafter to mean any carbon destined for sequestration in and under the world's oceans, at the point at which it enters the marine environment, while noting that debate continues about the pros and cons of the choices embodied in this definition. Ultimately, these efforts at color-coded taxonomical simplification are no substitute for a clear understanding of which carbon cycle processes, specifically, are being discussed, or governed, at any given time.

C. "Blue Carbon Law": The Rules of Intervention

Given the above, what is blue carbon law? The addition of one short word – "law" – has serious consequences, as it implies a profound shift in focus. Carbon is physical stuff. Blue carbon may be a human construct, but it is mostly a descriptive one, focusing, again, on matter, and matters, beyond human control. Blue carbon *law*, however, implies something more human: human activity, and human social systems to control or influence that activity. By adding one short word, therefore, we must add the consideration of human activities concerning blue carbon.

Defining blue carbon as carbon destined to be sequestered in marine environments, then it follows that relevant human activities are those that influence marine carbon sequestration processes, whether in quantity or quality. As already discussed, humanity's release of sequestered fossil carbon into the atmosphere is profoundly influencing Earth's carbon cycles. It is well established that this, in turn, is influencing the marine carbon cycle, as the oceans absorb CO_2 in relation to the amount of it in the atmosphere. But there are many, many other human activities that also influence the marine carbon cycle. Which should qualify as the purview of blue carbon law? As everything in the carbon cycle is connected, arguably even power plant emissions controls are blue carbon law, but this seems intuitively overbroad. Rather, some constraining factor is required.

The fluxes are that factor. To this point, Earth's carbon cycles have been discussed as if they "just happen," but the movement of material, the fluxes, are operative processes that are influenced by many outside factors, including human factors. In the marine context, two of these processes are often referred to as the "ocean carbon pumps": the "solubility pump" is the tendency of ocean circulation and pressure to draw carbon downward through the marine water column, while the "biological pump" describes the same phenomenon driven by marine life.[27] Other processes that result in marine carbon sequestration include transport via weathering of carbonaceous rocks and terrestrial organic carbon picked up in river waters[28] and sedimentation of dead vegetation in coastal ecosystems.[29] Human activities have influenced all of these processes. Shoreline development has reduced coastal carbon sequestration pathways.[30] Fishing has negatively influenced the ocean's biological carbon pump,[31] as has ocean acidification.[32] Having realized this, numerous proposals for purposeful human intervention into these cycles – marine geoengineering – have also arisen; as have numerous proposals to influence and regulate the human activities that indirectly influence blue carbon. It is in all of these human activities, finally, that law comes into play. All of these must be the subject of blue carbon law.

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[27] Tim DeVries, *The Ocean Carbon Cycle*, 47 ANN. REV. ENV'T RES. 317 (2022); David A. Siegel et al., *Quantifying the Ocean's Biological Pump and Its Carbon Cycle Impacts on Global Scales*, 15 ANN. REV. MAR. SCI. 329 (2023).

[28] Robert G. Hilton & A. Joshua West, *Mountains, Erosion and the Carbon Cycle*, 1 NAT. REV. EARTH ENV'T 284 (2020).

[29] Daniel M Alongi, *Carbon Sequestration in Mangrove Forests*, 3 CARBON MGMT. 313 (2012); Carlos M. Duarte & Dorte Krause-Jensen, *Export from Seagrass Meadows Contributes to Marine Carbon Sequestration*, 4 FRONT. MAR. SCI. art. 13 (2017); Dorte Krause-Jensen & Carlos M. Duarte, *Substantial Role of Macroalgae in Marine Carbon Sequestration*, 9 NAT. GEOSCI. 737 (2016).

[30] Tyler C. Coverdale et al., *Indirect Human Impacts Reverse Centuries of Carbon Sequestration and Salt Marsh Accretion*, 9 PLOS ONE e93296 (2014).

[31] Grace K. Saba et al., *Toward a Better Understanding of Fish-Based Contribution to Ocean Carbon Flux*, 66 LIMNOL. OCEANOGR. 1639 (2021); Daniele Bianchi et al., *Estimating Global Biomass and Biogeochemical Cycling of Marine Fish with and without Fishing*, 7 SCI. ADV. eabd7554 (2021); Gaël Mariani et al., *Let More Big Fish Sink: Fisheries Prevent Blue Carbon Sequestration—Half in Unprofitable Areas*, 6 SCI. ADV. eabb4848 (2020).

[32] Dieter A. Wolf-Gladrow & Björn Rost, *Ocean Acidification and Oceanic Carbon Cycling*, *in* GLOBAL ENV'T CHANGE 103 (Bill Freedman ed., 2014); Matthias Hofmann & Hans-Joachim Schellnhuber, *Oceanic Acidification Affects Marine Carbon Pump and Triggers Extended Marine Oxygen Holes*, 106 PNAS 3017 (2009).

In other words, blue carbon is not only a location or a destination or a moment of arrival, but the result of a variety of processes which, themselves, can be and are influenced by human behavior. The law of blue carbon, then, must be society's efforts to govern those behaviors. If "law" is understood as a general term for systems of socially agreed-upon rules to support social constructions of responsibility, entitlement, permission, and prohibition, then "blue carbon law" means the rules for the treatment of the ocean as a tool in the larger project of global carbon management—the rules to govern human intervention into Earth's marine carbon cycles.

As will be explored in detail below, many existing laws and legal systems already qualify as "blue carbon law" under these definitions. From local laws controlling shoreline development, to the international system of maritime jurisdiction under the UN Convention on the Law of the Sea, rules already exist that influence and govern (or decline to govern) human activities that impact marine carbon cycles. But before getting to these rule systems, it is necessary to examine in some detail another emerging legal system that is influencing all the others: the market commodification of carbon sequestration services.

III. BLUE CARBON IN THE INTERNATIONAL CARBON MARKET FRAMEWORK

At this moment, a law of blue carbon *markets* is emerging, and this in turn will render great change on many other systems of blue carbon law. This Part, therefore, discusses this new phenomenon, the rise of blue carbon in the international carbon market framework. With new market mechanisms creating new opportunities to profit from management of qualifying carbon resources, governments and private actors are increasingly recognizing their carbon resources as potential sources of revenue.[33] Simultaneously, blue carbon resources are increasingly understood as some of the highest-value carbon resources in existence, with blue carbon credits consistently attracting a premium on voluntary

[33] Natasha White & Ewa Kurkowska, *Global Carbon Markets Face Upheaval as Nations Remake the Rules*, BLOOMBERG GREEN (Jun. 5, 2023). *See also* Christine Bertram et al., *The Blue Carbon Wealth of Nations*, 11 NATURE CLIMATE CHANGE 704 (2021) (evaluating potential value of national blue carbon sequestration potential).

markets.[34] This combination of factors has driven the recent creation of blue carbon crediting mechanisms that could transform coastal and marine ecosystem conservation funding.

But in order to truly appreciate what is happening, it is necessary to begin by stepping back into the history of the international market framework for carbon sink protection and enhancement more generally. In the language of reservoirs and fluxes, there has been a great deal of effort to create market systems to incentivize the purposeful expansion of the atmosphere-biosphere carbon flux, by rewarding activities that increase the amount of carbon stored (or "sequestered")[35] in terrestrial plant life, which must necessarily have removed that carbon from the atmosphere.

As discussed below, blue carbon crediting is built on the international "land use, land-use change, and forestry" crediting rules that began developing under the UN Framework Convention on Climate Change and its subsidiary agreements in the mid-1990s. This body of law, primarily concerned with the inclusion of carbon sequestration-enhancing activities in climate emissions inventory and reduction regimes, attempted to commodify, monetize, and compensate carbon sequestration-promoting behaviors in terrestrial forests. It is mostly concerned with qualification rules, that is, in determining which activities "count" for purposes of inclusion in these schemes, and these questions have proven to be enormously controversial. Yet, as will become clear, all of the issues associated with the forest carbon credit system are directly translatable to the blue carbon context. Thus, the story of the "sinks options" under the international climate law framework is also where the legal story of blue carbon law must begin. Rules developed for the Clean Development Mechanism (CDM) and Reducing Emissions from Deforestation and Forest Degradation (REDD+)

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[34] Daniel A. Freiss et al., *Capitalizing on the Global Financial Interest in Blue Carbon*, 1 PLOS CLIMATE e0000061 (2022) ("Current blue carbon credit sales attract a premium in comparison to traditional large-scale REDD+ projects"); *Carbon Exchange CIX Completes 250,000 Tonne Carbon Credit Auction*, REUTERS (Nov. 4, 2022) (blue carbon credits sold at 40% premium).

[35] Although carbon sequestration is, technically, the "long-term storage" of carbon in a non-atmospheric reservoir, major challenges arise in defining the length of time that qualifies as "long-term," or, better yet, "permanent." *See generally* *Carbon sequestration*, ENCYCLOPEDIA BRITANNICA (online ed. 2023).

programs initiated under the Kyoto Protocol live on in the emerging law of blue carbon markets.

A. The Model: "Sinks Options" under International Climate Law

The United Nations Framework Convention on Climate Change (UNFCCC) is the primary international treaty on climate change,[36] and the international law of climate change is, primarily, whatever is agreed to by the parties following UNFCCC processes. The UNFCCC, as ratified in 1992, contained no binding emissions reduction commitments by signatory nations, rather leaving those to be developed later. At the first UNFCCC Conference of Parties (COP1),[37] held in Berlin in 1995, the parties, including the United States, agreed to begin developing a subsidiary treaty protocol that would include stringent national emissions reduction commitments by industrialized nations.[38] The work on this new protocol was completed in 1997, and the treaty parties officially adopted the new framework for mandatory national emissions reductions at COP3, held at Kyoto.[39]

The Kyoto Protocol, as it was called, was mostly concerned with creating a binding schedule of carbon emissions reductions to be followed by wealthy, industrialized nations. In the language of the treaty, these parties agreed to achieve "quantified emission limitations" by means of national "reduction

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[36] U.N. Framework Convention on Climate Change, May 9, 1992, S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107. *See also* https://unfccc.int/ (UNFCCC information portal).

[37] By convention, the UNFCCC conferences of parties are identified sequentially, COP1, COP2, etc. The outcomes of the meetings are also often identified by the name of the city where the conference was held (e.g., Berlin, Kyoto, Bali, Cancun, etc.). *See*, *Bodies: Conference of Parties (COP)*, UN CLIMATE CHANGE (last visited Feb. 14, 2024). Party decisions are numbered sequentially as #/CP.# – for example the third decision at COP4 is identified 3/CP.4.

[38] UNFCCC Dec. 1/CP.1, *The Berlin Mandate: Review of the Adequacy of Article 4, Paragraph 2(a) and (b), of the Convention, including Proposals related to a Protocol and Decisions on Follow-up* (Apr. 7, 1995), *published in* UN Doc. FCCC/CP/1995/7/Add.1.

[39] UNFCCC Dec. 1/CP.3, *Adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change*, *published in* UN Doc. FCCC/CP/1997/7/Add. [hereinafter Kyoto Protocol]. Confusingly, the Kyoto Protocol required its own series of meetings and decisions, which occurred simultaneously with the COPs, and were called Conferences of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). Decisions reached at these meetings are designated #/CMP.#.

commitments."[40] As relevant here, however, the agreement endorsed several mechanisms that allowed participating nations to reduce their national emissions reduction responsibilities not by actually reducing emissions at the source, but rather by protecting and enhancing carbon "sinks," meaning reservoirs that are drawing in atmospheric carbon, primarily in forests. In the language of the treaty, nations could take credit for reductions-equivalents achieved via the "protection and enhancement of sinks and reservoirs of greenhouse gases."[41]

i. The Kyoto Mechanisms and REDD+ Paradigm

The Kyoto Protocol's "sinks options" required the creation of a complex system of accounting rules for identifying and tracking units of reduced-emissions-via-sinks-activities, and new rules to define which activities would and would not be allowed to generate qualifying credits. The Kyoto Protocol created three pathways, or "mechanisms" in the language of the treaty, for claiming GHG reductions via sinks protection and enhancement: "Joint Implementation" (JI), which allowed nations to transfer certain "emissions reduction units" they generated by "enhancing anthropogenic removals by sinks;"[42] the "Clean Development Mechanism" CDM), which allowed industrialized nations to accrue "certified emissions reductions" through investment in "project activities" in developing nations;[43] and market trading mechanisms, or at least support for an international carbon credit market, as the parties were allowed to work to define "the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading" in the future.[44]

Writing in 2001, in terms that resonate to this day, analysts noted that there was a great deal of controversy over the inclusion of the Kyoto Protocol's sinks options even as they were introduced:

> These so-called 'sinks' options have remained controversial for several reasons. Some fear that changes in emissions and uptakes

[40] *Id.* Art. 3, ¶ 1.
[41] *Id.* Art 2, ¶ 1(a)(ii).
[42] *Id.* Art. 6.
[43] *Id.* Art. 12.
[44] *Id.* Art. 17.

> by sinks cannot be measured with sufficient accuracy, thus distorting compliance requirements and threatening trading in carbon credits. Some see carbon stored in terrestrial pools as inherently impermanent and unstable, in that human activities may lead to their release at any time. Others see them as a diversion from … the reduction of fossil emissions.[45]

All of these concerns have a basis in reality. Measurement of carbon sequestration on broad scales is an extraordinarily difficult task involving a great deal of uncertainty that can only be reduced, never eliminated, by incorporating up to date scientific research into accounting methodologies which must then be consistently and accurately applied. Credits must rely on what are essentially promises not to disturb or release sequestered carbon, which always presents risks that promises will be broken – or that events more outside of human control, like forest fires, will render promises meaningless. And finally, even if the market is working perfectly, it is simply not possible to offset all of humanity's carbon emissions through the sinks options, and fears that forestry activities will be used to mask failures to achieve necessary absolute emissions reductions is probably the most important contributor to ongoing hesitancy to incorporate these activities into existing emissions reduction schemes. But again, these problems have been recognized for over thirty years, and the UNFCCC parties still moved forward, slowly but steadily, with crediting rules.

Immediately after the Kyoto Protocol was ratified, work proceeded on developing rules for crediting terrestrial carbon stock management activities under its compliance mechanisms (Appendix 1 gathers the relevant decisions together for ease of reference). In 1998, the parties agreed to bifurcate the process and to begin by developing rules for human-induced "afforestation, reforestation, and deforestation,"[46] meaning rules to assess and credit various changes in terrestrial carbon stocks. What this meant was that the parties also agreed to put

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[45] Ian Noble and R.J. Scholes, *Sinks and the Kyoto Protocol*, 1 CLIMATE POLICY 5, 5-6 (2001).
[46] UNFCCC Dec. 9/CP.4, *Land-Use, Land-Use Change and Forestry* (1998), *published in* UN Doc. FCCC/CP/1998/16/Add.1.

off developing rules for carbon stock maintenance and conservation until a later date.

Consistent with this approach, from 1998 to 2005 the UNFCCC parties created rules for crediting what were now called "Land Use, Land Use Change, and Forestry" (LULUCF) activities under the Kyoto compliance mechanisms. LULUCF activities were allowed to be applied to industrialized nations' reduction commitments;[47] the standard unit of measurement was set to 1 ton of CO_2-equivalent (CO_2e);[48] the CDM was allowed to include only "afforestation and reforestation" activities for its first compliance period (2008-2012),[49] and these credits were only to be used while "taking into account the issues of non-permanence, additionality, leakage, uncertainties and socio-economic and environmental impacts, including impacts on biodiversity and natural ecosystems."[50] National limits were set on how much CDM forestry crediting could be used;[51] national inventories were ordered for terrestrial carbon reservoirs;[52] and good practice guidance for such inventories was developed and adopted.[53] These efforts ultimately resulted in detailed rules for validation,

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[47] Proposed in UNFCCC Dec. 15/CP.7, *Principles, Nature and Scope of the Mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol* (2001), *published in* UN Doc. FCCC/CP/2001/13/Add.2; adopted as proposed in UNFCCC Dec. 2/CMP.1 ¶ 6 (2005), *published in* UN Doc. FCCC/KP/CMP/2005/8/Add.1.

[48] Proposed in UNFCCC Dec. 16/CP.7, *Guidelines for the Implementation of Article 6 of the Kyoto Protocol* (2001), UNFCCC Dec. 17/CP.7, *Modalities and Procedures for a Clean Development Mechanism, as defined in Article 12 of the Kyoto Protocol* (2001), and UNFCCC Dec. 18/CP.7, *Modalities, Rules and Guidelines for Emissions Trading under Article 17 of the Kyoto Protocol* (2001), *published in* UN Doc. FCCC/CP/2001/13/Add.2; adopted as proposed in UNFCCC Decs. 9/CMP.1, 3/CMP.1, and 11/CMP.1 (2005), respectively, *published in* UN Docs. FCCC/KP/CMP/2005/8/Add.1 & /Add.2.

[49] UNFCCC Dec. 17/CP.7 ¶ 7(a) (2001).

[50] UNFCCC Dec. 11/CP.7 ¶ 2(e) (2001) (instructing development of "modalities" for including Article 12 afforestation and deforestation project activities). Avoided deforestation was excluded from the first Kyoto compliance period. Raymond E. Gullison et al., *Tropical Forests and Climate Policy*, 316 SCIENCE 985 (2007).

[51] Proposed in UNFCCC Dec. 11/CP.7, *Land use, Land-Use Change and Forestry*, *published in* UN Doc. FCCC/CP/2001/13/Add.1; adopted as proposed in UNFCCC Dec. 16/CMP.1, published in UN Doc. FCCC/KP/CMP/2005/8/Add.3.

[52] *Id.*

[53] Proposed in UNFCCC Dec. 13/CP.9, *Good practice guidance for land use, land-use change and forestry in the preparation of national greenhouse gas inventories under the Convention* (2003), published in UN Doc. FCCC/CP/2003/6/Add.1; adopted as proposed in UNFCCC Dec. 17/CMP.1 (2005), published in UN Doc. FCCC/KP/CMP/2005/8/Add.3.

verification, and registration of afforestation and reforestation projects under the Kyoto mechanisms.[54] Again, however, the LULUCF projects qualifying for the Kyoto mechanism did not include all sequestration-enhancing land use activities, nor any activities that reduced or avoided ongoing deforestation. These were left to other policy processes to develop.

The second set of crediting rules was developed under a framework the parties initially called "reducing emissions from deforestation in developing countries" (RED),[55] and then "reducing emissions from deforestation *and forest degradation* in developing countries" (REDD),[56] and finally REDD *plus* any "additional forest-related activities that protect the climate" (REDD+).[57] The various relevant UNFCCC discussions on the topic were eventually finalized in a series of decisions referred to as the Warsaw Framework for REDD+.[58] Unlike the LULUCF rules, which were used for national emissions reduction compliance purposes, the REDD+ paradigm developed into a voluntary program concerned with development financing in developing countries, to support their protection rather than exploitation and destruction of terrestrial carbon stocks, but without clear integration into the reduction compliance system. In the language of the treaty, the parties agreed to seek to encourage "appropriate market-based

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[54] Proposed in UNFCCC Dec. 19/CP.9, *Modalities and Procedures for Afforestation and Reforestation Project Activities under the Clean Development Mechanism in the First Commitment Period of the Kyoto Protocol* (2003), published in UN Doc. FCCC/CP/2003/6/Add.2; adopted as proposed UNFCCC Dec. 5/CMP.1 (2005), *published in* UN Doc. FCCC/KP/CMP/2005/8/Add.1.

[55] UNEP-WCMC, REDUCING EMISSIONS FROM DEFORESTATION: A KEY OPPORTUNITY FOR ATTAINING MULTIPLE BENEFITS (2007); UNEP-WCMC, REDUCING EMISSIONS FROM DEFORESTATION: GLOBAL MECHANISMS, CONSERVATION AND LIVELIHOODS (2007) (early reports discussing "RED").

[56] RA Houghton et al., *The Role of Science in Reducing Emissions from Deforestation and Forest Degradation (REDD)*, 1 CARBON MGMT. 253 (2010) (describing transition from RED to REDD to REDD+, 2007-2011) (emphasis added).

[57] UN Climate Change, *What is REDD+?*.

[58] *Warsaw Framework for REDD+*, REDD+ WEB PLATFORM (last visited Feb. 14, 2024). Additional documentation is available on the REDD+ Web Platform, and particularly the Lima REDD+ Information Hub, https://redd.unfccc.int/info-hub.html.

approaches"[59] and "results-based finance"[60] for REDD+ activities. Toward this end, developing country parties were invited to submit "forest reference emission levels," essentially determinations of ongoing deforestation rates, to serve as baselines against which avoided deforestation and associated payments could be calculated.[61] But avoided deforestation payments under REDD+ remained entirely voluntary, and the manner in which money flowed for them, and the manner in which credit for them was taken, was not resolved by UNFCCC rulemaking. Rather, private parties and the voluntary market (discussed in the next section) stepped in to fill the gap. REDD+ became a system for wealthy countries to pay countries with tropical forests to leave them intact rather than clear-cut them – but those payments were in addition to whatever activities those countries were doing to reduce their national emissions – and other parties attempting to take credit for these conservation activities has been highly controversial.

In summary, the Kyoto Protocol crediting frameworks for LULUCF activities under the JI, CDM, and carbon markets mechanisms, and later the rules for REDD+ programs, created the first public international law governing human intervention into carbon cycles, albeit only part of the terrestrial component of the atmosphere-biosphere cycle. The purpose of these rules was to create incentives for behavior impacting the quantity and rate of growth of terrestrial carbon reservoirs, with different rulesets for sequestration increases (afforestation and reforestation) and sequestration maintenance (avoided deforestation, etc.).

For purposes of the discussion of blue carbon, what is important is that these legal frameworks are directly translatable models for blue carbon law.

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[59] UNFCCC Dec. 2/CP.17, *Outcome of the Work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention* ¶66 (2011); UNFCCC Dec. 1/CP.18, *Agreed outcome pursuant to the Bali Action Plan* ¶¶28-29 (2012) (creating work plan to improve finance mechanisms), published in *Key Decisions Relevant for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+)* (Feb. 2016) [hereinafter Decision Booklet REDD+].

[60] UNFCCC Dec. 9/CP.19, *Work Programme on Results-Based Finance to Progress the Full Implementation of the Activities referred to in Decision 1/CP.16, Paragraph 70* (2013), published in Decision Booklet REDD+.

[61] UNFCCC Dec. 12/CP.17, *Guidance on Systems for Providing Information on How Safeguards Are Addressed and Respected and Modalities relating to Forest Reference Emission Levels and Forest Reference Levels as referred to in Decision 1/CP.16* (2011), published in Decision Booklet REDD+.

Increasing biomass, whether coastal vegetation or marine phytoplankton or something else, is akin to afforestation, in that it has a positive long-term carbon reservoir increase potential. Similarly, restoring damaged wetlands or fisheries stocks or ocean pH or anything else is akin to reforestation, and is subject to some of the same concerns about baselines and timing that reforestation rules have had to address. Just so, coastal wetlands conservation and other avoided reservoir degradation programs are directly equivalent to avoided deforestation paradigms, with all the same problems. The Kyoto Protocol, then, created a ready-made ruleset for blue carbon credit creation and exchange.

To better understand the developing law of many of these systems, however, it is also necessary to move beyond the UN framework, into the systems of private governance that have developed to define qualification for the associated benefits. That is, it is necessary to examine the voluntary markets and carbon credit methodologies which developed in response to the Kyoto sinks options, and which have recently expanded to encompass blue carbon projects.

ii. Voluntary Markets and Private Methodologies

The Kyoto Protocol drove the development of so-called "compliance markets" for emissions reduction credits, meaning credit systems that allowed regulated entities to demonstrate their compliance with reductions mandates or commitments. These compliance markets were concerned with gatekeeping, accepting only those credits that met each relevant mandate's standards.[62] But mandate systems like the Kyoto Protocol were never universally adopted, and therefore were not the only drivers of demand for carbon credits. Many parties not subject to mandatory reduction responsibilities still wished to demonstrate their environmental commitments by claiming carbon reduction through the purchase of credits, and a parallel "voluntary market" system developed, fractious and fragmented, to serve this demand.[63] Although these are often discussed as totally

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[62] *See, e.g.*, *Development of EU ETS (2005-2020)*, EUROPEAN COMM'N (last visited Feb, 15, 2024) (Kyoto Protocol drove "need for policy instruments to meet [its] targets."). N.B.: two significant subnational emissions reduction regimes emerged in the United States after that country refused to ratify the Kyoto Protocol. The California Cap-and-Trade system, and the Regional Greenhouse Gas Initiative influenced the development of qualification methodologies in similar fashion.
[63] *Mandatory & Voluntary Offset Markets*, CARBON OFFSET GUIDE (last visited Feb. 15, 2024).

distinct systems, methodologies have developed that serve both, and the distinction is not always so clear cut. Both systems are built on similar basic concepts relating to the creation of tradable credits, and thus the compliance and voluntary accreditation standards co-evolved, answering the same fundamental questions, sometimes differently, sometimes not. In both, credit "integrity" is of paramount concern, and legal uncertainties remain to be resolved.

The "carbon credit" concept has been around since at least the 1990s, as U.S. policymakers imported prior market-based air pollution control systems – particularly the Montreal Protocol cap and trade system for ozone depleting substances, and the 1990 Clean Air Act Amendments' marketable credit system for sulfur dioxide pollution – into the context of emerging international agreements on climate change.[64] Significant progress began to be made on standardization of carbon credit systems around 2005, the same time that the Kyoto Protocol parties adopted the LULUCF rules discussed above. In quick succession, several influential "project-based" accounting protocols were released.

In 2005, the GHG Protocol organization issued a *GHG Protocol for Project Accounting*, proposing voluntary rules for organizations attempting to claim reductions from emissions-sequestration project activities.[65] In 2006, the International Organization for Standardization issued its ISO 14064 standard, including ISO-14064-2 and 14064-3, creating "principles and requirements … for monitoring, quantifying and reporting [GHG] project performance relative to baseline," and for "validating or verifying" the GHG removal claims made in any given creditable carbon projects.[66] In the same year, the Voluntary Carbon

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[64] Carbon credits were first discussed in the U.S. Congress in 1991, by reference to these analogous systems. Testimony of Rep. Sherwood Boehlert, *Technologies and Strategies for Addressing Global Warming: Hearing before the House Committee on Science, Space, and Technology, 102d Cong.* 8-10 (Jul. 17, 1991) (advocating for a market-based approach to GHG reduction based on the acid rain market system enacted in the Clean Air Act Amendments of 1990).

[65] THE GREENHOUSE GAS PROTOCOL, THE GHG PROTOCOL FOR PROJECT ACCOUNTING (2005). Around the same time, the GHG Protocol also issued corporate accounting protocols that have been much more influential. *See* THE GREENHOUSE GAS PROTOCOL, A CORPORATE ACCOUNTING AND REPORTING STANDARD (2004) (revised in 2015).

[66] INT'L ORG. FOR STANDARDIZATION, ISO 14064-2:2006 v (2006).

Standard Association (VCSA, renamed "Verra" in 2018) published its first Voluntary Carbon Standard (VCS), which was updated for consistency with ISO-14064 in 2007.[67] This last effort proved to be the most important and lasting of the early standards.

VCS 2007, as it was called, sought to provide universal rules for the creation of what it called Voluntary Carbon Units (VCUs), meaning credits for the reduction or removal of one ton of CO_2e from the atmosphere, for project-based activities. VCSA contemplated the creation of VCUs according to what it called "methodologies," meaning any "approach related to: the determination of project baseline scenario(s); identification and determination of GHG sources, sinks, and reservoirs associated with the baseline scenario(s) and project; demonstration of the project's additionality; and definition of the project's monitoring process." That is, it created rules for assessing existing conditions, rules for determining what the project activities could be said to do under those circumstances, rules for monitoring project outcomes, and, most importantly, rules for determining whether the project was doing something that wouldn't have just happened on its own without the project occurring, i.e., its additionality.[68] All of the VCS additionality tests had one thing in common: project-based carbon credits could not, under any circumstances, be awarded for activities that were already mandated by law.[69]

Within the VCS 2007 framework, other VCS products set out the activity-specific rules for generating VCUs. Beginning in 2008, VCS began releasing "methodologies," "modules," and "tools" – typically developed and reviewed by third parties – designed to develop VCUs for the voluntary carbon markets in numerous project contexts. Although they did create some direct reduction methodologies, the great majority of the VCS rulesets contemplated crediting forestry and other land use projects. VCS followed the international framework closely, separating its work between Kyoto-style LULUCF activities (though it used the term "agriculture, forestry, and other land use," or "AFOLU"),[70] and

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[67] VCSA, VOLUNTARY CARBON STANDARD 2007 (2007).
[68] *Id.* at 14-15.
[69] *Id.*
[70] VCSA, METHODOLOGY FOR IMPROVED FOREST MANAGEMENT THROUGH EXTENSION OF ROTATION AGE (VM0003) version 1.0 (finalized 2010).

conservation protocols based on REDD+.[71] As of this writing, VCSA/Verra had issued over one billion VCUs under the VCS framework.[72]

Unlike the Kyoto mechanisms, however, it is not necessary to speculate about how the VCS system could or would apply to blue carbon projects, because Verra itself has published methodologies on two relevant project types: VM0024 (Methodology for Coastal Wetland Creation) and VM0033 (Methodology for Tidal Wetland and Seagrass Restoration).[73] Although VM0024 has never been used to generate VCUs, the first VM0033 project was registered in 2021,[74] and the first U.S. project is now under development in Virginia.[75] These methodologies are not perfect, and they all make controversial decisions regarding additionality, permanence, or other issues that pertain to credit quality and integrity, meaning whether these credits represent actual or only chimeric sequestration value. To their credit, the VCS methodologies are open source and have been subject to critique and debate in the scientific and policy literature. For example, the original version of VM0033 was immediately criticized for overstating sediment sequestration.[76] Meanwhile, the methodologies have been discussed in research seeking to address knowledge gaps,[77] and proposing to incorporate what has been learned into new standards and protocols.[78]

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[71] VCSA, REDD+ METHODOLOGY FRAMEWORK (REDD+MF) (VM0007) version 1.0 (finalized 2010).
[72] *Verified Carbon Standard Project and Credit Summary*, VERRA (last visited Feb. 15, 2024).
[73] VERRA, METHODOLOGY FOR TIDAL WETLAND AND SEAGRASS RESTORATION (VM0033) (introduced 2015), version 2.0 (2021).
[74] Methodology searches performed at https://registry.verra.org/app/search/VCS.
[75] *VCS Project 2360: Virginia Coast Reserve Seagrass Restoration Project*, Verra (last visited Feb. 15, 2024).
[76] Sophia C. Johannessen & Robie W. Macdonald, *Geoengineering with Seagrasses: Is Credit Due Where Credit Is Given?* 11 ENV'T RSCH. LET. 113001 (2016); Matthew P. Oreska et al., *Comment on Geoengineering with Seagrasses: Is Credit Due Where Credit Is Given?*, 13 ENV'T RSCH. LET. 38001 (2018); Sophia C. Johannessen & Robie W. Macdonald, *Reply to Oreska et al 'Comment on Geoengineering with seagrasses: is credit due where credit is given?'*, 13 ENV'T RSCH. LET. 38002 (2018); Brian A. Needelman et al., *The Science and Policy of the Verified Carbon Standard Methodology for Tidal Wetland and Seagrass Restoration*, 41 ESTUARIES AND COASTS 2159 (2018).
[77] E.g., Clint Cameron et al., *High Greenhouse Gas Emissions Mitigation Benefits from Mangrove Rehabilitation in Sulawesi, Indonesia*, 40 ECOSYSTEM SERVICES 101035 at 2 (2019).
[78] E.g., Mark S. Reed et al., *Governing High-Integrity Ecosystem Markets* (unpublished 2023).

Legal literature has its own contributions to make, as there remain many unresolved legal issues that are not clearly handled in the crediting methodologies. REDD+ in particular has generated legal controversy as carbon commodification involves *de jure* or *de facto* decisions about who owns the carbon resource and has the right to benefit from it, questions that turn on property law.[79] This is particularly important in areas where indigenous communities have claims to land that is being managed by third parties or incumbent governments for financial gain in the international system, and where benefits sharing practices and agreements may be lacking. These problems have been severe in REDD+ – a UN project – and are likely to persist in any voluntary market system.[80] Furthermore, blue carbon has its special credit integrity problems: in addition to traditional tenure and carbon right questions, blue carbon credits require measurement of a poorly understood resource, and determinations about permanence in the face of ongoing sea level rise. Each of these and many other problems have been addressed in a recent white paper, titled *High-Quality Blue Carbon Principles and Guidance*, published by a group of ocean carbon credit stakeholders,[81] but only time will tell the extent to which these principles will be integrated into emerging international voluntary carbon credit markets.

iii. The Paris Synthesis: Toward Worldwide Voluntary Markets

Notwithstanding advances made under the Kyoto-style binding emissions reduction commitments, the Kyoto system ultimately was abandoned because the United States refused to participate. The mandatory system was replaced in an agreement finalized during COP21, held in Paris,[82] that shifted the world climate

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[79] Charlotte Streck, *Who Owns REDD+? Carbon Markets, Carbon Rights and Entitlements to REDD+ Finance*, 11 FORESTS 959 (2020).
[80] *Id.*
[81] CONSERVATION INTERNATIONAL ET AL., HIGH-QUALITY BLUE CARBON PRINCIPLES AND GUIDANCE (2022).
[82] UNFCCC Dec. 1/CP.21, *Adoption of the Paris Agreement* (2015), *published in* UN Doc. FCCC/CP/2015/10/Add.1 [hereinafter "Paris Agreement"].

change regime toward voluntary reductions efforts.[83] The Paris Agreement, as it is called, requires that each UNFCCC party nation submit a regular "nationally determined contribution" to global emissions reduction efforts,[84] which contribution is wholly voluntary and left to each party to attempt to achieve.

Other parts of the Paris Agreement exist to facilitate the parties' achieving their voluntary targets, and one of its primary mechanisms is an international voluntary carbon market.[85] In the language of the Treaty, the parties recognized that "voluntary cooperation" between nations could increase their mitigation "ambition" and "promote sustainable development and environmental integrity."[86] The parties were therefore authorized to use "internationally transferred mitigation outcomes [ITMOs] to achieve nationally determined contributions,"[87] provided they do so in a manner to "promote sustainable development," "ensure environmental integrity and transparency, including in governance," "apply robust accounting," and "avoid[] double counting."[88] The parties also established a "mechanism" to facilitate trading of private and public carbon credits,[89] while preserving activities similar to REDD+ incentive payments as "non-market mechanisms" developed for similar purposes.[90] As with Kyoto, the development of decisions to agree on the meaning of these terms and the rules underlying the systems they created – the so-called "Paris Rulebook" – was left to further meetings of the parties.

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[83] Robert Faulker, *The Paris Agreement and the New Logic of International Climate Politics*, 92 INTL. AFFAIRS 1107 (2015) (discussing shift); Annalisa Savaresi, *The Paris Agreement: A New Beginning?*, 34 J. ENERGY & NAT. RES. L. 16 (2016) (same). *See generally* Matthew J. Hoffman, CLIMATE GOVERNANCE AT A CROSSROADS: EXPERIMENTING WITH A GLOBAL RESPONSE AFTER KYOTO (2011) (discussing rise of "governance experiments" in shadow of Kyoto).
[84] Paris Agreement Arts. 3, 4.2.
[85] *Id.* Art 6.
[86] *Id.* Art. 6.1.
[87] *Id*. Art. 6.3.
[88] *Id.* Art. 6.2.
[89] *Id.* Art. 6.4.
[90] *Id.* Art. 6.8.

The process of agreeing on the Paris Article 6 Rulebook has been technical and prolonged. After failure to come to terms in 2019,[91] much of the Article 6 Rulebook was finalized at COP26 in Glasgow in 2021.[92] Further slow progress on implementation was made at COP28 in Sharm al-Sheik in 2022.[93] Major disputes included fights over the rules for avoiding double-counting, the use of billions of remaining Kyoto-era credits in the new market, the set-aside of market proceeds for adaptation funding in developing nations, and how overall emissions reductions were to be accomplished.[94] Ultimately parties agreed to allow some but not all unused Kyoto compliance credits (but not REDD+ credits) to be carried forward, attempted to strengthen provisions related to double counting, created a grievance process to handle disputes over offsetting projects, and set up systems to divert funds to adaptation and ensure overall emissions reductions. But with respect to blue carbon, a key remaining issue remains unresolved as of this writing: how to define "removals" for purposes of the Paris market mechanisms, a matter that was taken up but not resolved during the 2023 Conference of Parties in Dubai.[95]

In summary, over the last thirty years the parties to the UNFCCC have debated the extent to which carbon management activities in the terrestrial

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[91] *In-Depth Q&A: How 'Article 6' Carbon Markets Could 'Make or Break' the Paris Agreement*, CARBON BRIEF (Nov. 29, 2019, updated Dec. 23, 2019); *COP25: Key Outcomes Agreed at the UN Climate Talks in Madrid*, CARBON BRIEF (Dec. 15, 2019).

[92] UNFCCC Decs. 2/CMA.3, *Guidance on Cooperative Approaches referred to in Article 6, Paragraph 2, of the Paris Agreement*, 3/CMA.3 *Rules, Modalities and Procedures for the Mechanism Established by Article 6, paragraph 4, of the Paris Agreement*; 4/CMA.3 *Work Programme under the Framework for Non-Market Approaches referred to in Article 6, Paragraph 8, of the Paris Agreement*, all published in UN Doc. FCCC/PA/CMA/2021/10/Add.1 (2021). *See also COP26: Key Outcomes Agreed at the UN Climate Talks in Glasgow*, CARBON BRIEF (Nov. 15, 2021); *COP26: Key Outcomes for Food, Forests, Land Use and Nature in Glasgow*, CARBON BRIEF (Nov. 17, 2021).

[93] UNFCCC Decs. 6/CMA.4, *Matters relating to Cooperative Approaches referred to in Article 6, Paragraph 2, of the Paris Agreement*; 7/CMA.4, *Guidance on the Mechanism Established by Article 6, paragraph 4, of the Paris Agreement*; 8/CMA.4, *Matters relating to the Work Programme under the Framework for Non-Market Approaches referred to in Article 6, Paragraph 8, of the Paris Agreement*, all published in UN Doc. FCCC/PA/CMA/2022/10/Add.2 (2023). *See also COP27: Key Outcomes Agreed at the UN Climate Talks in Sharm el-Sheikh*, CARBON BRIEF (Nov. 21, 2022).

[94] Cf. Carbon Brief summaries in prior footnotes.

[95] Subrata Chakrabarty & Ashwini Hingne, *Operationalizing Article 6: Issues for COP28 To Address*, WRI INDIA (Feb. 23, 2023).

ecosystem context, particularly forestry, can be used to demonstrate progress in parties' efforts to reduce emissions and respond to climate change. It is relatively straightforward to extend these concepts to blue carbon, which has already been done in the voluntary carbon market sector, and is likely to be coming in the new international carbon market under the UNFCCC framework. The objections to these practices also persist: fears of greenwashing and paper reductions that do not have real-world value have accompanied every step of each process discussed above. Yet these years have also resulted in the development of open-source crediting methodologies and processes to debate and improve them, and the slow emergence of an international voluntary carbon market framework that will allow the use of credits developed under these rules.

As discussed in the next two sections, these developments may be treated very differently from jurisdiction to jurisdiction. This is visible in the largely negative treatment of terrestrial carbon offset credits in the compliance markets on the one hand, and the growing interest in carbon markets for purposes of revenue generation in states without compliance markets, on the other. These latter developments, in particular, pose novel policy questions.

B. Blue Carbon Credits in Compliance Markets

Although the UNFCCC processes have been the source of most carbon market rules to date, these processes ultimately rely on member nations to develop their own carbon market systems, which may impose additional requirements on what kinds of offsets can be used. The compliance markets, focused primarily on driving emissions reductions at their sources, have largely avoided the incorporation of offset crediting.

For example, the European Union Emissions Trading System (EU ETS) was developed to allow EU countries to meet their compliance obligations under the Kyoto Protocol, and is now the largest compliance market in the world. Although offset credits were permitted in the EU ETS, rules for its third phase prohibited the use of credits from LULUCF projects, and after 2020 the system is no longer allowing offset crediting, pending decisions on Paris Article 6

mechanisms.[96] Consequently, it seems unlikely that the EU ETS will incorporate blue carbon credit offsets in the near future.

In the United States, the Regional Greenhouse Gas Initiative created a cap and trade system for emissions reductions from the power sector in northeastern U.S. states.[97] Regulated energy utilities can meet a certain percentage (currently 3.3%) of their compliance obligation by provision of offset credits.[98] One of the eligible offset credit types is similar to the LULUCF and REDD+ paradigms discussed above, allowing project-derived credits for reforestation, improved forest management, avoided conversion, and (in limited circumstances) afforestation activities.[99] RGGI has its own credit qualification rules,[100] and each RGGI state has its own rules governing their use, built off a model rule.[101] Thus, although blue carbon projects are still effectively invisible to the RGGI compliance framework, a model does exist for incorporating them should that be desired. Similarly, the California Cap and Trade system also currently allows covered entities to use offsets to cover up to 6% of their total compliance obligations.[102] California has developed its own protocols for forest-based offsets,[103] and again forestry activities, including reforestation, improved forest management, and avoided conversion activities, are eligible.[104] These credits are limited to activities in the United States however, and while California has considered permitting REDD+ projects, this has been fiercely debated and the

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[96] *Climate Action: Use of International Credits*, EUROPEAN COMM'N DIRECTORATE-GENERAL FOR CLIMATE ACTION (last visited Feb. 15, 2024).
[97] *See generally* THE REG'L GREENHOUSE GAS INITIATIVE (RGGI), https://rggi.org (last visited Feb. 15, 2024).
[98] *Offsets*, RGGI (last visited Feb. 15, 2024).
[99] *Forestry and Afforestation*, RGGI (last visited Feb. 15, 2024).
[100] *Verification Process*, *Offsets Requirements*, RGGI (last visited Feb. 15, 2024).
[101] *State Statutes & Regulations*, RGGI (last visited Feb. 15, 2024). *See also* RGGI, OFFSET HANDBOOK FOR REGIONAL GREENHOUSE GAS INITIATIVE (RGGI) MODEL RULE OFFSET SUBPART XX-10 AND MODEL OFFSET CONSISTENCY APPLICATIONS AND MODEL MONITORING AND VERIFICATION REPORTS VERSION 1.1 (2015); RGGI, RGGI MODEL RULE: SUBPART XX-1 CO_2 BUDGET TRADING PROGRAM GENERAL PROVISIONS (2017).
[102] *California's Compliance Offset Program*, CAL. AIR RES. BD. (CARB) (Oct. 27, 2021).
[103] *Id.*
[104] CARB, COMPLIANCE OFFSET PROTOCOL U.S. FOREST PROJECTS 11-15 (2015).

state has not yet done so.[105] California has not yet developed a protocol for crediting blue carbon projects in its Cap and Trade program.

Perhaps the most permissive compliance market system in the world today is the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which allows airlines to claim to meet emissions reduction commitments using not only reforestation, afforestation, and improved forest management, but also REDD+ credits. However, to date, even CORSIA has not integrated blue carbon into its offset crediting rules. Other emerging compliance markets are still developing their rules as well. Under the New Zealand Emissions Trading Scheme, companies can offset their emissions through forestry activities including afforestation and reforestation (but not avoided deforestation), but only if those activities occur in New Zealand, although this is currently under revision.[106] The Chinese ETS also allowed for use of credits from domestic forestry projects, although this has been suspended since 2017 and the status is currently unclear.[107]

In other words, although none of the compliance markets in the world today specifically allow the use of offset credits generated by blue carbon projects, many have developed mechanisms for recognition and use of terrestrial carbon sequestration models that could be expanded. The barriers to doing so are primarily political and policy-driven, though technical challenges will always exist. Even lacking compliance market integration, however, the carbon market sector offers a potentially enormous source of revenues for jurisdictions with

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[105] CARB, STAFF WHITE PAPER: SCOPING NEXT STEPS FOR EVALUATING THE POTENTIAL ROLE OF SECTOR-BASED OFFSET CREDITS UNDER THE CALIFORNIA CAP-AND-TRADE PROGRAM, INCLUDING FROM JURISDICTIONAL "REDUCING EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION PROGRAMS (2015); *Sector-Based Offset Credits*, CARB (last visited Feb. 15, 2024); Jesse Leuders et al., *The Ongoing Political History of California's Initiative to Include Jurisdictional REDD+ Offsets within Its Cap-and-Trade System*, *in* THE CALIFORNIA REDD+ EXPERIENCE (Center for Global Development 2014).

[106] N.Z. MINISTRY FOR THE ENV'T, A REDESIGNED NZ ETS PERMANENT FOREST CATEGORY (2023).

[107] GUO MINPING ET AL., INT'L INST. OF GREEN FIN., *Exploring the Forestry Carbon Offsets in China*, (2021); Xu Nan, *Rebooting China's Carbon Credits: What Will 2022 Bring?*, CHINA DIALOGUE (Jun. 9, 2022).

carbon resources,[108] and in the face of potential billions this model has proven too tempting to ignore.

C. Emerging Carbon Commodification in Resource-Rich U.S. States

Although many U.S. states with robust climate laws and mandatory compliance markets have declined to incorporate forestry and have not yet considered including blue carbon crediting in their limited offset systems, a number of other U.S. states, many of which would not be considered leaders in the climate law space, have recently begun developing surprisingly comprehensive carbon resource inventory systems. Their reason for doing so is not altruistic: these states are preparing to attempt to generate revenue from their previously uncompensated conservation activities.

For example, the Governor of Alaska has recently initiated a legislative program seeking to capitalize on emerging carbon markets. In his words, "Alaska has vast forests and coastlines that can provide natural carbon management. Just as our forests act as carbon 'sinks,' so, too, can we host offshore kelp forests that can absorb carbon, reduce ocean acidification, and *generate revenue and economic activity*."[109] Emphasizing that Alaska Native corporations had brought in over $370 million in carbon management revenue between 2019 and 2023,[110] the Governor's office submitted two bills to the Alaska legislature, including a bill that would create a leasing program to allow third parties to use state land to generate carbon credits, and to authorize the state itself to seek to generate carbon offset credits on state lands, which program requires the state to develop project criteria for additionality, validation and verification, and so on.[111] With Alaska's

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[108] *E.g.*, JULIEN CLAES ET AL., MCKINSEY INSIGHTS ON SUSTAINABILITY, *Blue Carbon: The Potential of Coastal and Oceanic Climate Action*, (2022); *Are blue carbon markets becoming mainstream?*, ECONOMIST IMPACT (Apr. 11, 2022); *see also* Haley Toadvine, *Blue Carbon Credits Emerge as Potential New Market for Global Sustainability*, EARTH.ORG (Jun. 11, 2021); Nicola Jones, *Why the Market for 'Blue Carbon' Credits May Be Poised to Take Off*, YALE ENV'T 360 (Apr. 13, 2021).

[109] *Alaska Must Act Now to Capitalize on Carbon Markets*, OFF. OF GOVERNOR MIKE DUNLEAVY (Jan. 16, 2023) (emphasis added).

[110] *Governor Dunleavy Outlines Carbon Management Bill Package*, OFF. OF GOVERNOR MIKE DUNLEAVY (Jan. 12, 2023).

[111] H.B. 49, 33rd Leg. (Alaska 2023).

budget in chaos,[112] state leaders with dollar signs in their eyes are hoping to fill gaps with billions in carbon revenues.[113] Louisiana and Texas, similarly, hope to commodify their conservation activities. As discussed further below, both states are moving to coordinate their coastal zone management activities with the voluntary carbon markets. Researchers are studying the potential for Mississippi's participation as well,[114] and even the state of Washington is considering legislation to permit state conservation activities to qualify for carbon credits.[115]

These state proposals raise policy questions that have not yet received adequate attention. Resource-rich U.S. states are, in effect, hoping to step into the shoes of the developing countries under the REDD+ paradigm, something that has never been permitted before. The international carbon sequestration crediting initiatives developed under the UNFCCC cannot, by their fundamental definitions, apply to projects undertaken in industrialized nations like the United States. REDD+ was, by its own terms, confined to reduction of deforestation activities "in developing countries." Kyoto-style JI and CDM were constrained as their purpose was to qualify reductions in non-Annex I countries for compliance responsibilities by Annex I countries. A core requirement of VCS accreditation is the demonstration of additionality – that the project would not have happened anyway – and among the concerns of additionality is that it excludes all activities that are already required by law. Operating compliance markets in the United States place significant limits on sequestration-based offset crediting. In other words, under prevailing market systems, ongoing governmental conservation activities in the United States are entirely excluded from monetization. There is currently no way for, say, the state of Georgia to access international carbon

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[112] Elwood Brehmer, *Alaska's Budget Fights Resemble Lower 48 Fiscal Struggles*, ALASKA J. OF COMMERCE (Sep. 29, 2021); Matt Acuna Baxton, *Alaska's State Government Could Run Out of Money before July, but It Probably Won't*, ALASKA CURRENT (Feb. 23, 2023); Sean Maguire & Iris Samuels, *Alaska Budget Stalled with Special Session All but Inevitable*, ANCHORAGE DAILY NEWS (May 13, 2023).

[113] Jennifer L, *Alaska to Earn $30B from A New Revenue Source: Carbon Credits*, CARBONCREDITS.COM (Dec. 19, 2022).

[114] Bonnie A. Coblentz, *Emerging Carbon Offset Market May Benefit State*, MISS. STATE UNIV. EXTENSION (Oct. 14, 2021).

[115] Isabella Breda, *DNR Wants in on WA's Emerging Carbon-Credit Market*, THE SEATTLE TIMES (Feb. 9, 2023).

finance flows for simply maintaining its carbon stocks. The only way to monetize existing carbon stocks is to threaten to, or actually, exploit them.

The question should be discussed and debated: should this change? Should additionality requirements constrain compensation for currently uncompensated state-managed conservation? On the one hand, land management funding has largely flowed to developing countries, and this in essence would place U.S. states in competition with those nations for carbon credit finance. On the other hand, Alaska, Texas, and Louisiana all currently generate significant state revenues from the oil and gas industries, and face significant pressure to commodify and extract their natural resources – which they can be paid to do – rather than conserve them, for free. If payment for state conservation can replace (rather than supplement) state revenues for oil and gas development, that could be a net positive for the climate. But to the extent that states simply seek to generate a secondary revenue stream while continuing to extract oil and gas as fast as possible, there seems to be little climate benefit to permitting their conservation activities to profit from international carbon markets. To the extent that they are excluded from the international markets, furthermore, there may be potential for the United States itself to reimburse state conservation activities, and to use the conditional availability of federal conservation funds as a lever to achieve other climate goals. It appears that the rise of blue carbon crediting, and the vast potential to make money from conservation, will require answers to these questions in the near future.

In summary, the worldwide shift from compliance to voluntary carbon credit market systems, and the rising awareness of the potential value of coastal ecosystem carbon sequestration, have combined to drive interest in the incorporation of blue carbon projects into existing carbon market credit rules, even as doing so still faces major challenges, especially in the United States. As discussed in the following section, the carbon market rules are not the only ones that qualify as "blue carbon law," and the interest in commodification of blue carbon is also raising questions about the extent to which blue carbon value is already being, or could be, integrated into existing legal regimes.

IV. RESPONSIVE INTEGRATION OF BLUE CARBON COMMODIFICATION CONCEPTS INTO EXISTING LAWS

The prior Part reviewed the rules and controversies surrounding the creation of marketable carbon credits for terrestrial carbon sequestration protection and enhancement, the application of those rules in the blue carbon context, the coming finalization of long-awaited rules for international carbon markets, and the rising interest in commodifying and monetizing carbon resources, including coastal blue carbon resources, in resource-rich jurisdictions. This Part reviews how the pressures toward commodification of carbon sequestration activities might be incorporated into existing laws, from natural resource protection regimes, to industrial regulations, to subtler but no less important rules for environmental inventory and valuation. It is not intended to be a comprehensive accounting of every possible law related to blue carbon, but rather to identify major important examples and consider the extent to which they have been already, or might be in the future, modified to contend with ongoing blue carbon commodification. Integration of blue carbon considerations into existing laws was first proposed in 2013,[116] and although the last ten years have seen little progress, the recent developments in market-based credit systems are creating new pressures that may soon be reflected in existing laws.

Prior to beginning the more detailed review, however, one overarching legal system deserves mention: the UN Convention on the Law of the Sea (UNCLOS), which, among other things, divides up jurisdiction over marine areas. Being primarily concerned with the marine environment, blue carbon law will necessarily entail examinations of the problems of marine jurisdiction – the legal authority to govern the sea. Today, that jurisdiction is highly fragmented, or missing, and questions of jurisdiction over marine carbon sequestration activities

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[116] Linwood H. Pendleton et al., *Considering "Coastal Carbon" in Existing U.S. Federal Statutes and Policies*, 41 COASTAL MGMT. 439, 446–47 (2013); Ariana E. Sutton-Grier et al., *Incorporating Ecosystem Services into the Implementation of Existing U.S. Natural Resource Management Regulations: Operationalizing Carbon Sequestration and Storage*, 43 MARINE POL'Y 246, 249-50 (2014).

are just beginning to be raised.[117] International, national, and subnational authorities around the world share jurisdiction over parts of the ocean and shore areas, completely without regard to the physical realities of biogeochemical cycles, and, particularly in cases where new international regulation or coordination is proposed, blue carbon law will require grappling with thorny jurisdictional questions. More concretely, however, many existing laws do already govern many parts of the larger system, and this Part considers how blue carbon issues might begin to change even those laws that do exist.

A. Natural Resource Protection Laws and Blue Carbon Commodification

In the United States, federal laws such as the Coastal Zone Management Act ("CZMA")[118] and Section 404 of the Clean Water Act[119] operate to prevent human disturbances to natural resources providing carbon sequestration services. These laws have not traditionally focused on the carbon consequences of their operations, but the rising interest in blue carbon commodification is already driving change in the CZMA, if not in Section 404.

i. The Coastal Zone Management Act

The CZMA incentivizes state coastal resource conservation – and therefore blue carbon conservation – by conditioning state eligibility for certain conservation funding on federal approval of state Coastal Management Programs (CMPs).[120] The CZMA can be considered a blue carbon law because it indirectly governs human interventions into the coastal carbon cycle, disincentivizing the destruction of carbon-sequestering coastal resources and the release of that sequestered carbon, and, at least potentially, incentivizing coastal habitat restoration activities that promote increased carbon sequestration over the status quo.

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[117] *E.g.*, ROMANY WEBB ET AL., SABIN CTR. FOR CLIMATE CHANGE L., COLUM. L. SCH., REMOVING CARBON DIOXIDE THROUGH OCEAN ALKALINITY ENHANCEMENT AND SEAWEED CULTIVATION: LEGAL CHALLENGES AND OPPORTUNITIES (2021).
[118] 16 U.S.C. §§ 1451-1466.
[119] 33 U.S.C. § 1344.
[120] 16 U.S.C. § 1455.

However, the CZMA's blue carbon impact is indirect, as the law itself, and its several programs, were drafted and implemented without attention to the carbon sequestration value of conserved resources, and have not incorporated carbon management concepts in any significant way so far. The CZMA's CMP provisions do not require states to consider or discuss carbon management, and do not identify carbon sequestration as a policy priority.[121] NOAA regulations governing CMP evaluation consequently do not discuss or require submissions related to carbon,[122] and NOAA evaluations of state CMPs do not examine state carbon management programs.[123] Indeed, in 2019 NOAA itself said that while it was "supportive" of comments urging more consideration of carbon management in CMPs, emissions mitigation and "sequestration of carbon dioxide are beyond the scope" of NOAA's CMP review.[124]

The CZMA's state grant programs have also not incorporated carbon considerations. The CZMA § 306A Resource Management Improvement Grant program[125] funds state programs to preserve or restore coastal resources through land purchase, but the program's guidance does not discuss carbon sequestration as a potential conservation value or award criterion.[126] Similarly, the CZMA § 309 Coastal Zone Enhancement Grant program[127] funds state initiatives that pursue specific conservation policy objectives, including particularly wetlands protection, but again NOAA's regulations[128] and guidance[129] do not discuss carbon in any way. And the CZMA's Coastal Estuarine and Land Conservation

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[121] 15 U.S.C. §§ 1455, 1456.
[122] 15 C.F.R. Part 923 (NOAA regulations for review and approval of state coastal management program).
[123] Reviewed NOAA Final Evaluation Findings for Washington, Oregon, California, Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Maryland, Rhode Island.
[124] NOAA OFF. FOR COASTAL MGMT. (NOAA OCM), FINAL EVALUATION FINDINGS: CALIFORNIA COASTAL MANAGEMENT PROGRAM JANUARY 2009 TO JUNE 2018 54 (2019).
[125] 16 U.S.C. § 1455a.
[126] NOAA OCM, COASTAL ZONE MANAGEMENT ACT SECTION 306A GUIDANCE (2023).
[127] 16 U.S.C. § 1456b.
[128] 15 C.F.R. Part 923, Subpart K.
[129] NOAA OCM, CZMA SECTION 309 PROGRAM GUIDANCE: 2021 TO 2025 ENHANCEMENT CYCLE (2019); NOAA OCM, CZMA SECTION 309 PROGRAM GUIDANCE: 2016 TO 2020 ENHANCEMENT CYCLE (2014).

Program,[130] which is supposed to protect valuable coastal resources, include guidelines for conservation purchases that have not been updated since 2003 and make no mention of carbon.[131] Even as these programs received significant injections of new funds under the Bipartisan Infrastructure Law,[132] the CZMA's blue carbon impact remains entirely indirect.

It is possible, however, that NOAA's future CZMA activities will need to better integrate carbon sequestration values, as states are increasingly pushing to incorporate the potential financial value of the coastal carbon resource they are protecting into their CZMA plans and programs. In Texas, for example, the 2017 Texas Coastal Resiliency Master Plan (TCRMP)[133] did not mention carbon sequestration once, but the 2023 TCRMP discussed carbon sequestration dozens of times, and has begun quantifying carbon sequestration outcomes of the state's conservation and restoration programs.[134] Similarly, Louisiana's new Climate Action Plan calls for integration of carbon inventory and sequestration quantification into all CZMA CMP projects.[135] Lacking federal guidance, these states are making their own claims about the carbon value of their activities, and undertaking their own efforts to monetize coastal conservation. NOAA's CMP review, grant proposal review, and research programs under the CZMA will need updating if they are to keep abreast of the states on these issues.

ii. Section 404 Wetlands Compensatory Mitigation

Clean Water Act § 404 prohibits discharge of dredged or fill material into waters and wetlands under federal jurisdiction except as permitted by appropriate

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[130] 16 U.S.C. § 1456d, Pub. L. 107–77, title II, 115 Stat. 776 (2001).
[131] NOAA OCM, COASTAL AND ESTUARINE LAND CONSERVATION PROGRAM: FINAL GUIDELINES (2003).
[132] *Bipartisan Infrastructure Law and Inflation Reduction Act Awards*, NOAA OCM (last visited Feb. 16, 2024).
[133] TEX. GEN. LAND OFF., TEXAS COASTAL RESILIENCY MASTER PLAN (2017).
[134] *Id.* at 33, 35, 37, 38,
[135] LA. CLIMATE INITIATIVES TASKFORCE, LOUISIANA CLIMATE ACTION PLAN 90-91 (2022).

agencies.[136] Section 404's implementing regulations require that federal permitting agencies avoid and minimize dredge and fill impacts whenever possible, and impose compensatory mitigation responsibilities on permittees to offset most unavoidable impacts.[137] Many of the waters and wetlands protected under Section 404 are coastal, and so, like the CZMA, the Section 404 program regulates human disruption and release of blue carbon and therefore meets this Article's definition of blue carbon law.[138]

As early as 2014 ocean science and policy experts were arguing that blue carbon ought to be worked into Section 404's compensatory mitigation rules.[139] Where any wetland fill was approved, they suggested that "the stored carbon in the wetland and the carbon sequestration potential of the wetland could be added as additional functions that would need to be mitigated."[140] Similarly, carbon sequestration offsetting has been recognized in passing by legal academic literature calling for incorporation of ecosystems services valuation into Section 404 and other natural resource laws.[141] However, also like the CZMA, Section 404 implementing agencies have not taken action to incorporate carbon considerations into their work, and, unlike the CZMA agencies, there is also no indication that Section 404 implementing agencies have had any appetite for doing so. Longstanding calls to integrate ecosystems services frameworks into

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[136] Although the *Sackett* decision is likely to significantly curtail Section 404 wetlands protections, this is likely to be less of a concern for coastal wetlands, which tend to be more physically connected and obviously adjacent to federal waters, and thus jurisdictional. *See* Sackett v. EPA, 598 U.S. 651 (2023). However, the full implications of the *Sackett* decision will not be clear for several years as implementing agencies issue rulemakings and jurisdictional determinations. *Id.*
[137] U.S. ENV'T PROT. AGENCY (U.S. EPA) & U.S. ARMY CORPS OF ENG'R (USACE), MEMORANDUM OF AGREEMENT REGARDING MITIGATION UNDER CWA SECTION 404(B)(1) GUIDELINES (discussing mitigation hierarchy: avoidance, minimization, and compensatory mitigation); 40 C.F.R. Part 230, Subpart J (Section 404 compensatory mitigation rules).
[138] WETLAND CARBON AND ENVIRONMENTAL MANAGEMENT (Ken W. Krauss et al. eds., 2022).
[139] Sutton-Grier et al., *supra* note 116, at 249.
[140] *Id.*
[141] J. B. Ruhl, James Salzman & Iris Goodman, *Implementing the New Ecosystem Services Mandate of the Section 404 Compensatory Mitigation Program - A Catalyst for Advancing Science and Policy*, 38 STETSON L. REV. 251 (2008); J. B. Ruhl, *Ecosystem Services and the Clean Water Act: Strategies for Fitting New Science into Old Law*, 40 ENV'T L. 1381 (2010); J. B. Ruhl & James Salzman, *Ecosystem Services and Federal Public Lands: A Quiet Revolution in Natural Resources Management*, 91 U. COLO. L. REV. 677 (2020).

federal natural resources laws have had minimal effect so far,[142] and there is currently no reason to suspect that calls to integrate carbon sequestration services will fare any better. Quite the contrary, the U.S. Supreme Court significantly curtailed the jurisdictional scope of the Section 404 program and most of the coming regulatory development under that law is going to be focused on issuing yet another rule providing regulatory definitions of Waters of the United States.[143] To this author's knowledge there have been no effort to define Section 404 compensatory mitigation responsibilities by reference to carbon sequestration services.

On the other hand, it is at least possible that carbon market incentives will drive change, although not in terms of potential profit. Rather, as mitigation requirements are akin to project costs, then blue carbon markets could serve as lower-cost alternative compliance mechanisms in the Section 404 system. Crediting regimes could certainly facilitate carbon-oriented compensatory mitigation rules, where Section 404 permittees could be required to offset carbon impacts, and allowed to do so by purchasing blue carbon credits as part of their compliance obligations. Furthermore, in the same way that U.S. compliance markets impose geographical limits on qualifying credits, so the Section 404 system could achieve its purpose of U.S. water quality protection by requiring credits for blue carbon projects to be developed in the United States (or even the same watershed), and to demonstrate that the credits also provide water quality co-benefits. It is not suggested that this would be a panacea, and offset crediting would be problematic in the wetlands compensatory mitigation space as much as in the carbon emissions reduction space, but the development of an international voluntary carbon market that includes blue carbon resources and wetlands projects in the United States does suggest some intriguing possibilities for Section 404 mitigation if otherwise well managed.

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[142] Donna R. Harwell, *Ecosystem Services in U.S. Environmental Law and Governance for the Ecosystem-Based Management Practitioner*, *in* ECOSYSTEM-BASED MANAGEMENT, ECOSYSTEM SERVICES AND AQUATIC BIODIVERSITY: THEORY, TOOLS AND APPLICATIONS 373-74 (Timothy G. O'Higgins et al., eds. 2020); Ruhl & Salzman, *supra* note 141, at 694-96.

[143] For the history of rulemaking and current status of ongoing efforts at revision following *Sackett*, *see* U.S. EPA, *Current Implementation of Waters of the United States* and *Definition of "Waters of the United States": Rule Status and Litigation Update*.

B. Industrial Regulations and Blue Carbon Commodification

As scientific understanding of marine carbon cycles improves, it is becoming apparent that many restrictions on industrial and resource extraction activities also qualify as blue carbon laws. If marine biomass contributes to the ocean's biological carbon pump, then fish stocks have carbon relevance, and the federal fisheries law is a blue carbon law. If seabed resource extraction activities have the potential to disturb marine carbon sequestration processes, then laws governing activities like aquaculture and mining are blue carbon laws. In the future, as links between terrestrial and marine carbon reservoirs are better understood, even terrestrial resource protection laws might count. As this occurs, it is likely that permitted activities requiring environmental review will increasingly be required to incorporate blue carbon considerations. And as nations and private actors investigate the use of the oceans for carbon sequestration purposes, these activities themselves will become separate industries subject to further carbon-cognizant restrictions. The commodification of carbon sequestration may create competing pressures that influence resource extraction and permitting, but also create new industries with their own attendant environmental risks.

i. The Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA)[144] governs the pace of removal of a significant amount of biomass from the oceans, a direct intervention in the ocean carbon cycle. As mentioned above, emerging evidence demonstrates that fishing harms marine carbon sequestration functions,[145] and therefore rules that regulate fishing also act to conserve bulks of marine biomass that feed marine carbon sequestration processes. Thus, the MSA and laws like it also arguably meet this Article's definition of blue carbon law.

However, it may be even more difficult to integrate carbon considerations into MSA regulatory programs than into the CZMA or Section 404. The MSA establishes regional fishery management councils that are responsible for

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[144] 16 U.S.C. §§ 1851-1870.
[145] Saba et al., Bianchi et al., Mariani et al., *supra* note 31.

developing fishery management plans (FMPs), which must operate to prevent overfishing and achieve the largest long-term catch that can be taken from a fishery without harming its productivity.[146] The MSA accomplishes this by setting annual catch limits (ACLs) and other regulatory controls on the fishing industry,[147] but these rules make no reference to ecosystem services, the closest being the requirement that determinations of optimum yield "tak[e] into account the protection of marine ecosystems,"[148] and identification of the "benefits of protection afforded to marine ecosystems … resulting from maintaining viable populations (including those of unexploited species), … maintaining evolutionary and ecological processes (e.g., disturbance regimes, hydrological processes, [and] *nutrient cycles*)."[149] There has also been some discussion of incorporating more ecosystem-based fisheries management concepts into the MSA, which would likely involve considering ecosystem services to a greater degree, although potentially more focused on services that the marine ecosystem provides to support fisheries than on services that fish stocks themselves provide to carbon sequestration and other processes.[150] Other literature, however, has developed the idea of ecosystem services provided by fish stocks, including carbon flux regulation,[151] and it would be possible to update MSA processes to include consideration of carbon sequestration impact of fisheries activities as part of a fisheries law revision focused on creating more climate-ready fisheries.[152]

It is also useful, however, to consider whether the MSA's animating regulatory philosophy is consistent with blue carbon concerns. Arguably, the MSA's worldview is more hostile than helpful. The MSA's provisions are entirely directed toward protection of fisheries for fishing, not for any other purpose, and

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[146] 16 U.S.C. §§ 1851-53.
[147] *E.g.*, 50 C.F.R. § 600.310.
[148] *Id.* § 600.10.
[149] *Id.* § 500.310(e)(3) (emphasis added).
[150] Peter T. Kuriyama et al., *Issues at the Fore in the Land of Magnuson and Stevens: A Summary of the 14th Bevan Series on Sustainable Fisheries*, 54 MARINE POL'Y 118 (2015); Marina Cucuzza et al., *Evaluating the Theoretical and Practical Linkages between Ecosystem-Based Fisheries Management and Fisheries Co-Management*, 126 MARINE POL'Y 104390 (2021).
[151] Cecilia M Holmlund & Monica Hammer, *Ecosystem Services Generated by Fish Populations*, 29 ECO. ECON. 253 (1999).
[152] *See, e.g.*, Ocean Based Climate Solutions Bill, H.R. 8632, 116th Cong. (2020) (containing provisions on climate ready fisheries).

to the extent that blue carbon concerns are considered in the fisheries context, they may militate *against* fishing, to the extent that the amount of fishing that a particular fishery can sustain productively is more than the optimum amount for carbon sequestration. It may be, therefore, that the best way to integrate carbon considerations into the MSA is via environmental impact review (see discussion below) or, again, through some sort of market-based system. Either, however, will be heavily dependent on high-quality information about carbon stocks and flows as related to fisheries which do not yet exist.

ii. Deep-Sea Mining Regulations

In addition to carbon-bearing sediments, parts of the deep ocean floor are covered with millions of "polymetallic nodules" – metal-bearing concretions that have formed over millions of years and now constitute a potentially important new source of rare metals needed for electric vehicle batteries and other new energy technologies.[153] Recently, mining companies and nations with nodule resources have proposed expanded deep sea mining operations to exploit this resource.[154] In some respects, including disrupted sequestered carbon, deep sea mining may be less environmentally harmful than terrestrial mining operations.[155] However, many of the impacts are not well understood, and there is concern that dredging and vacuuming the ocean floor to recover nodules will have environmental effects, including both species and carbon sequestration impacts,

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[153] James R. Hein et al., *Deep-Ocean Polymetallic Nodules as a Resource for Critical Materials*, 1 NATURE REV. EARTH & ENV'T 158 (2020); Kira Mizell, *What's in a Nodule?*, NOAA OCEAN EXPLORATION (Aug. 26, 2021).

[154] *E.g.*, *Norway Proposes Opening Its Waters to Deep Sea Mining, Says Minerals Needed in Green Transition*, ASSOC. PRESS (Jun. 20, 2023); Joanna Chu, *Why has a Canadian Company Partnered with the Tiny Island of Nauru to Fast-Track Deep-Sea Mining?*, TORONTO STAR (Feb. 20, 2023).

[155] Daina Paulikas, *Life Cycle Climate Change Impacts of Producing Battery Metals from Land Ores versus Deep-Sea Polymetallic Nodules*, 275 J. CLEANER PROD. 123822 (2020) (modeling climate impacts, including sequestration degradation, between terrestrial and deep-sea mining).

that could take millennia to undo.[156] Rules regulating deep-sea mining of polymetallic nodules must then also qualify as blue carbon laws.

Currently, deep-sea mining regulation is conducted by the International Seabed Authority (ISA), an organization operating under the auspices of UNCLOS.[157] The ISA maintains a Mining Code that is supposed to govern both exploration and exploitation of deep-sea mineral resources, but currently only the exploration regulations have been completed. The exploitation element of the Mining Code has been under development since 2014, and was supposed to be finished by 2020 but has been delayed.[158] In June 2021, the island nation of Nauru submitted a formal demand to the ISA that triggered a two-year countdown before ISA had to begin accepting deep sea mining applications, with or without a code.[159] The ISA did not finish its work before its July 2023 meeting.[160] Meanwhile, nations and advocates have called for worldwide moratoria, for strict environmental protections in the eventual mining code, and for the ISA to hurry, while mining companies have been submitting applications to begin operations.[161]

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[156] Raphaël Deberdt & Philippe Le Billon, *A Green Transition Should Prioritize the Ocean's Carbon Sinks over Deep-Sea Mining*, POL'Y OPTIONS (Jul. 28, 2022) (citing relevant literature); Lisa A. Levin et al., *Challenges to the Sustainability of Deep-Seabed Mining*, 3 NATURE SUSTAINABILITY 784 (2020); Daniëlle S.W. de Jonge et al., *Abyssal Food-Web Model Indicates Faunal Carbon Flow Recovery and Impaired Microbial Loop 26 years after a Sediment Disturbance Experiment*, 189 PROGRESS IN OCEANOGRAPHY 102446 (2020) (disruptions to biotic processes that influence carbon cycle); PIPPA HOWARD ET AL., FAUNA & FLORA INT'L, AN ASSESSMENT OF THE RISKS AND IMPACTS OF SEABED MINING ON MARINE ECOSYSTEMS (2020); and 2023 Update to same; Mary Beth Gallagher, *Understanding the Impact of Deep-Sea Mining*, MIT NEWS (Dec. 5, 2019).

[157] *About ISA*, INT'L SEABED AUTH. (last visited Feb. 16, 2024).

[158] Jenessa Duncombe, *The 2-Year Countdown to Deep-Sea Mining*, EOS (Jan. 24, 2022).

[159] *Id*.

[160] Karen McVeigh, *Row Erupts over Deep-Sea Mining as World Races To Finalise Vital Regulations*, THE GUARDIAN (Mar. 21, 2023).

[161] Valentina Ruiz Leotaud, *Greenpeace Mexico Launches Campaign against Deep-Sea Mining*, MINING.COM (Jun. 11, 2023); Florence Jones, *Banks Representing a Third of UK Assets Vow Not to Invest in Deep-Sea Mining*, MINING TECH. (Jun. 23, 2023); *European Science Advisory Group Urges Moratorium on Deep-Sea Mining*, ENVIROTEC (Jun. 2023); Catarina Demony & Helen Reid, *France's Macron Says Deep-Sea Mining Must Not Go Ahead*, REUTERS (Jun. 30, 2022); *G7 Countries Say Strict Environmental Rules Needed for Deep-Sea Mining*, REUTERS (May 27, 2022); *UN to Start Allowing Deep-Sea Mining Applications from July*, DW (Apr. 1, 2023).

The ISA's draft exploitation regulations include environmental impact statement and harm minimization requirements, but it is not clear how effective such regulations can actually be in environments that are very poorly understood in the first place.[162] Certainly the carbon impacts of these operations are not well understood – the U.S. Geological Survey (USGS) for example is only now funding basic research to characterize carbon in sediments in critical marine mineral environments.[163] And as recent research has claimed to have identified over 5,000 previously undocumented species in an area of the deep ocean targeted for sea-bed mining, it is increasingly clear that biological impacts are poorly understood as well.[164] It is not clear how mining companies or the ISA can accurately assess the environmental, species, or carbon impacts of exploitation activities when the processes and resources being impacted are barely understood, but it is also possible that a carbon market could support such activities. The availability of offset mechanisms could justify conditioning deep-sea mining on scientifically defensible environmental resource evaluation and, with respect to carbon impacts, replacement of disturbed seabed carbon via a compensatory mitigation strategy similar to that in Section 404 discussed above. Again, this is not offered as a panacea – it is possible that no amount of offsetting can replace deep sea sediment carbon values, and it is possible that such mining should be avoided based entirely on biodiversity considerations. But if such mining is to continue, then it is probably better that its carbon sequestration impacts be required to be assessed and mitigated, rather than ignored.

iii. Geoengineering Project Rules and Requirements

While fishing and deep-sea mining are not directly intended to influence carbon cycles, the rise of carbon sequestration commodification is incentivizing the development of new industries specifically focused on doing so. "Geoengineering" is a broad term encompassing human interventions into earth

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[162] INT'L SEABED AUTH., DRAFT EXPLOITATION REGULATIONS (2019).
[163] *Deciphering Blue Carbon in Critical Marine Mineral Environments*, U.S. GEOLOGICAL SURVEY, MENDENHALL RSCH. FELLOWSHIP PROGRAM (last visited Feb. 16, 2024).
[164] Muriel Rabone, *How Many Metazoan Species Live in the World's Largest Mineral Exploration Region?*, 33 CURRENT BIOLOGY 2383 (2023) (claiming discovery of over 5,000 unnamed species on abyssal plain in region targeted for mining).

systems at a worldwide scale.[165] Several geoengineering techniques involve the ocean: deep ocean carbon burial involves pumping liquified CO_2 into marine subsurface geologic formations; ocean fertilization involves increasing marine nutrient density to encourage phytoplankton growth and sequestration, and ocean liming and other techniques involve altering ocean chemistry to enhance carbon removal.[166] However, the "nature-based solutions" carbon removal paradigm somewhat confounds the traditional geoengineering distinctions. For example, many of the carbon credit legal regimes discussed in Section II.A. actually discuss carbon sink enhancement activities as a form of emissions reduction, rather than geoengineering. Nonetheless, many of the activities that might accomplish these sequestration goals would also qualify under most definitions of geoengineering, and in particular raise many of the ethical problems of that field. While ocean carbon sequestration enhancement via mangrove planting might not be as problematic as, say, addition of physical materials to change ocean chemistry, such as ocean liming, both are achieving similar ends. Whether or not the distinction is fully justified, there is increasing concern that these activities are not possible to regulate, particularly when undertaken in ocean and marine environments outside national jurisdictions.

The sea, of course, is not entirely law-free, and ocean geoengineering has been the subject of a great deal of debate in several international law treaty conventions. The parties to the UN Convention on Biological Diversity – ratified by every UN member state except the United States – called for its member states to ensure that no ocean geoengineering activities that may affect biodiversity be conducted.[167] Parties to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the 1996 replacement protocol (London Protocol) – including the U.S. – adopted

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[165] *See generally* Geoengineering, Encyclopedia Britannica (online ed. 2023).
[166] *Id.*; Paul Voosen, *Ocean Geoengineering Scheme Aces Its First Field Test*, SCIENCE (Dec. 16, 2022).
[167] UN CBD Dec. X/33, *Biodiversity and Climate Change* ¶¶ 8(w), (x) (Oct. 29, 2010), published in UN Doc. UNEP/CBD/COP/DEC/X/33; *reaff'd* UN CBD Dec. XI/20, *Climate-Related Geoengineering* (Dec. 5, 2012), UN Doc. UNEP/CBD/COP/DEC/XI/20; UN CDB Dec. XIII/4, *Biodiversity and Climate Change* (Dec. 17, 2016), UN Doc. CBD/COP/DEC/XIII/4.

restrictions on commercial-scale ocean fertilization activities[168] More detailed reviews have identified other potentially applicable restrictions on ocean alkalinity enhancement and seaweed cultivation for purposes of carbon sequestration.[169] Most of these decisions are non-binding, however, and ocean-based geoengineering restrictions are currently more a matter of norms than enforceable rules. The creation of carbon market incentives will likely drive efforts to experiment with carbon sequestration technologies and techniques on the shores and deep oceans.

In the United States, there is little clarity on what regulations will be imposed on researchers testing new ocean carbon removal processes. A recent proposal for a model law to govern potential use conflicts and create a clear permitting regime suggests that much work is still needed.[170] While current calls are intended to be proactive, the rising pressures of carbon finance may require the adoption of these rules reactively, as businesses seek to find profit in ocean experimentation.

iv. Environmental Impact Assessment

Although it is difficult to assess the exact impact of environmental review law, it is widely believed that mandatory environmental impact assessment serves to promote the avoidance of environmental harms, even where harm minimization is not otherwise required. Thus, environmental review already serves as a general-purpose guardrail on some industrial activities, forcing the assessment and disclosure of potential environmental harms from actions subject to review. Furthermore, general environmental review mandates, such as those under the

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[168] *See generally* *Ocean Fertilization under the LC/LP*, Int'l Maritime Org. (IMO) (last visited Feb. 16, 2024); *Marine Geoengineering*, IMO (last visited Feb. 16, 2024).

[169] ROMANY M. WEBB ET AL., SABIN CTR. FOR CLIMATE CHANGE L., COLUM. L. SCH., REMOVING CARBON DIOXIDE THROUGH OCEAN ALKALINITY ENHANCEMENT: LEGAL CHALLENGES AND OPPORTUNITIES (2021); KOREY SILVERMAN-ROAT ET AL., SABIN CTR. FOR CLIMATE CHANGE L., COLUM. L. SCH., REMOVING CARBON DIOXIDE THROUGH SEAWEED CULTIVATION: LEGAL CHALLENGES AND OPPORTUNITIES (2021); *see also* Phillipe Sands et al., *Re: The Restriction of Geoengineering under International Law*, UNITED NATIONS HUMAN RIGHTS OFF. OF THE HIGH COMM'R (Mar. 26, 2021).

[170] ROMANY M. WEBB & KOREY SILVERMAN-ROATI, SABIN CTR. FOR CLIMATE CHANGE L., COLUM. L. SCH., DEVELOPING MODEL FEDERAL LEGISLATION TO ADVANCE SAFE AND RESPONSIBLE OCEAN CARBON DIOXIDE REMOVAL RESEARCH IN THE UNITED STATES (2023).

National Environmental Policy Act (NEPA), allow and often require the integration of emerging science in a manner that more purpose-built and less flexible environmental laws can rarely match. Thus, environmental impact assessment may serve as a useful source of protection in the blue carbon space.

In the United States, NEPA has incorporated climate change for many years.[171] The most recent NEPA climate guidance, furthermore, directly discusses carbon sequestration in natural sinks.[172] Pursuant to the new guidance, "for actions involving potential changes to biological GHG sources and sinks, agencies should include a comparison of net GHG emissions and carbon stock changes that are anticipated to occur, with and without implementation of the proposed action and reasonable alternatives," including "carbon sequestration potential, and the net change in relevant carbon stocks in light of the proposed actions and timeframes under consideration."[173] The guidance specifically notes that "actions that involve ecosystem restoration," and "some resource management activities," will require analysis and disclosure of complex changes in carbon sequestration potential, and encourages agencies to use available scientific tools in their assessments.[174]

A review of recently published environmental impact statements with the word "ocean" and "marine" in the title[175] reveals that blue carbon sequestration has now been incorporated into at least one environmental impact statement, although without particularly robust or detailed quantitative measurements or estimates.[176] As new science is developed, it is likely that parties will increasingly demand assessment of carbon impacts under NEPA and other environmental review processes. Even lacking a mitigation requirement, the forced production of

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[171] *See* Michael D. Smith, *NEPA and Climate Change*, 10 ENV'T PRACTICE 75 (2008) (discussing early developments).
[172] National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change, 88 Fed. Reg. 1196, 1207 (Jan. 9, 2023).
[173] *Id.*
[174] *Id.*
[175] Search performed at the U.S. EPA's Environmental Impact Statement (EIS) Database.
[176] *E.g.*, U.S. BUREAU OF OCEAN ENERGY MGMT., OCEAN WIND 1 OFFSHORE WIND FARM FINAL ENVIRONMENTAL IMPACT STATEMENT 3.6-7 to -8 (2023). *But see* NOAA, EFFECTS OF OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN FINAL ENVIRONMENTAL IMPACT STATEMENT (Oct. 2016) (no discussion of carbon).

information may be prove extremely useful in mainstreaming the use of resource inventory and valuation data that is being developed independently.

C. Mandated Inventory and Valuation, and Blue Carbon Commodification

It is said that "what gets measured gets managed."[177] And indeed, measurement – making people and resources "legible" and manageable for purposes of top-down control – is arguably a core function of most government.[178] From the activities of the USGS to the international framework for global climate inventory, significant government resources are invested in simply generating reliable information about the world, and many of these are focused on environmental resources and values. Thus, some existing inventory and resource tracking laws are likely to need to increasingly confront and consider blue carbon going forward.

i. Carbon and Coastal Wetlands Inventories

Every year since 1993 the United States Environmental Protection Agency (EPA) has published and updated a national inventory of greenhouse gas emissions and sinks.[179] The most recent, published in 2023, covers the period from 1990 to 2021.[180] However, the EPA's annual inventory does not address ocean carbon, restricting its review to coastal wetlands and submerged lands within the U.S. territory.[181] This omission is traceable to the underlying inventory methodologies that EPA follows, the international *IPCC Guidelines for National*

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[177] This is a fairly common saying, but for some critical discussion of it, *see* Paul Zak, *Measurement Myopia*, THE DRUCKER INST. (Apr. 7, 2013); Danny Buerkli, *"What Gets Measured Gets Managed" — It's Wrong and Drucker Never Said It*, CTR. FOR PUBLIC IMPACT (Apr, 8, 2019).

[178] JAMES C. SCOTT, SEEING LIKE A STATE: HOW CERTAIN SCHEMES TO IMPROVE THE HUMAN CONDITION HAVE FAILED (1998).

[179] Press Release, U.S. EPA, EPA Publishes 30th Annual U.S. Greenhouse Gas Inventory (Apr. 21, 2023).

[180] U.S. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2021 (2023).

[181] *See generally id*. Ch. 6 (Land Use, Land-Use Change, and Forestry).

Greenhouse Gas Inventories,[182] and the 2013 *Wetlands Supplement* to those guidelines.[183] As discussed above, the international framework for climate change response is focused on national actions, and rules for national inventories focus on resources under national control, meaning particularly terrestrial ecosystems like forests, and wetlands, including coastal wetlands, but missing many other resources relevant to blue carbon measurement. Currently, EPA explains that its inventory "includes all privately- and publicly-owned coastal wetlands (i.e., mangroves and tidal marsh) along the oceanic shores of the conterminous United States, [except] in Alaska, Hawaii, or any of the United States Territories. Seagrasses are not currently included within the Inventory due to insufficient data …." The inventory's coastal wetlands carbon values are determined by a NOAA data tool developed in NOAA's Coastal Change Analysis Program (C-CAP).[184] Future updates may incorporate data from the Smithsonian's Coastal Wetland Carbon Research Coordination Network (CCRN),"[185] add seagrass values, reconcile differences between the NOAA C-CAP and other federal resource inventories.[186] There are many other wetlands inventories, including most importantly the National Wetlands Inventory Plus (NWI+ or NWIPlus), which among other things can be used to extrapolate carbon sequestration values of various wetlands types.[187]

Most of the legal initiatives discussed above, from crediting to impact assessment and mitigation, require accurate data. As the value of carbon sequestration resources increase, so should the value of public wetlands and blue carbon inventories. To the extent that the U.S. federal government cannot be moved to support the development of such inventories for the public good, it may

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[182] IPCC TASK FORCE ON NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TFI), 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES (2006); IPCC TFI, 2019 REFINEMENT TO THE 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES.
[183] IPCC TFI, 2013 SUPPLEMENT TO THE 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES: WETLANDS (2013).
[184] *Id.* at 6-103 to 6-121. *See also Coastal Change Analysis Program (C-CAP) Land Cover Atlas*, U.S. CLIMATE RESILIENCE TOOLKIT (June 21, 2021).
[185] IPCC TFI, *supra* note 183, at 6-111. *See also Coastal Carbon Network*, SMITHSONIAN (last visited Feb. 15, 2024). The CCN published a report in 2021 reviewing state-level availability of state-level wetlands inventories.
[186] IPCC TFI, *supra* note 183, at 6-24, 6-111.
[187] RALPH W. TINER, *USA Wetlands: NWI-Plus Classification System*, *in* THE WETLAND BOOK 1555 (C. Max Finlayson et al. eds. 2018).

be more wiling to do so in order to promote private gain – with, hopefully, some attendant public benefit.

ii. Natural Resource Damages Valuation

Natural Resource Damages (NRD) are payments recoverable in lawsuits under certain environmental laws, intended to compensate for degraded value of natural resources caused by pollution.[188] In the marine context, NRD are available under the Oil Pollution Act of 1990 (OPA),[189] which governs polluter liability for oil spills in coastal areas and jurisdictional navigable waters.[190] Enormous potential liability for impairing an ecosystem's carbon sequestration services could serve as a strong incentive against such action, and thus NRD assessment and valuation laws could also, arguably, qualify under this Article's definition of blue carbon law.

Again, this is not a new idea, with blue carbon in NRD Assessment (NRDA) first examined in 2013, in the context of NOAA programs that have been used to support NRDA.[191] As of 2013 NOAA NRDA had not incorporated carbon sequestration services valuation into its damage assessments, although it appears to have authority to do so.[192] A review of post-2013 assessments reveals that this has not changed since then.[193] For example, the NRDA for the *Deepwater Horizon* oil spill in the Gulf of Mexico, did not assess impact to carbon sequestration services,[194] although such impacts have been argued to be have

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[188] *See generally* BRIAN D. ISRAEL ET AL., NATURAL RESOURCE DAMAGES: A GUIDE TO LITIGATING AND RESOLVING NRD CASES (2019)
[189] 33 U.S.C. § 2706 (OPA NRD statute). NRD are also recoverable under CERCLA, 42 U.S.C. § 9607, and the Clean Water Act, 33 U.S.C. § 1321, but the assessment processes and concepts are similar enough in those statutes that this Article focuses only on OPA.
[190] 33 U.S.C. § 2702.
[191] Pendleton et al., *supra* note 116, at 443-44.
[192] *Id.*
[193] *Damage Assessment, Remediation, and Restoration Program*, NOAA (last visited Feb. 16, 2024).
[194] *See* Folder 5 (Preassessment/Assessment) at Restoring the Gulf of Mexico After the Deepwater Horizon Oil Spill- Administrative Record, U.S. DEP'T OF THE INTERIOR (last visited Feb. 16, 2024).

occurred.[195] NRDA for other more recent spills also do not include carbon sequestration valuation components.[196] A recent review confirms that inclusion of ecosystem services in marine NRDA is not simply theoretical, but does not discuss carbon sequestration valuation.[197]

NRD have also been assessed by the International Court of Justice, which rendered its first environmental compensation decision in 2018.[198] In that case, Costa Rica claimed damages equivalent to NRD, including for "gas regulation and air quality services, such as carbon sequestration, which was allegedly caused by Nicaragua's unlawful activities."[199] Ultimately, the court included impaired ecosystem services – including "gas regulation," meaning carbon sequestration services – in its award, although the exact basis for its valuation was left unclear.[200] Nonetheless, this appears to have been the first-ever judicial recognition of and award granted for carbon sequestration damages.

On the specific question of valuation, emerging pricing mechanisms may prove useful for incorporating carbon sequestration into NRDA. The international community and the United States federal government have been working to develop a "social cost of carbon" to set a regulatory (rather than market-based)

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[195] Melissa Rohal et al., *The Effect of the Deepwater Horizon Oil Spill on Two Ecosystem Services in the Northern Gulf of Mexico*, 133 ENV'T MODELLING & SOFTWARE 104793 (2020) (finding decrease in subsurface particulate organic carbon sequestration).

[196] *E.g.*, NOAA, BAYPORT CHANNEL COLLISION OIL SPILL WATER COLUMN INJURY ASSESSMENT REPORT (2021), available at https://www.diver.orr.noaa.gov/web/guest/diver-admin-record/12302; Consent Decree for Natural Resources Damages, U.S. v. Kirby Marine, Dkt. 9, Case No. 21-CV-00180 (S.D. Tex. Sep. 1, 2021) (same case, does not discuss carbon or ecosystem services damages).

[197] Robin Kundis Craig, *Re-Valuing the Ocean in Law: Exploiting the Panarchy Paradox of a Complex System Approach*, 41:3 STAN. ENV'T L. J. 3, 49 (2022) ("Other examples of ecosystem function injuries include impaired cycles of organic matter and nutrients from the water column to oil-contaminated bottom sediments").

[198] Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v. Nicaragua), INT'L CT. JUST. (last visited Feb. 16, 2024); *See also* Nilufer Oral, *ICJ Renders First Environmental Compensation Decision: A Summary of the Judgment*, IUCN (Apr. 9, 2018) (summarizing decision).

[199] INT'L CT. JUST., *Compensation Owed by the Republic off Nicaragua to the Republic of Costa Rica, Costa Rica v. Nicaragua* ¶¶64-65 (Feb. 2, 2018).

[200] *Id.* at ¶ 75 (affirming gas regulation harm), ¶¶ 76-77 (criticizing parties' valuation methodologies), ¶¶ 78-86 (awarding $120,000 aggregate).

carbon price.[201] The U.S. has also recently created a tax incentive for carbon sequestration that arguably acts as a price signal,[202] although at this time the credit is applicable only to direct air capture and geologic sequestration activities, and does not include nature-based sequestration activities.[203] Finally, of course, the carbon markets themselves are developing methodologies for carbon sequestration valuation, although market pricing integration into damages assessments should be done carefully, given that many factors other than resource value influence pricing in current markets.

V. CONCLUSION: O BRAVE BLUE WORLD

The prior Part demonstrated that many laws already impact and govern human interventions into the marine carbon cycle, and that the profit incentives of emerging carbon markets and blue carbon crediting methodologies might be incorporated into some of those laws, proactively or reactively. But ultimately, intelligent management of carbon resources is also likely to require new national legislation. In the United States, proposals for this have started to emerge, and, particularly given the interest from resource-rich states, some may even have bipartisan support.

The first federal legislative proposal appeared in 2019, as Sens. Whitehouse (D-RI) and Murkowski (R-AK) proposed to create research and development prizes "to catalyze the rapid development and deployment of data collection and monitoring technology related to … oceans … and coasts," among other things to enhance ocean carbon sequestration. [204] In the same year, Sens. Whitehouse, Reed (D-RI), and Sullivan (R-AK) proposed setting aside funds for

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[201] E.g., *EPA's "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances"*, U.S. EPA (Dec. 2, 2023); INTERAGENCY WORKING GROUP ON SOCIAL COST OF GREENHOUSE GASES, UNITED STATES GOVERNMENT, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON, METHANE, AND NITROUS OXIDE INTERIM ESTIMATES UNDER EXECUTIVE ORDER 13990 (2021).
[202] 26 U.S.C. § 45Q.
[203] CONG. RSCH. SERV., THE SECTION 45Q TAX CREDIT FOR CARBON SEQUESTRATION (updated Aug. 23, 2023); *Alert: Inflation Reduction Act Expands the Carbon Capture and Sequestration Tax Credit*, JONES DAY (Aug. 2022).
[204] Bolstering Long-Term Understanding and Exploration of the Great Lakes, Oceans, Bays, and Estuaries (BLUE GLOBE) Act, S. 933, 116th Cong. § 13 (2019).

the department of defense to investigate the development of technologies that remove carbon from sea water.[205] This latter proposal was ultimately passed in the 2020 Defense Budget,[206] while the other died in committee.

More comprehensive legislative initiatives have gotten closer to passage in the 117th Congress, 2021-2022. In early 2022, the House passed the America COMPETES Act,[207] which would require a NOAA-National Academies blue carbon assessment to study the impacts of marine species decline on ocean carbon sequestration potential, the mitigation potential of fish and marine mammal population recovery, a literature review on geologic and deep sea carbon storage, and the potential for human activities to impact blue carbon storage.[208] The House bill also included the Blue Carbon For Our Planet Act,[209] which would have established an interagency working group on coastal blue carbon tasked with developing a national blue carbon resource map, establish national coastal blue carbon conservation and research priorities, and a strategic plan for federal research and development. The Senate, however, passed a competing version of the law that did not include these provisions, and the competing versions of the bill went to conference, where they languished for some time before finally exiting conference without the blue carbon provisions.[210]

Also in 2022, the House Committee on Natural Resources held hearings on a bill that would have called for NOAA to develop methods for incorporating carbon sequestration ecosystem services considerations into existing conservation policies, inventory national blue carbon stocks and fluxes, support the

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[205] Securing Energy for our Armed Forces Using Engineering Leadership (SEA FUEL) Act, S. 1679, 116th Cong. (2019).
[206] National Defense Authorization Act for FY 2020, Pub. L. 116-92 § 223 (2019).
[207] America Creating Opportunities for Manufacturing, Pre-Eminence in Technology, and Economic Strength (America COMPETES) Act, H.R. 4521, 117th Cong. (as engrossed in House Feb. 4, 2022).
[208] *Id.* § 71002.
[209] *Id.* §§ 71801-71806, originally H.R. 2750, 117th Cong. (2021).
[210] U.S. Innovation and Competition Act, H.R. 4521, 117th Cong. (as amended and engrossed in Senate, Mar. 28, 2022); Brian Mosley, *USICA and Competes Act Update: Legislation is Stalled and its Future is Uncertain*, COMPUTING RSCH. POL'Y BLOG (Jun. 15, 2022); Brian Molsey, *"Chips and Science" NSF Legislation, Formerly the USICA and COMPETES Acts, Heads Towards Passage into Law*, COMPUTING RSCH. POL'Y BLOG (Jul. 28, 2022); CHIPS and Science Act, H. R. 4346, 117th Cong. (2022), *enacted* Pub. L. 117-167 (Sep. 8, 2022).

development of marketable carbon credits for blue carbon protection and restoration initiatives, assess national blue carbon storage potential, "[a]ssess legal issues of landownership and leases in blue carbon markets," and even "protect and restore habitats, waters, and organisms that are long-term carbon sinks or will be subject to habitat change as a result of climate change and development;" as well as operating a state conservation grant program with a goal of protection or restoration 1.5 million acres over ten years, these last two funded at nearly a billion dollars over five years.[211] This proposal, however, died in committee. A Senate bill proposed directing the Department of Energy to undertake a technology research program that would have included carbon mineralization in the shallow oceans, and would have made DOE responsible for developing ocean carbon removal strategies, including coastal blue carbon sequestration enhancement, direct ocean capture, algae cultivation, and ocean alkalinity enhancement. [212] It died in committee as well, as did a proposal for a living shorelines grant program.[213]

Legislative proposals relating to blue carbon have not yet become highly polarized, and there has been some indication that the revenue potential could allay some conservative opposition. Nonetheless, it should never be forgotten that there is a significant partisan divide on federal environmental legislation that prevents a great deal of creativity at the national level. To that end, Rep. Bruce Westerman (R-AR) began developing a conservative antiregulatory opposition to blue carbon law in a "dissenting view" appended to a House Report on the Ocean-Based Climate Solutions Act of 2022,[214] which would have incorporated several of the above proposals and which also died in committee. In his words:

> [This bill] should be called the "Blue New Deal" because it reflects a broad list of Democratic big government "solutions" that would eliminate inland and offshore jobs and increase bureaucratic red tape. …

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[211] Blue Carbon Protection Act, H.R. 3906, 117th Cong. (2022).
[212] Carbon Removal and Emissions Storage Technologies (CREST) Act, S. 4420 § 121, 117th Cong. (2022) (adding oceanic carbon removal activities to EPAct 2005 § 969D).
[213] Living Shorelines Act, H.R. 4235, 117th Cong. (2021).
[214] H.R. 3764, 117th Cong. (2022).

> For example, the national blue carbon ecosystem map mandated in the bill would require that the National Oceanic and Atmospheric Administration (NOAA) identify upstream structures or pollution sources that affect the watershed and potential for blue carbon sequestration. This requirement has no limits on how far upstream that process might reach. … A Republican amendment … was offered to strike this mapping requirement but was rejected by the Democratic Majority.
>
> Additional red tape H.R. 3764 would create includes new consultation requirements for all federal agencies where a proposed action has the potential to cause an adversarial impact to "blue carbon areas of significance" or "marine mammal climate impact management plans." … [T]hese requirements would undoubtedly create yet another layer of environmental bureaucracy and potential litigation that will be used to block federal actions, such as maintaining or building new infrastructure of all kinds near water … A Republican amendment offered by Mr. Bentz of Oregon sought to protect inland water infrastructure but that was also rejected by the Democratic Majority.
>
> … This bill is a federal government-knows-best partisan exercise rammed through Committee without consideration of its impacts to the economy and those who depend on our working oceans and rivers. For this reason, it passed on a party-line vote. Even then, it has shown itself to be too radical for even the House Democratic Caucus since it was never considered as a stand-alone measure on the House floor in the 117th Congress.[215]

In other words, the polarization of blue carbon law has begun. If this opposition gains traction, it may make it impossible for the U.S. Congress to act, leaving federal agencies to make do within existing statutory authorities. In that case, emerging scientific knowledge about blue carbon will no doubt be integrated

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[215] H.R. Rep. No. 117-695, at 266-67 (Dec. 30, 2022). NB: Rep. Westerman was the primary proponent of the Trillion Trees Act, H.R. 5859, 116th Cong. (2021).

to some degree into federal regulatory programs as discussed in Part III, but it is likely that the frontlines in the development of blue carbon law will remain elsewhere, particularly in the development of voluntary carbon market accreditation methodologies, international carbon market frameworks, and responsive subnational programs integrated with the carbon markets, as discussed in Part II.

Even so, it is worth pausing to reflect on Rep. Westerman's novel color-coded play on words, and what a "Blue New Deal" could entail. Perhaps, it would ensure that the harms of any coming transition are minimized, and the benefits shared equitably across and within societies. Perhaps, it would integrate carbon concepts into existing laws in a rational fashion. Perhaps, it would promote the highest possible offset credit quality in the emerging international carbon market framework, to hold state actors seeking to produce revenues accountable to these very high standards, and call for the consideration of blue carbon consequences in the operation and implementation of any law that governs human interventions into the marine carbon cycles. Perhaps, it would ensure that U.S. ocean carbon management policy contributed only positively to global efforts to combat climate change and protect ocean biodiversity.

Ultimately, the criteria along which blue carbon law should be judged will be familiar ones. Do these laws accomplish what they should? Are they cost effective? Are they fair? In this regard, evidence from the terrestrial carbon management offsetting programs and the state of forests might be worthwhile to consider. Despite LULUCF efforts, despite REDD+, and despite recent recommitments to halt it, worldwide deforestation has continued at a rapid pace, contributing enormously to global greenhouse gas emissions. Is this because these efforts are fundamentally flawed, or because the opposition to them has rendered them less effective than they could otherwise have been? Has the money spent on these programs produced results and bought time for technological innovations and direct emissions reductions to do their work, or has it been wasted on boondoggles and distractions while the climate clock ticks down? And have these funds benefited vulnerable people in any way, or been captured primarily by the wealthy in extractive economies and governments, cementing existing power structures and the disenfranchisement of the many to the benefit of the few?

These questions have dominated the debates over terrestrial carbon management for decades, and, with the rise of blue carbon, are now poised to dominate debates over coastal and marine ecosystem protection for years to come. While appearing new, blue carbon is law is, in fact, an extension of existing ideas applied in a new way. It is hoped that the above exploration, by tying together the disparate-seeming threads, will contribute to the development of a more comprehensive body of rules to protect the environment and the people in it – ever the goals of environmental law.

MIRANDA:

O, wonder!
How many goodly creatures are there here!
How beauteous mankind is! O brave new world,
That has such people in't!

PROSPERO:

... 'Tis new to thee.[216]

[216] WILLIAM SHAKESPEARE, THE TEMPEST, Act 5, Scene 1, lines 182-86 (~1611).

Appendix 1: UNFCCC / Kyoto Protocol Decisions on Crediting Forestry Sinks Activities

Year	Decision	Title
Afforestation/Reforestation Decisions		
1997	1/CP.3	*Adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change*
1998	9/CP.4	*Land-use, land-use change and forestry*
1999	16/CP.5	*Land-use, land-use change and forestry*
2001	11/CP.7	*Land use, land-use change and forestry*
2001	15/CP.7	*Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol [joint implementation, clean development mechanism, and emissions trading]*
2001	16/CP.7	*Guidelines for the implementation of Article 6 of the Kyoto Protocol [joint implementation]*
2001	17/CP.7	*Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol*
2001	18/CP.7	*Modalities, rules and guidelines for emissions trading under Article 17 of the Kyoto Protocol*
2001	19/CP.7	*Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol*
2002	21/CP.8	*Guidance to the Executive Board of the clean development mechanism [Article 12]*
2003	13/CP.9	*Good practice guidance for land use, land-use change and forestry in the preparation of national greenhouse gas inventories under the Convention*
2003	19/CP.9	*Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism [Article 12] in the first commitment period of the Kyoto Protocol [2008-2012]*
2005	2/CMP.1	*Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol [joint implementation, clean development mechanism, and emissions trading]*

2005	5/CMP.1	*Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism [Article 12] in the first commitment period of the Kyoto Protocol [2008-2012]*
2005	6/CMP.1	*Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism [Article 12] in the first commitment period of the Kyoto Protocol [2008-2012[and measures to facilitate their implementation*
2008	9/CMP.1	*Guidelines for the implementation of Article 6 of the Kyoto Protocol*
2008	11/CMP.1	*Modalities, rules and guidelines for emissions trading under Article 17 of the Kyoto Protocol [emissions trading]*
2008	16/CMP.1	*Land use, land-use change and forestry*
2008	17/CMP.1	*Good practice guidance for land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol*
REDD+ Decisions		
2007	2/CP.13	*Reducing emissions from deforestation in developing countries: approaches to stimulate action*
2009	4/CP.15	*Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*
2010	1/CP.16	*The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*
2011	2/CP.17	*Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*
2011	12/CP.17	*Guidance on systems for providing information on how safeguards are addressed and respected and modalities relating to forest reference emission levels and forest reference levels as referred to in decision 1/CP.16*
2012	1/CP.18	*Agreed outcome pursuant to the Bali Action Plan*
2013	9/CP.19	*Work programme on results-based finance to progress the full implementation of the activities referred to in decision 1/CP.16, paragraph 70*

2013	10/CP.19	*Coordination of support for the implementation of activities in relation to mitigation actions in the forest sector by developing countries, including institutional arrangements*
2013	11/CP.19	*Modalities for national forest monitoring systems*
2013	12/CP.19	*The timing and the frequency of presentations of the summary of information on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected*
2013	13/CP.19	*Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels*
2013	14/CP.19	*Modalities for measuring, reporting and verifying*
2013	15/CP.19	*Addressing the drivers of deforestation and forest degradation*
2013	16/CP.19	*Alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests*
2013	17/CP.19	*Further guidance on ensuring transparency, consistency, comprehensiveness and effectiveness when informing on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected*
2013	18/CP.19	*Methodological issues related to non-carbon benefits resulting from the implementation of the activities referred to in decision 1/CP.16, paragraph 70*
2015	16/CP.21	*Alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests*
2015	17/CP.21	*Further guidance on ensuring transparency, consistency, comprehensiveness and effectiveness when informing on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected*
2015	18/CP.21	*Methodological issues related to non-carbon benefits resulting from the implementation of the activities referred to in decision 1/CP.16, paragraph 7*