A CLIMATE SOLUTION ON SHAKY GROUND: THE VOLUNTARY CARBON MARKET AND AGRICULTURAL SEQUESTRATION

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Climate change demands concerted and immediate efforts to reduce levels of atmospheric carbon. One effort, the voluntary carbon market, allows carbon polluters to offset their emissions by purchasing carbon credits representative of reduced carbon dioxide emissions. Recent years have seen growing interest in the voluntary carbon market, especially by private enterprises in search of "net-zero" carbon footprints. This market is "voluntary" in that no government requires participation by private actors, but those who do participate face complicated questions of contract and property law.

To generate carbon credits, parties enter contracts, the performance of which result in property interests in the credits. They can then be bought, sold, traded, and relied upon for "net zero" claims. Making carbon dioxide emissions something that can be bought and sold is easier said than done because measuring and monitoring carbon in different settings is difficult and subject to high levels of uncertainty. With many methods used to generate carbon credits, it can be difficult to say that a unit of carbon dioxide represented by a credit was in fact removed from the atmosphere.

Measuring and monitoring carbon is especially difficult where credits are generated through agricultural soil carbon sequestration. This method of credit generation has been the subject of considerable interest as a solution to climate change. Governments have taken steps to encourage the generation of carbon credits through agricultural changes and to increase the reliability of credits in general, but the legal landscape remains in flux.

By focusing on agricultural carbon sequestration as an especially unreliable means of carbon credit generation, this Note aims to expose and analyze legal problems with the voluntary carbon market. It concludes that legislative and regulatory action is necessary to bring clarity to the voluntary carbon market and explores possible means by which the law might facilitate reliable and permanent removal of carbon dioxide from the atmosphere.

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I. INTRODUCTION

In many ways, United States climate policy has been a series of failed starts. After joining the UN Framework Convention on Climate Change ("UNFCCC") in 1992, the U.S. was poised to lead an international response to increasing global temperatures.[1] But its failure to ratify the 1997 Kyoto Protocol[2] and its on-again-

1. *See* United Nations Framework Convention on Climate Change, May 9, 1992, S. Treaty Doc. No. 102-38, 1771 U.N.T.S. 107, https://unfccc.int/resource/docs/convkp/conveng.pdf [https://perma.cc/BA7Y-KHTP].

2. *See* Conference of the Parties to the Framework Convention on Climate Change: Kyoto Protocol, Dec. 10, 1997, 37 ILM 22 (1998), https://unfccc.int/sites/default/files/resource/docs/cop3/l07a01.pdf [https://perma.cc/D9NM-EJEE].

off-again relationship with the 2015 Paris Agreement[3] have dashed high hopes for international climate leadership from the U.S.

Domestically, Congress came closest to taking serious action when the House of Representatives passed the American Clean Energy and Security Act of 2009,[4] but negotiations to bring legislation across the finish line fell apart in the Senate.[5] The Obama White House, which some blame for the failed negotiations securing lasting cap-and-trade legislation,[6] then pursued climate policy through the Environmental Protection Agency ("EPA").[7] Those efforts resulted in the EPA in 2015 issuing its Clean Power Plan ("CPP") rule pursuant to Section 111 of the Clean Air Act.[8] Through the CPP, the EPA aimed to bring about "large[] emission reductions . . . to address climate change."[9] As part of the Plan, energy producers would have had the option to participate in a "cap-and-trade regime" similar to that which eluded Congress early on in President Obama's tenure.[10]

But the CPP came up short as well. First, in a highly unusual ruling, the Supreme Court in 2016 issued a stay[11] on the EPA's implementation of the CPP.[12] Never before had the Court halted a regulation before first allowing a federal appeals court to review the matter.[13] Then the Trump Administration repealed the CPP and issued its own rule under Section 111, the Affordable Clean Energy ("ACE") rule, which was essentially a watered-down version of the CPP.[14] Endorsing the Obama Administration's interpretation, the Circuit Court of Appeals held that the repeal of the CPP "rested critically on a mistaken reading of the Clean Air Act" and ordered further consideration by the EPA.[15] In the end,

3. *See* Paris Agreement, Dec. 12, 2015, 55 I.L.M. 743 (2016), https://unfccc.int/sites/default/files/english_paris_agreement.pdf [https://perma.cc/76HN-BH92].

4. *See* H.R. 2454, 111th Cong. (as passed by the House, June 26, 2009). This Note was drafted and submitted for publication prior to passage of the Inflation Reduction Act of 2022. Pub. L. No. 117-169. This Act is undoubtedly the most significant piece of U.S. legislation responding to climate change to date, and many of the points raised in this Note may be relevant to implementing sequestration efforts funded by the Act. *See id.*

5. Ryan Lizza, *As the World Burns*, NEW YORKER (Oct. 3, 2010), https://www.newyorker.com/magazine/2010/10/11/as-the-world-burns [https://perma.cc/AH4F-C9FF].

6. *Id.*

7. Umair Irfan, *Trump's EPA Just Replaced Obama's Signature Climate Policy with a Much Weaker Rule*, VOX (June 19, 2019, 3:51 PM), https://www.vox.com/2019/6/19/18684054/climate-change-clean-power-plan-repeal-affordable-emissions [https://perma.cc/3HDB-W9RH].

8. West Virginia v. EPA, 142 S. Ct. 2587, 2602–03 (2022).

9. *Id.*

10. *Id.* at 2603–04; Lizza, *supra* note 5.

11. Order in Pending Case, West Virginia v. EPA, 577 U.S. 1126 (2016) (No. 15-A773), https://www.documentcloud.org/documents/2709346-15A773-West-Virginia-v-EPA-Order-c1.html?embed=true&responsive=false&sidebar=false&text=false [https://perma.cc/ZX8S-44BA].

12. Courtney Scobie, *Supreme Court Stays EPA's Clean Power Plan*, AM. BAR ASS'N (Feb. 17, 2016), https://www.americanbar.org/groups/litigation/committees/environmental-energy/practice/2016/021716-energy-supreme-court-stays-epas-clean-power-plan/ [https://perma.cc/7KXM-SYZQ].

13. *Id.*

14. *West Virginia*, 142 S. Ct. at 2605.

15. *Id.* at 2605–06.

the Court struck down the rule under its "major questions doctrine,"[16] holding that the EPA's interpretation of Section 111 was not supported by the statute and that the CPP was beyond Congress's delegation in the Clean Air Act.[17]

With the federal branches sparring over what to do and how and whether it can be done, some states have taken it upon themselves to pass climate legislation. California oversees a statewide cap-and-trade program in coordination with the Canadian province of Quebec,[18] as does a regional coalition of eleven northeastern states.[19] In 2021, Illinois passed landmark legislation requiring a transition to 100% renewable energy production by 2045.[20]

Efforts to address the problem of climate change do not stop with government. This Note explores a climate solution put forward and coordinated by private enterprise. This solution, the "voluntary carbon market," has grown to meet demand from companies seeking to purchase carbon credits in the absence of any statutory mandate, with a series of actors working together to generate carbon credits.[21] A carbon credit is best thought of as an instrument, similar to a security, representing a unit of emission reductions that can be traded between parties who value those reductions.[22] Voluntary carbon markets differ from carbon markets administered for compliance purposes under statutory schemes. [23] Unlike statutory programs, the voluntary market is wholly the product of private contractual agreements between individuals and organizations.[24]

16. *Id.* at 2614.

17. *Id.* at 2616. The Court explained that the wide-ranging impact the rule would have made it "'reluctant to read into ambiguous statutory text' the delegation claimed to be lurking there." *Id.* at 2609 (quoting Utility Air Regul. Grp. v. EPA, 573 U.S. 302, 324 (2014)). *But see* Massachusetts v. EPA, 549 U.S. 497, 532 (2007) ("[T]he fact that a statute can be applied in situations not expressly anticipated by Congress does not demonstrate ambiguity. It demonstrates breadth.") (quoting Pa. Dep't of Corr. v. Yeskey, 524 U.S. 206, 212 (1998)).

18. *AB 32 Global Warming Solutions Act of 2006*, CAL. AIR RES. BD. (Sept. 28, 2018), https://ww2.arb.ca.gov/resources/fact-sheets/ab-32-global-warming-solutions-act-2006 [https://perma.cc/H6DE-CV2R]; *see also Program Linkage*, CAL. AIR RES. BD., https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/program-linkage (last visited Feb. 5, 2023) [https://perma.cc/K48K-VZZK].

19. *Regional Greenhouse Gas Initiative (RGGI)*, CTR. FOR CLIMATE AND ENERGY SOLS., https://www.c2es.org/content/regional-greenhouse-gas-initiative-rggi/ (last visited Feb. 5, 2023) [https://perma.cc/F4L6-7WYQ].

20. Energy Transition Act, Pub. L. No. 102-0662, 2021 Ill. Legis. Serv. P.A. 102-662 (S.B. 2408) (West) (codified at 70 ILL. COMP. STAT. 730 (2021)); Press Release, Ill. Gov., Gov. Pritzker Signs Transformative Legislation Establishing Illinois as a National Leader on Climate Action, (Sept. 15, 2021), https://www.illinois.gov/news/press-release.23893.html [https://perma.cc/PT8W-Q72G].

21. Christopher Blaufelder, Cindy Levy, Peter Mannion & Dickon Pinner, *A Blueprint for Scaling Voluntary Carbon Markets to Meet the Climate Challenge*, MCKINSEY SUSTAINABILITY (Jan. 29, 2021), https://www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge [https://perma.cc/7DN6-24RD].

22. *What Is the Carbon Trade?*, INVESTOPEDIA (Mar. 15, 2022), https://www.investopedia.com/ask/answers/04/060404.asp [https://perma.cc/A323-NM8M]; *see also* West Virginia v. EPA, 142 S. Ct. 2587, 2603 (2022).

23. *See West Virginia*, 142 S. Ct. at 2603.

24. Blaufelder et al., *supra* note 21.

A. The Growing Climate Solutions Act

In an effort to increase confidence and activity in voluntary carbon markets, the United States Senate in June 2021 passed the Growing Climate Solutions Act (the "Act"), a bill that would authorize the Secretary of Agriculture (the "Secretary") to certify third-party verifiers of carbon credits generated by "farmers, ranchers, and private forest landowners."[25] The Act would authorize the Secretary to develop a "program to reduce barriers to entry for farmers . . . in certain voluntary markets" which trade credits "derived from . . . carbon sequestration on agricultural land."[26] The official name for the program would be "Greenhouse Gas Technical Assistance Provider and Third-Party Verifier Certification Program" (the "Program").[27]

Should the Act become law, it will mandate that an Advisory Council be convened to advise the Secretary on how to best structure and implement the Program.[28] The Advisory Council would consist of representatives from the United States Department of Agriculture ("USDA"), the EPA, the National Institute of Standards and Technology, the agriculture and forestry industries, scientific researchers, experts in carbon credits, and voluntary carbon market participants.[29] The leaders of the relevant agencies would be required to submit, within 240 days of the Act's enactment, an assessment to the "Committee on Agriculture, Nutrition, and Forestry of the Senate and the Committee on Agriculture of the House of Representatives,"[30] after which the Secretary will make a determination about whether establishing the Program would further the purposes of the Act.[31]

B. Agricultural Soil Carbon Sequestration

"[L]and or soil . . . sequestration" is the first activity listed for which certification would be available under the program proposed.[32] This credit-generating activity involves farmers decreasing atmospheric carbon concentrations by altering agricultural practices to increase levels of carbon in the soil.[33] The method, agricultural soil carbon sequestration,[34] follows from the recognition that we can

25. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).
26. *Id.*
27. *Id.* § 2(c).
28. *Id.* § 2(a)(4).
29. *Id.* § 2(g)(2)(C)(i)–(x).
30. *Id.* § 2(h)(1).
31. *Id.* § 2(c).
32. *Id.* § 2(d)(2)(A).
33. *See* Laura Van der Pol, Dale Manning, Francesca Cotrufo & Megan Machmuller, *To Make Agriculture More Climate-Friendly, Carbon Farming Needs Clear Rules*, CONVERSATION (June 30, 2021, 8:12 AM), https://theconversation.com/to-make-agriculture-more-climate-friendly-carbon-farming-needs-clear-rules-160243 [https://perma.cc/4N8U-MN3H].
34. In popular parlance, agricultural soil carbon sequestration is often referred to as "carbon farming." *See* Brian Barth, *Carbon Farming: Hope for a Hot Planet*, MODERN FARMER (Mar. 25, 2016), https://modernfarmer.com/2016/03/carbon-farming/ [https://perma.cc/8YVZ-KQ6Q]. To match the language used in most

increase carbon stored in soils through changes in land management practices.[35] Practices used to capture atmospheric carbon in the soil on farms engaged in annual row-cropping include planting cover crops, reducing the frequency and magnitude of tillage, changes to crop rotation, and incorporating animals into crop systems.[36] Scientific and legal uncertainties pose many challenges to holding sequestered carbon in soils on working farms.[37]

A typical project involves a landowner making an agreement, usually for a five-to-ten-year duration, with any number of intermediaries.[38] Depending on a landowner's chosen program, carbon credits are ultimately purchased by parties, usually a corporation, looking to offset its emissions.[39] As "net-zero" emission plans have become more common among private companies, demand has increased for carbon credits.[40]

Parties in the voluntary carbon market rely on contractual agreements to develop long-term projects.[41] Because the market is developing in its early stages, related litigation and resulting case law is sparce.[42] Further, because voluntary carbon credits are not the product of government mandates and because the market is largely unregulated, the current legal landscape consists mostly of private agreements between market participants.[43] A discussion about carbon

sources cited here, this Note uses the term "agricultural soil carbon sequestration," or simply "agricultural sequestration." *See, e.g.*, Ronald Amundson & Léopold Biardeau, *Soil Carbon Sequestration Is an Elusive Climate Mitigation Tool*, 115 PROC. NAT'L ACAD. SCIS. 11652, 11652 (2018); Mark A. Bradford et al., *Soil Carbon Science for Policy and Practice*, 2 NATURE SUSTAINABILITY 1070, 1071–72 (2019).

35. Amundson & Biardeau, *supra* note 34, at 11652–53.

36. E.E. OLDFIELD, A.J. EAGLE, R.L. RUBIN, J. RUDEK, J. SANDERMAN & D.R. GORDON, AGRICULTURAL SOIL CARBON CREDITS: MAKING SENSE OF PROTOCOLS FOR CARBON SEQUESTRATION AND NET GREENHOUSE GAS REMOVALS 5 (2021); Van der Pol et al., *supra* note 33; Barth, *supra* note 34.

37. TASKFORCE SCALING VOLUNTARY CARBON MARKETS, PHASE II REPORT 12 (2021), https://www.iif.com/Portals/1/Files/TSVCM_Phase_2_Report.pdf [https://perma.cc/32BR-G2DU] [hereinafter TASKFORCE]; Amundson & Biardeau, *supra* note 34, at 11653–55.

38. *See* Silvia Favasuli & Vandana Sebastian, *Voluntary Carbon Markets: How They Work, How They're Priced and Who's Involved*, S&P GLOB. (Nov. 25, 2021), https://www.spglobal.com/platts/en/market-insights/blogs/energy-transition/061021-voluntary-carbon-markets-pricing-participants-trading-corsia-credits [https://perma.cc/M9N8-CRGR].

39. *Id.*

40. Jess Shankleman & Akshat Rathi, *Wall Street's Favorite Climate Solution Is Mired in Disagreements*, BLOOMBERG GREEN (June 2, 2021, 5:43 PM), https://www.bloomberg.com/news/features/2021-06-02/carbon-offsets-new-100-billion-market-faces-disputes-over-trading-rules [https://perma.cc/93YS-GXD3].

41. *See, e.g.*, Peggy Kirk Hall, *Considering Carbon Farming? Take Time to Understand Carbon Agreements*, OHIO ST. UNIV.: OHIO AG L. BLOG (Aug. 3, 2021), https://farmoffice.osu.edu/blog/tue-08032021-126pm/considering-carbon-farming-take-time-understand-carbon-agreements [https://perma.cc/39V4-V63B].

42. For an interesting case discussing the nature of rights to carbon credits, see Roseland Plantation, L.L.C. v. U.S. Fish & Wildlife Serv., No. 05-0793, 2006 U.S. Dist. LEXIS 29334, at *9–10 (W.D. La. Apr. 5, 2006).

43. Ryan Evens, *Carbon Contracts Beg Many Questions*, AGUPDATE (July 26, 2021), https://www.agupdate.com/agriview/news/business/carbon-contracts-beg-many-questions/article_7269ee3d-5400-5266-855c-7747870a1f49.html [https://perma.cc/8GJK-2XSE] ("Carbon contracts between producers and aggregators are still very new and have little to no standardization, according to Dave Aiken, professor and agricultural-law specialist . . . .").

contracts is therefore a suitable starting place for questions related to how voluntary transactions for carbon credits are viewed under the law.[44]

The voluntary market is highly fragmented, with countless variations in agreements between market participants.[45] With little to no guidance from legislatures, courts, or regulators, market participants remain unclear as to details as basic as the legal nature of carbon credits.[46] A study of the nature of the property rights underlying carbon credits is therefore needed to determine what legal mechanisms are available to support their viability and efficacy as solutions to the climate crisis.[47]

C. Purpose and Roadmap

This Note aims to inform legislative and regulatory efforts to scale the voluntary carbon market. By focusing on agricultural soil carbon sequestration, this Note highlights issues relating to an especially difficult and unreliable means of generating carbon credits. The carbon capture potential of annual crop systems is especially suspect due to regular disturbances to the soil profile. This is the focus of this Note. By addressing a weak link in carbon credit generation, the voluntary market's ability to utilize agricultural credits as a meaningful climate solution may be improved.

Several issues the Secretary will need to consider if the Act becomes law are raised and addressed below. In that way, this Note could function as guidance to the Secretary and other regulators charged with carrying out the Act. Even if the Act does not become law, this Note can inform future regulatory (private or public) efforts in voluntary carbon markets and agricultural soil carbon sequestration.

Because market participants have raised concerns about the unclear legal nature of carbon credits,[48] this Note takes up that issue and explores how they might be best characterized under law. This Note argues that policymakers should be focused on ensuring that voluntary carbon credits produce reliable outcomes and thereby serve the public interest by tangibly reducing atmospheric carbon.[49] The public should be concerned about corporate reliance on carbon credits that lack firm scientific foundations to make claims of carbon neutrality. Such reliance risks false conceptions about companies' environmental integrity, a practice known as "greenwashing."[50]

44. *See id.*

45. TASKFORCE, *supra* note 37, at 53.

46. *Id.*

47. ANNA KNOX, DARRYL VHUGEN, SOLEDAD AGUILAR, LEO PESKETT & JONATHAN MINER, FOREST CARBON RIGHTS GUIDEBOOK 7 (2012) ("In developing an understanding of carbon rights, it can be helpful to take a fresh look at property rights more generally.").

48. TASKFORCE, *supra* note 37, at 53.

49. *See* Amundson & Biardeau, *supra* note 34.

50. *See* Will Kenton, *What Is Greenwashing? How it Works, Examples, and Statistics*, INVESTOPEDIA (Oct. 17, 2022), https://www.investopedia.com/terms/g/greenwashing.asp#:~:text=Greenwashing%20is%20the%20

Part II provides background on the climate and soil science before discussing public and private efforts to facilitate the generation of agricultural carbon credits. Emphasis is placed on attributes that make sales of agricultural carbon credits, and the contracts supporting those transactions, especially uncertain and financially risky endeavors. Part III analyzes the ways in which uncertainties in soil science influence the validity of agricultural carbon credits and presents the general framework of sequestration projects. Private and public sector efforts to scale the voluntary market are then discussed alongside their shortcomings. Part IV recommends guidance for lawmakers and regulators aiming to ensure voluntary carbon markets can scale and operate with integrity.

II. BACKGROUND

This Part details background information to facilitate a legal discussion about agricultural carbon credits sold through the voluntary carbon market. It begins by describing climate change in basic terms, followed by an overview of the current state of soil science as it relates to carbon sequestration and storage. As explained below, carbon credits representing carbon sequestered on working farms are least likely to reliably represent long-term storage of carbon,[51] and they thus provide helpful examples for discussing shortcomings of the voluntary market and possible solutions to those shortcomings.

Understanding the scientific moorings of climate change and soil sequestration is not an esoteric task of concern only to scientific experts—disputes arising from carbon credits will require the careful study of scientific fields by attorneys and judges.[52] Specifically, where parties present testimony attesting to the validity or invalidity of carbon capture, the Supreme Court's evidence jurisprudence dictates that trial judges' first task is to assess "whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue."[53]

By paying mind to the science underlying contracts behind carbon credits, attorneys can confront what Judge Posner considers the "widespread . . . discomfort among lawyers and judges confronted by [] scientific . . . issue[s]."[54] Doing so is important, as the legal profession's aversion to technical fields, according to Judge Posner, is "increasingly concerning, because of the extraordinary rate of scientific . . . advances that figure increasingly in litigation."[55]

process%20of,company's%20products%20are%20environmentally%20friendly [https://perma.cc/86UZ-WHQL] ("Greenwashing is the process of conveying a false impression or providing misleading information about how a company's products are more environmentally sound."); *see also* Amundson & Biardeau, *supra* note 34, at 11652.

51. *See* discussion *infra* Subsection III.E.2.ii.

52. *See* Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 592–93 (1993).

53. *See id.*

54. *See* Jackson v. Pollion, 733 F.3d 786, 787 (7th Cir. 2013).

55. *Id.* at 788.

A. The Problem: Climate Change

Nineteenth-century scientists observed that Earth is warmer than calculations using its size and distance from the sun suggest.[56] To explain, they hypothesized that the atmosphere acts like a sort of blanket, holding in radiation from the sun.[57] Modern commentators often explain this phenomenon by saying the atmosphere "acts like the ceiling of a greenhouse, trapping solar energy" and retaining heat;[58] ergo it is called the "greenhouse effect."[59] Drawing from this idea, Gilbert Plass published *The Carbon Dioxide Theory of Climatic Change* in 1956, predicting a 30% increase in atmospheric carbon by the end of the twentieth century.[60] According to Plass, influx in atmospheric carbon is "increasing the average temperature by 1.1°C per century."[61]

Plass's predictions have proved eerily accurate; today's climate scientists link increased temperatures to more frequent and severe floods, droughts, heat waves, and tropical storms,[62] along with the "'destruction of ecosystems[]' and 'potentially significant disruptions of food production.'"[63] Accordingly, they urge drastic reductions in carbon emissions to avoid the calamity that would accompany two-, three-, and four-degree increases in Earth's average temperature above nineteenth-century levels, increases that are all very real possibilities.[64] Even in the best-case scenario, there is no avoiding increasingly warmer global temperatures until at least mid-century.[65]

Climate change is a colossal problem; many consider it to be "the most pressing environmental challenge of our time."[66] The leading scientific authority on climate change, the Intergovernmental Panel on Climate Change (the "Panel"), considers it "unequivocal that human influence has warmed the atmosphere, ocean and land" and asserts that "[w]idespread and rapid changes . . . have [already] occurred."[67] Despite continued denial and flat-out lies from our highest

56. *Climate Change: How Do We Know?*, NASA, https://climate.nasa.gov/evidence/ (last visited Feb. 5, 2023) [https://perma.cc/2KEK-73FP].

57. *Id.* at n.2.

58. *See* Massachusetts v. EPA, 549 U.S. 497, 505 (2007).

59. *See id.* at 509.

60. Gilbert N. Plass, *The Carbon Dioxide Theory of Climatic Change*, 8 TELLUS 140, 149 (1956).

61. *Id.*

62. IPCC, CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS 25 (V. Masson-Delmotte, P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, & B. Zhou eds., 2021) (2021).

63. West Virginia v. EPA, 142 S. Ct. 2587, 2627 (2022) (Kagan, J., dissenting) (quoting Am. Elec. Power Co. v. Connecticut, 564 U.S. 410, 417 (2011)).

64. *See id.* at 2638.

65. *Id.* at 14.

66. Massachusetts v. EPA, 549 U.S. 497, 505 (2007).

67. IPPC, *supra* note 62, at 4.

levels of government,[68] "[c]limate change's causes and dangers are no longer subject to serious doubt."[69]

The Panel is an international body of hundreds of leading scientists convened by the United Nations to assess and inform governments about the scientific basis for climate change.[70] In a recent report, it stated that atmospheric carbon dioxide concentrations in 2019 reached a *two-million*-year high.[71] Each of the past four decades has been successively warmer than the last.[72] The Panel's models show that heat waves, droughts, precipitation events, and tropical storms are both more intense and more frequent than they would be if atmospheric carbon dioxide were at 1850 levels.[73]

Global surface temperature between 2000 and 2021 was approximately one degree Celsius (+1°C) warmer than between 1850 and 1900 ("baseline levels").[74] The geologic record indicates that this increase has occurred at a rate not experienced on Earth in over 2,000 years; current temperatures are higher than at any time in the past 100,000 years.[75] If emissions of carbon dioxide persist at current rates until 2050, global temperatures are very likely to be *twice as high* as those we experience today (+2°C above baseline levels) during the final twenty years of this century.[76] Even under the Panel's best-case scenario, temperatures will be +1.8°C above baseline levels between 2081 and 2100.[77]

Limiting warming is essential to avoiding not only worst-case ecological outcomes but also to mitigating intense shocks to the world's economy, such as reductions in global economic output and skyrocketing insurance prices.[78] The question is, how do we limit warming efficiently, economically, and *quickly*?

68. *See, e.g.*, Helier Cheung, *What Does Trump Actually Believe on Climate Change?*, BBC NEWS (Jan. 23, 2020), https://www.bbc.com/news/world-us-canada-51213003 [https://perma.cc/87DC-QTF7]; Jeffrey Mervis, *From a Bully Pulpit, Ted Cruz Offers His Take on Climate Change*, SCIENCE.ORG (Dec. 9, 2015), https://www.science.org/content/article/bully-pulpit-ted-cruz-offers-his-take-climate-change [https://perma.cc/JM8Z-WHJM]; Oliver Milman, *EPA Head Scott Pruitt Says Global Warming May Help 'Humans Flourish'*, THE GUARDIAN (Feb. 7, 2018, 1:28 PM), https://www.theguardian.com/environment/2018/feb/07/epa-head-scott-pruitt-says-global-warming-may-help-humans-flourish [https://perma.cc/D3G8-L48V].

69. *West Virginia* v, 142 S. Ct. at 2626 (Kagan, J., dissenting).

70. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, WHAT IS THE IPCC?, https://www.ipcc.ch/site/assets/uploads/2021/07/AR6_FS_What_is_IPCC.pdf [https://perma.cc/R7D8-CYNS] (revised in July 2021).

71. IPPC et al., *supra* note 62, at 8.

72. *Id.* at 9.

73. *Id.*

74. *Id.* at 6.

75. *Id.* at 8.

76. *Id.* at 16–18.

77. *Id.* at 19.

78. Christopher Flavelle, *Climate Change Could Cut World Economy by $23 Trillion in 2050, Insurance Giant Warns*, N.Y. TIMES (Nov. 4, 2021), https://www.nytimes.com/2021/04/22/climate/climate-change-economy.html [https://perma.cc/6XEL-CUEK].

B. A Proposed Solution: Soils and the Voluntary Carbon Credit Market

1. Soils

It is difficult to overstate how important soils are to life on Earth.[79] Beyond their central role in food production, soils also filter water, store minerals and nutrients, support natural habitats, provide raw materials, and, most relevant to this Note, store carbon.[80] In fact, the Earth's soils contain over three times the amount of carbon held in the atmosphere.[81] Through the respiration of plants and soil-dwelling organisms, carbon dioxide is continuously exchanged between soils and the atmosphere.[82] When organisms die and decompose, much of the carbon in their cells is digested by soil organisms and ultimately becomes organic (carbon-based) matter in soils.[83] This process is known as "soil carbon sequestration."[84]

Soil scientists agree that soils have the potential to store far more carbon than they do at present.[85] In answer to calls for solutions to climate change from the scientific community, policymakers have proposed leveraging this potential as a means of mitigating the impacts of climate change.[86] The basic idea behind these proposals is that by facilitating increased carbon sequestration in soils, we can reduce concentrations of carbon dioxide in the atmosphere, and thereby reduce the warming of the planet.[87]

For example, in 2017, California launched its "Healthy Soils Program" which provides incentives to farmers for adopting practices that increase carbon sequestration in soils.[88] The European Union has issued guidance on "wide-scale adoption" of agricultural soil carbon sequestration schemes.[89] And, as outlined above, the U.S. Senate recently passed the Growing Climate Solutions Act of 2021 which includes soil carbon sequestration as an activity eligible for Program certification.[90]

79. Saskia D. Keesstra et al., *The Significance of Soils and Soil Science Towards Realization of the United Nations Sustainable Development Goals*, EUR. GEOSCIENCES UNION 112 (2016).

80. *Id.* at 114.

81. *Id.* at 117.

82. Katsuyuki Minami, *Soil and Humanity: Culture, Civilization, Livelihood and Health*, *Soil Science and Plant Nutrition*, 55 SOIL SCI. & PLANT NUTRITION 603, 609 (2009).

83. *Id.*

84. Keesstra et al., *supra* note 79, at 114.

85. Mark A. Bradford et al., *Soil Carbon Science for Policy and Practice*, 2 NATURE SUSTAINABILITY 1070, 1071 (2019).

86. *Id.*; EUR. COMM'N, TECHNICAL GUIDANCE HANDBOOK SETTING UP AND IMPLEMENTING RESULT-BASED CARBON FARMING MECHANISMS IN THE EU 16 (2021); Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

87. *See Healthy Soils Program Fact Sheet*, CAL. CLIMATE & AGRIC. NETWORK (Mar. 2018), https://calclimateag.org/wp-content/uploads/2018/10/Healthy-Soils-Fact-Sheet-2018.pdf [https://perma.cc/Q55Q-WYFN].

88. *Id.*

89. EUR. COMM'N, *supra* note 86, at 13.

90. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § (2)(d)(2)(A) (2021).

On the private-sector side, a group "represent[ing] buyers and sellers of carbon credits, standard setters, the financial sector, market infrastructure providers, civil society, international organizations and academics" have formed the Taskforce on Scaling Voluntary Carbon Markets (the "Taskforce") to "scale an effective and efficient voluntary carbon market to help meet the goals of the Paris Agreement."[91] Agricultural credits are one of a number of credits focused in the Taskforce's report that require "biological storage."[92]

2. Carbon Credit Trading Programs

The commodification of carbon has its beginnings in the first international treaty on climate change, the 1992 UNFCCC, to which the United States is one of 165 signatories.[93] A subsequent treaty, known as the Kyoto Protocol, included goals to create international cap-and-trade emission programs, but heavyweight emitters like the United States and China did not sign on.[94] The Kyoto Protocol led many countries to establish market-based solutions aimed at achieving emission reduction goals, and the European Union in 2005 introduced the first international mandatory cap-and-trade program.[95]

Under these programs, governments assign emitting entities, such as power plants, limited allowances of emissions which function as the "cap."[96] Entities can then conduct market transactions to redistribute the allowance as each entity deems expedient to its own operation; this is the "trade."[97] A number of states in the U.S. oversee such regulatory markets.[98] California established a statewide cap-and-trade program with the passage of Assembly Bill 32, also known as the California Global Warming Solutions Act of 2006, and subsequently linked its program with a counterpart in Quebec.[99] Eleven states in the Northeastern United States participate in a regional cap-and-trade system called the Regional Greenhouse Gas Initiative ("RGGI").[100]

91. TASKFORCE, *supra* note 37, at 3.

92. *Id.* at 75.

93. Brittany A. Harris, *Repeating the Failures of Carbon Trading*, 23 PAC. RIM L. & POL'Y J. 755, 760 (2014); United Nations Framework Convention on Climate Change, U.S. Treaty Document 102–38, 1771 U.N.T.S 107.

94. *Id.* at 762.

95. *Id.* at 762–64.

96. *Overview of ARB Emissions Trading Program*, CAL. AIR RES. BD., https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/guidance/cap_trade_overview.pdf (last visited Feb. 5, 2023) [https://perma.cc/36MJ-6Q3W].

97. *See id.*

98. *AB 32 Global Warming Solutions Act of 2006*, *supra* note 18; *Overview of ARB Emissions Trading Program*, *supra* note 96.

99. *AB 32 Global Warming Solutions Act of 2006*, *supra* note 18; *Overview of ARB Emissions Trading Program*, *supra* note 96.

100. *Regional Greenhouse Gas Initiative (RGGI)*, *supra* note 19.

3. The Voluntary Carbon Market

The concept of carbon credits as a tradable good was adopted from compliance markets to what are known as "voluntary carbon markets," through which organizations purchase credits to offset their carbon footprints.[101] By definition, participation in these markets is "voluntary"; market actors do not participate for purposes of regulatory compliance.[102] These markets commoditize carbon, facilitating sales of credits between emitters and sequestration projects.[103] Credits must be (1) additional, (2) permanent, (3) measurable, and (4) verifiable.[104] These concepts are expanded upon in depth in Part III of this Note.

Credits generated from changes in agricultural practices can be traded on the voluntary market.[105] Generation of agricultural soil carbon credits requires agreements between landowners,[106] and other parties, including registries, project developers, third-party verifiers, and end buyers.[107] Generally, registries operate behind-the-scenes, setting standards and methodologies, organized into comprehensive "protocols," for landowners to follow; registries also maintain ledgers of carbon credit projects.[108] Project developers typically coordinate directly with landowners to provide technical assistance and keep projects on track to be verified as compliant with the chosen protocol.[109] Third-party verifiers are approved by the registries to monitor soil conditions and confirm that land management changes in fact result in sequestration while adhering to standards set out in protocols.[110] End buyers are the "downstream" companies or individuals who purchase credits to claim as offsets to their greenhouse gas emissions.[111]

Agricultural sequestration projects in the voluntary market depend on a series of contractual agreements between landowners, project developers,

101. Blaufelder et al., *supra* note 21.

102. *Id.*

103. Shankleman & Rathki, *supra* note 40.

104. Robert J. Carpenter, *Implementation of Biological Sequestration Offsets in a Carbon Reduction Policy: Answers to Key Questions for a Successful Domestic Offset Program*, 31 ENERGY L.J. 157, 166 (2010); TASKFORCE, *supra* note 37, at 65.

105. Shankleman & Rathi, *supra* note 40.

106. Many sources identify these participants in carbon credit markets as "project owner[s]," *see, e.g.*, OLDFIELD ET AL., *supra* note 36, at 22, but due to concerns over whether or not tenants are able to contract for carbon credits, *see* Ryan Evens, *Checklist Available for Ag Producers, Landowners Considering Carbon Contracts*, NEB. TODAY (June 29, 2021), https://news.unl.edu/newsrooms/today/article/checklist-available-for-ag-producers-landowners-considering-carbon-contracts/ [https://perma.cc/V427-GC9D], this Note uses the term "landowner."

107. Favasuli & Sebastian, *supra* note 38.

108. *See* OLDFIELD ET AL., *supra* note 36, at 22; Favasuli & Sebastian, *supra* note 38; Peggy Kirk Hall, *Considering Carbon Farming? Take Time to Understand Carbon Agreements*, OHIO AG L. BLOG (Aug. 3, 2021), https://farmoffice.osu.edu/blog/tue-08032021-126pm/considering-carbon-farming-take-time-understand-carbon-agreements [https://perma.cc/39V4-V63B].

109. Hall, *supra* note 108.

110. *See* OLDFIELD ET AL., *supra* note 36, at 22. *See generally* Favasuli & Sebastian, *supra* note 38; Hall, *supra* note 108.

111. *See* Favasuli & Sebastian, *supra* note 38.

registries, third-party verifiers, and end buyers.[112] End buyers are those individuals or entities that agree to "retire" purchased carbon credits so that they can be "counted toward [] climate commitment[s]."[113] Voluntary carbon credits by definition operate outside of any statutory scheme requiring entities to transact carbon credits.[114] Voluntary carbon credits are therefore products of private agreements, and there is consequently wide variation and little standardization among project registries and project developers.[115] Registries develop sets of complex project standards called "protocols."[116] There are at least twelve major registries, each with different requirements.[117] As a result, parties' rights and obligations vary widely in the voluntary market.[118]

Companies participating in voluntary markets as end buyers, which include tech giants such as Apple, Microsoft, and Google, along with major airlines and even oil and gas companies, pursue emission reductions to appeal to shareholders and stakeholders.[119] These markets are not insubstantial—$300 million was traded on voluntary carbon markets in 2018[120] and demand, by some estimates, is expected to grow fifteen-fold by 2030 and up to 100-fold by 2050.[121]

Registries are not standardized, protocols and methodologies vary widely, and, as a result, consumer confidence among end buyers is low; this drives down the prices they are willing to pay for carbon credits generated through agricultural soil sequestration.[122] Many in the industry are therefore calling for standardization among protocols to match sellers more efficiently with buyers and encourage investment and lending in the market.[123]

112. Other market actors such as brokers, traders, and retailers may buy, sell, and trade credits and even bundle them into portfolios to be marketed to end buyers. *See generally id*. These transactions add complexities to the voluntary carbon market and are outside of the scope of this Note.

113. *How the Voluntary Carbon Market Can Help Address Climate Change*, MCKINSEY SUSTAINABILITY (Dec. 17, 2020), https://www.mckinsey.com/business-functions/sustainability/our-insights/how-the-voluntary-carbon-market-can-help-address-climate-change [https://perma.cc/VMU3-769T].

114. INT'L SWAPS & DERIVATIVES ASS'N, LEGAL IMPLICATIONS OF VOLUNTARY CARBON CREDITS 9 (2021).

115. OLDFIELD ET AL., *supra* note 36, at 4.

116. *Id*. at 6–7.

117. *Id.* at 34 tbl.A-1.

118. IOWA STATE UNIV. EXTENSION & OUTREACH, HOW TO GROW AND SELL CARBON CREDITS IN US AGRICULTURE 5–6 (2021).

119. Favasuli & Sebastian, *supra* note 38; Kelley Hamrick & Melissa Gallant, *Unlocking Potential: State of the Voluntary Carbon Markets 2017—Buyers Analysis*, ECOSYSTEM MARKETPLACE (Aug. 2017), https://www.forest-trends.org/wp-content/uploads/2017/07/doc_5677.pdf [https://perma.cc/4MCN-3U2U].

120. Shankleman & Rathki, *supra* note 40.

121. Blaufelder et al., *supra* note 21.

122. This point about the relationship between lack of standardization and credit-pricing applies to credit-generating projects in the voluntary carbon markets regardless of the nature of the project. *See* Blaufelder et al., *supra* note 21 ("When selling those credits, suppliers face unpredictable demand and can seldom fetch economical prices. Overall, the market is characterized by low liquidity, scarce financing, inadequate risk-management services, and limited data availability.").

123. *Id.*

C. Attempts to Put it All Together

The purpose of the Growing Climate Solutions Act (the "Act") is to encourage landowners to participate in "voluntary environmental credit markets."[124] The Act would authorize the Secretary of Agriculture to develop a certification program for third-parties looking to verify credits on the voluntary markets.[125] In doing so, the program would provide much-needed clarification and uniformity to the standards used to verify that credits in fact represent sequestered carbon.[126] Uniform legal treatment of carbon credits is recognized by market leaders as a much-needed key to scaling the voluntary carbon market.[127] Verifiers provide investors with "independent, transparent, and credible" analyses to inform investors of risks, and in doing so add predictability and confidence to the market.[128] The Act recognizes the value verifiers add to the credits market and aims to support consistency by establishing a USDA certification program for verifiers.[129] Currently, verifiers inspect projects to determine if they comply with protocols developed by registries that each operate independently in an unregulated market.[130]

In recognition of the complexity of the voluntary markets, instead of mandating specifics, the Act provides a foundation that authorizes the Secretary to develop a program overseen by an Advisory Council.[131] The Program would support the voluntary market by supporting entities that provide technical assistance and certifying third-party verifiers.[132] Echoing standards pursued by the carbon credit industry, the Program would require certified verifiers to maintain expertise with respect to additionality, permanence, measurability, and verification.[133] Credit-generating activities mentioned in the Act range from "on-farm energy generation" to "emissions reductions derived from fuel choice or reduced fuel use."[134] The first item on the nonexhaustive list provided is "land or soil carbon sequestration," a category which includes the agricultural generation of credits discussed in this Note.[135] Notably, verifiers would not be *required* to

124. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(a)(1) (2021).

125. *Id.* § 2(c)(1).

126. Blaufelder et al., *supra* note 21.

127. TASKFORCE, *supra* note 37, at 53.

128. Jessie S. Lotay, *Subprime Carbon: Fashioning an Appropriate Regulatory and Legislative Response to the Emerging U.S. Carbon Market to Avoid a Repeat of History in Carbon Structured Finance and Derivative Instruments*, 32 HOUS. J. INT'L L. 459, 499 (2010).

129. *See generally* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

130. OLDFIELD ET AL., *supra* note 36, at 4, 9; Will Mathis & Ivan Levingston, *Startup That Rates Carbon Offsets Finds Almost Half Fall Short*, BLOOMBERG (May 13, 2021, 4:45 AM), https://www.bloomberg.com/news/articles/2021-05-13/carbon-offsets-have-a-new-ratings-agency-with-startup-sylvera [https://perma.cc/Z7SV-VTBV].

131. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(a)(4) (2021).

132. *Id.* § 2(c)(1).

133. *Id.* § 2(d)(3)(A)(i)–(iv). What the Act refers to as "quantification" in subsection (i), this Note calls measurability.

134. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(d)(2) (2021).

135. *Id.* § 2(d)(2)(A).

become certified under the Act.[136] Certification is instead an optional and self-imposed process.[137]

Meanwhile, with the Act stalled in the House of Representatives, a task-force of private-sector leaders—the Taskforce on Scaling Voluntary Carbon Markets (the "Taskforce")—has taken steps to develop "core carbon principles" which would set "a threshold standard for defining high quality" carbon credits.[138] In its 2021 report, the Taskforce points to uncoordinated standards as a major obstacle to scaling the voluntary carbon markets.[139] Inconsistencies in dispute resolution and the legal treatment of transactions occurring voluntary markets are also identified as major challenges.[140] The Program contemplated by the Act would go a long way to answering these calls by the private sector for clarity and uniformity.[141]

III. ANALYSIS

Regardless of the Act's fate in Congress, it stands as the most significant legislative effort to establish uniformity in the voluntary carbon market.[142] Its approval by the Senate and parallel efforts in the private sector to establish consistent standards in the voluntary carbon market indicates that the time is ripe for a legal discussion relating to carbon markets and agriculture.[143] The Act's focus on agricultural carbon credits is appropriate because soil carbon sequestration is difficult to both verify and maintain for the necessary lengths of time; this is particularly so in row-crop (*e.g.*, corn, soybean, wheat) agriculture.[144] This Note focuses on credit generation on row-crop land because it poses some of the most challenging issues in the voluntary carbon credit market.[145] To effectuate the Act, or any subsequent legislative effort to bring uniformity to the voluntary

136. Dave Aiken, *The Growing Climate Solutions Act of 2021 and Ag Carbon Markets*, UNIV. OF NEB.–LINCOLN INST. OF AGRIC. & NAT. RES. (Aug. 4, 2021), https://cap.unl.edu/policy-legal/growing-climate-solutions-act-2021-and-ag-carbon-markets [https://perma.cc/T5K8-6WCC] ("Certification is voluntary, and producers of ag or forest carbon credits are not required to work with only certified technical assistance providers or third-party verifiers.").

137. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(e)(1) (2021).

138. TASKFORCE, *supra* note 37, at 11.

139. TASKFORCE, *supra* note 37, at 40.

140. *Id.*

141. *See* Aiken, *supra* note 136.

142. *In Case You Missed It: Here's What They're Saying About the Growing Climate Solutions Act*, U.S. SENATE COMM. ON AGRIC., NUTRITION, & FORESTRY (Apr. 22, 2021), https://www.agriculture.senate.gov/newsroom/dem/press/release/in-case-you-missed-it-heres-what-theyre-saying-about-the-growing-climate-solutions-act [https://perma.cc/UTE2-AR56].

143. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(d)(1)(A)(i) (2021); TASKFORCE, *supra* note 37, at 6–7.

144. *See* Mark A. Bradford et al., *Soil Carbon Science for Policy and Practice*, 2 NATURE SUSTAINABILITY, 1070, 1071 (2019); Amundson & Biardeau, *supra* note 34, at 11652.

145. Karl Plume, *Farmers Struggle to Break into Booming Carbon-Credit Market*, REUTERS (Apr. 28, 2021, 6:00 AM), https://www.reuters.com/business/energy/farmers-struggle-break-into-booming-carbon-credit-market-2021-04-28/#:~:text=April%2028%20(Reuters)%20%2D%20When,trap%20carbon%20in%20the%20soil [https://perma.cc/S3CP-MLRK].

carbon market, the Secretary (or whatever body is charged with oversight) will need a sound understanding of climate and sequestration science.[146]

Despite the potential row-crop agriculture has for generating carbon credits, these projects are rife with monitoring and measuring problems.[147] This makes it difficult for verifiers to say with confidence that projects comply with registries' protocols.[148] When Microsoft sought to finance credit-generating projects and solicited project bids, proposals presented claimed sequestration potential with questionable scientific foundations, which risks the integrity of not just the specific projects, but the carbon credit market at large.[149]

The time and expense to discern well-founded proposals from dubious ones significantly increases the cost of generating credits.[150] By some estimates, verification accounts for 75% of the costs of generating carbon credits.[151] Even where parties do consider sequestration to be reliably verifiable, credits generated on row-crop land require careful monitoring to ensure sequestered carbon is not lost to management practices like annual tillage.[152] Such reversals render end buyers' emission reduction claims void and set back the voluntary market's ultimate goal of mitigating climate change by wasting time, expense, and effort.[153] To avoid reversals, protocols set permanence periods for sequestered carbon.[154] Still though, reversals will inevitably happen, and depending on agreements and relationships between parties to carbon credit transactions, liability for reversals will fall to different parties.[155]

A. Framework of Sequestration Projects

Credit-generating projects can be characterized as one of three types: avoidance, reduction, and removal.[156] Avoidance projects include initiatives that prevent emissions, such as renewable energy development, as well as efforts to protect wetlands and forests.[157] Reduction projects include efforts to make energy use or production more efficient and less polluting.[158] Agricultural soil carbon sequestration projects are of the removal type, along with reforestation and

146. The Act itself recognizes this. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(b)(7) (2021) (defining "protocol" as a "systematic approach that follows a science-based methodology that is transparent and thorough to establish requirements").

147. *See* Plume, *supra* note 145.

148. *Id.*

149. *Id.*

150. *See id.*

151. *Id.*

152. *Id.*

153. *See* OLDFIELD ET AL., *supra* note 36, at 9.

154. *Id.* at 34 tbl. A-1.

155. Gregg Marland, Kristy Fruit & Roger Sedjo, *Accounting for Sequestered Carbon: The Question of Permanence*, 4 ENV'T SCI. & POL'Y 259, 265 (2001).

156. *See* Favasuli & Sebastian, *supra* note 38.

157. *Id.*

158. *Id.*

machine-based sequestration.[159] No matter the method used to generate credits, one verified credit, in theory, represents one metric ton of carbon dioxide emissions avoided, reduced, or removed.[160]

Price points per credit vary widely, from a few cents per credit to fifteen dollars per credit,[161] largely due to variable costs of different projects.[162] Unsurprisingly, "nature-based," or biological, storage in soils costs far less than machine-based storage, a method that employs high-tech equipment to store carbon in bedrock deep underground[163] This affordability, along with a supposed high potential for scalability, has gained agricultural projects significant attention from firms looking to quickly generate credits to offset their emissions.[164]

Another reason for low prices of agricultural credits are concerns about quality.[165] In effort to attain quality credits, carbon credit programs, both compulsory and voluntary, employ a vocabulary of essential terms denoting concepts designed to ensure the integrity of credits.[166] Credits must be (1) additional, (2) permanent, (3) measurable, and (4) verifiable.[167] Where each of these is achieved with respect to a given project, credits generated from that project are said to be "high quality."[168] In theory, the higher the quality of a credit, the higher its value, since end buyers can be more confident when purchasing that credit.[169] When offered a strong assurance of permanence, end buyers assume less risk that sequestered carbon will escape into the atmosphere, a phenomenon referred to as "reversal."[170]

Each of the four terms above are described briefly here. Additionality seeks to confirm that the sequestration would not have happened without the credit-generating project and change (*e.g.*, introduction of cover crops, no-till practices, or changes to fertilizer practice in row-crop agriculture).[171] Permanence asks whether carbon sequestered will stay sequestered for a desired period of time,[172] known as the "permanence period."[173] Measurability refers to our ability to

159. *Id*.

160. *Id*.

161. *Id*.

162. Lucas Joppa et al., *Microsoft's Million-Tonne CO2-Removal Purchase—Lessons for Net Zero*, 597 NATURE 629, 629–32 (2021).

163. *Id*. at 630.

164. *See* Plume, *supra* note 145.

165. *Id*.; TASKFORCE, *supra* note 37, at 6–7.

166. *See* Carpenter, *supra* note 104, at 166; *see also* TASKFORCE, *supra* note 37, at 17.

167. *See* Carpenter, *supra* note 104, at 166; *see also* TASKFORCE, *supra* note 37, at 81.

168. *See* TASKFORCE, *supra* note 37, at 7.

169. *See* Favasuli & Sebastian, *supra* note 38.

170. *Id*.

171. Carpenter, *supra* note 104, at 166–67; CLIMATE ACTION RESERVE, SOIL ENRICHMENT PROTOCOL 12 (2022), https://www.climateactionreserve.org/wp-content/uploads/2022/06/Soil-Enrichment-Protocol-V_1.1-final.pdf [https://perma.cc/LP5P-BMXQ]. This discussion does not include concepts of concern for avoidance projects, such as "leakage," a circumstance that occurs when emissions are stopped in one place but occur somewhere else instead. *See* Carpenter, *supra* note 104, at 170.

172. Carpenter, *supra* note 104, at 166–67.

173. OLDFIELD ET AL., *supra* note 36, at 23–24.

quantify the amount of carbon sequestered with some level of confidence,[174] ideally vis-à-vis figures in pre-project baselines.[175] Verification, based on established guidelines or parameters, assigns an entity with authority to declare that a project in fact sequestered carbon.[176] High transaction costs related to verification translate to low liquidity of carbon credits, in what many experts consider the foremost impediment to market growth.[177]

B. Difficulty Verifying Carbon Storage and Reversal Risk

The science underlying agricultural sequestration credits offers good news and bad news.[178] The good news is that soil scientists agree that the Earth's soils indeed have the physical capacity to store significantly more carbon than they presently do;[179] since the advent of agriculture 10,000 years ago, the equivalent of ten years' carbon emissions have been released from global soils.[180] The bad news is that soil scientists *also* agree that current soil sampling technology is too limited to reliably link changes in carbon concentrations to changes in agricultural practices.[181] Protocols differ in the tools they use to quantify soil carbon, with options ranging from on-site soil coring to modeling and remote sensing, but confidence levels vary and the use of different methods undermines the fungibility of credits.[182] Moreover, without reliable measuring and monitoring methods, it is difficult to establish baselines against which increases in stored carbon can be compared.[183] Absent agreed-upon measurement methods and agreed-upon levels of confidence in those methods, our ability, or inability, to say how much carbon is truly in the soil undercuts claims assuring permanence.[184]

Row-crop operations present an especially uncertain basis for credit generation due to regular tillage of the soil.[185] Some experts have stated that the potential of soil sequestration is overstated due to biochemical changes that are likely under future conditions.[186] For example, as the climate warms, so too does the soil profile, "set[ting] in motion a positive feedback loop with soil carbon, which is converted to carbon dioxide by soil microbes responding to increasing

174. Carpenter, *supra* note 104, at 175.
175. *See* OLDFIELD ET AL., *supra* note 36, at 17.
176. Carpenter, *supra* note 104, at 179.
177. Blaufelder et al., *supra* note 21.
178. *See* Bradford et al., *supra* note 34, at 1071; Amundson & Biardeau, *supra* note 34, at 11652–53.
179. Amundson & Biardeau, *supra* note 34, at 11652–53.
180. *Id*. at 11652.
181. Bradford et al., *supra* note 34, at 1071.
182. *See* OLDFIELD ET AL., *supra* note 36, at 4.
183. *See id.* at 17.
184. *See id.* at 13 (explaining that many soil models "lack a baseline measurement of" soil carbon levels, "limiting the capacity to resolve the true trajectory of SOC stocks over time and in response to specific management interventions").
185. Plume, *supra* note 145.
186. Amundson & Biardeau, *supra* note 34, at 11652–53.

temperature[s]."[187] Adding further cause for concern is evidence that increases in soil carbon causes increased nitrous oxide emissions from soils, negating benefits of carbon sequestration altogether, since nitrous oxide is a potent greenhouse gas.[188] With that, where carbon sequestration triggers nitrous oxide emissions, the result may be a net gain in climate-warming greenhouse gases, and thus contracts encouraging carbon sequestration may undermine the voluntary market's efforts to mitigate climate change.[189] These realities underscore the importance of careful monitoring, seeing as net gains in atmospheric greenhouse gases may appropriately be considered reversals.[190]

Thus, reversal risk is quite high with agricultural soil carbon credits. Landowners selling these credits are therefore likely to be faced with especially stringent standards to assure permanence, and the related contract terms are likely to assign them liability for reversals.[191]

C. How the Market Navigates Risks of Agricultural Carbon Credits: A Case Study Exploring Carbon Credit Purchases

Risks inherent to agricultural carbon credits are recognized by the voluntary market.[192] When Microsoft made the largest purchase of carbon credits to date in January 2021,[193] 200,000 credits were derived from agricultural practices, topping any other purchase of agricultural credits.[194] With many farms vying to take part in the deal, Microsoft determined numerous claims of sequestration lacked scientific support.[195] Additionally, the sequestration per year and reliability of measurements related to agricultural sequestration were the lowest among other credit-generating projects financed in Microsoft's transaction.[196] Forest expansions and machine-based capture both had higher sequestration rates and were easier to measure and verify.[197] On the other hand, agricultural credits do carry a low likelihood for negative side effects and are among the lowest-cost means of producing credits.[198] Still, agricultural credits made up less than 7% of Microsoft's purchase, highlighting buyers' skepticism of their reliability and quality.[199]

187. *Id.* at 11654.

188. Emanuele Lugato, Adrian Leip & Arwyn Jones, *Mitigation Potential of Soil Carbon Management Overestimated by Neglecting N_2O Emissions*, 8 NATURE CLIMATE CHANGE 219, 219 (2018).

189. *See id.*

190. *See id.*

191. Marland et al., *supra* note 155, at 265 ("The essential issue for permanence is liability.").

192. Plume, *supra* note 145.

193. Joppa et al., *supra* note 162, at 629–32.

194. Plume, *supra* note 145.

195. *Id.*

196. Joppa et al., *supra* note 162, at 630.

197. *Id.*

198. *Id.*

199. Plume, *supra* note 145.

The Microsoft carbon credit purchase serves as a powerful example of the risks agricultural credits pose as compared to other means of generating credits.[200] Yet, it also demonstrates one end buyer's willingness to invest in them nonetheless: though Microsoft did not disclose its purchase price,[201] at current market rates, 200,000 agricultural credits would be valued at $600,000–$1,000,000.[202] While Microsoft may operate on the fringe of the market due to its immense wealth,[203] plenty of other firms with deep pockets are eyeing agricultural credits.[204] Furthermore, with demand for carbon credits projected to outpace supply, market prices could see a five-to-tenfold increase by 2030.[205] If dollars spent on agricultural credits track this trend, substantial sums of money will be invested in agricultural credits over the next decade.[206] It has even been suggested that the U.S. government should itself purchase credits using existing USDA funding allocations.[207]

200. *See id.*

201. *See id.*

202. University College London, *Ten-Fold Increase in Carbon Offset Cost Predicted*, SCIENCEDAILY (June 4, 2021), https://www.sciencedaily.com/releases/2021/06/210604122439.htm [https://perma.cc/42B9-G43V].

203. *See generally Microsoft Company Profile*, FORTUNE, https://fortune.com/company/microsoft/fortune500/ (last visited Feb. 5, 2023) [https://perma.cc/BQX9-9Z69].

204. Mike Dorning, Marcy Nicholson, & Isis Almeida, *The Carbon Market Gold Rush in American Agriculture*, BLOOMBERG (Apr. 20, 2021, 6:00 AM), https://www.bloomberg.com/news/articles/2021-04-20/the-carbon-market-gold-rush-in-american-agriculture [https://perma.cc/H9X6-C333].

205. University College London, *supra* note 202.

206. *See id.*

207. Robert Bonnie, Leslie Jones & Meryl Harrell, *Climate 21 Project Transition Memo*, U.S. DEP'T AGRIC. 9 (2021), https://climate21.org/documents/C21_USDA.pdf [https://perma.cc/N5P2-9D3M].

D. Where the Public Sector Has Been and Where It Is Headed

All the while, soil scientists have made clear that the means of measuring carbon sequestration in soils on a large scale and verifying that particular changes in practice actually led to any observed changes are highly unreliable.[208] At this juncture though, it seems that parties are willing to move forward with agricultural carbon credits while keeping a steady eye on the development of related scientific fields.[209] With that, governments have taken notice and are moving to encourage and stabilize the voluntary market as it relates to in agricultural credits through initiatives like the Act.[210]

Although the Act is stalled in the House, it nevertheless serves as a useful tool for discussion about the direction of and appetite for regulation of the voluntary carbon market in the United States.[211] The nonbinding nature of the Act is in many ways par for the course in U.S. Climate Policy. As detailed earlier in this Note, after momentum for a national cap-and-trade scheme came to a grinding halt early on in President Obama's term, as his Administration pursued its carbon emission reduction goals through the EPA's regulatory authority.[212] This authority became increasingly controversial after the Administration announced its Clean Power Plan following the signing of the Paris Agreement.[213] Several states challenged the plan in court, and the Supreme Court, in a highly unusual ruling, stayed the rule-making process.[214] After the election of Donald Trump, the EPA changed course and released the ACE rule, caving to the Republican Party's antagonism to the Panel's climate science.[215]

Perhaps the Supreme Court has also caved. Where it was content in *Massachusetts v. EPA* to read open-ended language in the Clean Air Act to indicate breadth and Congress's intent for the statute to evolve,[216] that approach to statutory construction is absent in *West Virginia v. EPA*.[217] Indeed, the majority waited until page twenty-eight of its thirty-one-page opinion to turn to the statute's language at all.[218] The Court instead spends its first twenty pages (unconvincingly) insisting that its "major questions doctrine" is evident in an "identifiable body of law."[219] As a result, federal courts are provided with a two-step

208. *See* Amundson & Biardeau, *supra* note 34, at 11655; Bradford et al., *supra* note 144, at 1070–71.

209. Blaufelder et al., *supra* note 21.

210. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

211. *See id.*

212. West Virginia v. EPA, 142 S. Ct. 2587, 2599–2600 (2022); Lizza, *supra* note 5.

213. *See, e.g.*, Umair Irfan, *Trump's EPA Just Replaced Obama's Signature Climate Policy with a Much Weaker Rule*, VOX (June 19, 2019), https://www.vox.com/2019/6/19/18684054/climate-change-clean-power-plan-repeal-affordable-emissions [https://perma.cc/ASK8-87K9].

214. Scobie, *supra* note 12.

215. *Republican Platform 2016*, REPUBLICAN NAT'L COMM. 22 (2022) ("The United Nations' Intergovernmental Panel on Climate Change is a political mechanism, not an unbiased scientific institution.").

216. 549 U.S. 497, 532 (2007).

217. *See generally* 142 S. Ct. 2587 (2022).

218. *See id.* at 2614–15.

219. *See id.* at 2609.

inquiry, not limited to actions by the EPA but applicable to all federal agencies, asking first if the action is "extraordinary"[220] and second, if the agency can point to a "clear congressional authorization."[221] Trained readers will rightfully ask what all this means for federal courts' approach to agency review known as *Chevron* deference; but the majority does not say. The Court fails to even cite *Chevron*,[222] preferring instead to reference a law review article calling for limitations on *Chevron* deference.[223] It seems that where Congress must be "clear and direct,"[224] the Court has different ideas for itself.

The near unanimous passage of the Growing Climate Solutions Act demonstrates its noncontroversial nature.[225] Without any requirement that third-party verifiers become certified, it places faith in the market to ensure participation in the proposed certification program.[226] Ultimately, this approach could well be sufficient; the voluntary market currently presents many would-be investors with an intolerable level of investment risk.[227] A program like that proposed in the Act could instill sufficient confidence in the market so as to provide a stabilizing force that catalyzes market growth.[228] Yet it would be foolhardy to suppose a carbon market lacking any required reporting or oversight is risk-free.[229] While it is true that a project developer or a registry may "require" reporting and monitoring[230] for the duration of the permanence period, the voluntary nature of the voluntary market lacks much motivation for parties to seek enforcement.[231] In fact, once they have claimed credits as offsets in their emission-reduction programs, end buyers may have every incentive for the underlying carbon storage to *not* be monitored.[232] At that point, customers and shareholders are informed the end buyer has reduced its carbon footprint, and thus the bulk of the benefit sought has been conferred.[233] Absent some level of oversight of end buyers, it is

220. *Id.* at 2608.

221. *Id.* at 2609.

222. *See generally* Chevron, U.S.A., Inc. v. NRDC, Inc., 467 U.S. 837 (1984).

223. *West Virginia*, 142 S. Ct. at 2609; *see* Ernest Gellhorn & Paul Verkuil, *Controlling* Chevron*-Based Delegations*, 20 CARDOZO L. REV. 989, 1011 (1999).

224. *West Virginia*, 142 S. Ct. at 2619 (Gorsuch, J., concurring) (quoting ICC v. Cincinnati, N. O. & T. P. R. Co., 167 U. S. 479, 505 (1897)).

225. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021); *see also* S.1251—Growing Climate Solutions Act of 2021, CONGRESS.GOV, https://www.congress.gov/bill/117th-congress/senate-bill/1251/all-actions (last visited Feb. 5, 2023) [https://perma.cc/Q93Q-PU9E].

226. *See id.*

227. Favasuli & Sebastian, *supra* note 38.

228. *See id.*

229. Lotay, *supra* note 128, at 498–99.

230. CLIMATE ACTION RESERVE, *supra* note 171, at 63.

231. *See* KNOX ET AL., *supra* note 47, at 18–19 (discussing the need in carbon markets for mechanisms "capable of making right holders accountable for their obligations").

232. Umair Irfan, *Can You Really Negate Your Carbon Emissions? Carbon Offsets, Explained*, VOX (Feb. 27, 2020, 8:10 AM), https://www.vox.com/2020/2/27/20994118/carbon-offset-climate-change-net-zero-neutral-emissions [https://perma.cc/CDH6-EHSQ].

233. *See* Shankleman & Rathi, *supra* note 40.

unlikely end buyers will care much about soil monitoring, much less seek legal action against landowners to ensure permanence of sequestered carbon.[234]

As the voluntary carbon market continues to take shape and grow, the utility of third-party verifiers serving to reduce associated risks by assessing and confirming the integrity of credits is increasingly apparent.[235] The Senate appears hopeful about this means of instilling confidence in agricultural credits.[236] One prospect for enforcement, at least for end buyers required to register with the Securities Exchange Commission ("SEC"), is for net-zero claims to be incorporated into climate change disclosures.[237] Commissioner Allison Herren Lee on March 15, 2021 sought public comment about how the SEC should approach corporate disclosures of climate-related risks.[238] Companies with net-zero and emission-reduction plans that purchase offsets claim that doing so reduces risks to which climate change exposes their shareholders and investors.[239] Whether that is true is anyone's guess, but including offset purchases in SEC disclosures would help to validate and even bolster corporate claims of risk mitigation.[240]

E. The Need for Regulation

Without oversight and clarity, the voluntary market cannot scale and deliver on its sequestration goals. Many of the details surrounding carbon credit ownership and lifespan remain unclear. Uncertainties and disagreements will need to be settled before parties can engage in carbon credit projects and sales with confidence. A few of them are presented here.

1. Uncertainty Regarding Property Interests in Carbon Credits

i. Carbon Credits Carrying an Interest in Real Estate

No matter where regulation of carbon credits goes next, questions as basic as their legal definition will need to be considered. Since the basic legal nature of carbon credits is unclear, a brief discussion on this point is included here.[241] Depending on the classification of property interests of carbon credits, real or personal, tangible or intangible, parties' legal rights and obligations with respect

234. *See* KNOX ET AL., *supra* note 47, at 18–19.

235. Lotay, *supra* note 128, at 498–99.

236. *See* Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

237. *See* Allison Herren Lee, *Public Input Welcomed on Climate Change Disclosures*, U.S. SEC. & EXCH. COMM'N (Mar. 15, 2021), https://www.sec.gov/news/public-statement/lee-climate-change-disclosures [https://perma.cc/KQ2H-YPUZ].

238. *Id.*

239. Martin Reeves, David Young, Julia Dhar & Annelies O'dea, *Net-Zero: The Risks and Benefits for Companies Pledging to Save the Climate*, WORLD ECON. FORUM: CTR. FOR NATURE & CLIMATE (Feb. 28, 2022), https://www.weforum.org/agenda/2022/02/net-zero-risks-benefits-climate/ [https://perma.cc/V5UH-MAX9].

240. *See id.*

241. TASKFORCE, *supra* note 37, at 40, 52.

to those credits would vary.[242] In its recent report, the Taskforce claims that "[c]arbon credits are specifically not recognized as property rights."[243] The corresponding discussion in the source cited to support this claim, however, is circumscribed to the credits issued pursuant to the U.S. acid rain cap-and-trade program under the Clean Air Act, as well as those issued by the State of California under its carbon cap-and-trade program.[244] Voluntary carbon credits, by contrast, are not statutorily created, so inquiries into their legal nature need to look elsewhere.[245]

Contrary to the Taskforce's claim, when faced with a controversy regarding carbon sequestered in trees, a Louisiana District Court had no trouble finding that carbon credits "make up a portion of the bundle of rights in the real property" at issue.[246] There, the defendant challenged the ripeness of the case on the on grounds that no "further legislative or executive action" had given rise to carbon credits in the United States.[247] Finding this point unpersuasive, the district court underscored that the "right to report, transfer, or sell carbon credits" was included the plaintiff's real property interests, regardless of the government's lack of commentary on the subject.[248] Moreover, including carbon rights as one stick in the bundle of property rights landowners hold in fee simple absolute is consistent with the traditional view that fee simple absolute includes "the soil, vegetation growing in the soil" and the right to benefit from the use of those resources.[249]

When characterizing the property interests in carbon credits generated from agricultural land use, it is helpful to distinguish "carbon credits, as tradable market instruments," from the "carbon assets underlying them."[250] The rights to benefit from those assets and their sequestration potential may be thought of more broadly as "carbon rights,"[251] or "sequestration rights."[252] Thus, it might be said that carbon rights are "link[ed]" to the underlying asset, such as soil, with which more traditionally recognized property rights are associated.[253] Implicitly,

242. INT'L SWAPS & DERIVATIVES ASS'N, *supra* note 114, at 9.

243. TASKFORCE, *supra* note 37, at 52.

244. Charlotte Streck & Moritz von Unger, *Creating, Regulating and Allocating Rights to Offset and Pollute: Carbon Rights in Practice*, 10 CARBON CLIMATE L. REV. 178, 183–84 (2016); *see* Clean Air Act Amendments of 1990, Title IV-A - Acid Deposition Control, 42 U.S.C. § 7651b(f) ("An allowance allocated under this subchapter is a limited authorization to emit sulfur dioxide in accordance with the provisions of this subchapter. Such allowance does not constitute a property right."); CAL. CODE REGS. tit.17 § 95820(c) (2022) ("A compliance instrument issued by the Executive Officer does not constitute property or a property right.").

245. INT'L SWAPS & DERIVATIVES ASS'N, *supra* note 114, at 8.

246. Roseland Plantation, L.L.C. v. U.S. Fish & Wildlife Serv. Agency, No. 05-0793, 2006 U.S. Dist. LEXIS 29334, at *9 (W.D. La. Apr. 5, 2006).

247. *Id.*

248. *Id.* at *9–10.

249. Steven A. Kennett, Arlene J. Kwasniak & Alastair R. Lucas, *Property Rights and the Legal Framework for Carbon Sequestration on Agricultural Land*, 37 OTTAWA L. REV. 171, 180 (2005).

250. *Id.* at 204.

251. KNOX ET AL., *supra* note 47, at 1.

252. Kennett et al., *supra* note 249, at 186.

253. *See* KNOX ET AL., *supra* note 47, at 21.

carbon rights are vested in the owner of the underlying asset by virtue of the owner's "legal rights to benefit from" that asset.[254]

Therefore, where the asset that confers carbon rights is soil, an interest in the underlying real property is linked to carbon credits generated via the exercise of those rights.[255] Where protocols impose permanence periods beyond the length of contracts (*i.e.*, the crediting period), this link may persist for the duration of the permanence period, which could entitle holders of credits, usually end buyers, to challenge the permanence of sequestered carbon in which they have a property interest.[256] Sale of the credits may then reasonably be said to transfer an interest in a landowner's real property to other parties such as registries and end buyers.[257] This makes sense because landowners typically agree to ongoing monitoring and testing of their soil to ensure relying parties about the permanence of sequestered carbon.[258] In doing so, landowners are contracting with respect to their right to exclude, a quintessential real property right.[259]

ii. Carbon Credits as Personal Property

Under another view, carbon credits could be considered personal property.[260] In a case before a California state court, leased equipment was used to generate environmental resource credits, which are analogous to carbon credits.[261] The lessor was entitled to a share of the value in credits generated by the operation by the lessee of the leased equipment.[262] This logic could apply in the case of agricultural carbon credits; equipment used in no-till farming, a common credit-generating activity, is costly and may be leased or financed by parties other than landowners and farmers.[263] Thus, if agricultural carbon credits are considered personal property, then lenders' and lessors' leasehold interests in equipment used to generate credits may translate to a personal property interest in

254. *Id.* at 16.

255. *See id.* at 1, 16, 21.

256. *See id.* at 18 (discussing how, in a legal framework that allows separability of carbon rights from rights to land, holders of carbon rights need ways to prevent interferences with their carbon rights and to enforce rights holders' obligations).

257. *Cf. id.*

258. *See* OLDFIELD ET AL., *supra* note 36, at 24 (discussing monitoring requirements under various protocols).

259. *Cf.* KNOX ET AL., *supra* note 47, at 7 tbl.1.

260. *See* Michael D. Minton & Christine L. Weingart, *Legal and Tax Issues of Carbon Credit Trading*, DEAN MEAD, https://www.deanmead.com/wp-content/uploads/2011/04/Legal-and-Tax-Issues-of-Carbon-Credit-Trading.pdf (last visited Feb. 5, 2023) [https://perma.cc/6GMA-ZAPS].

261. *See* Kaiser Int'l Corp. v. Hearing Bd. of S. Coast Air Quality Mgmt. Dist., No. B178997, 2006 WL 991028, at *2, *5 (Cal. Ct. App. Apr. 17, 2006).

262. *See id.* at *15.

263. Francis M. Epplin, Curtis J. Stock, Darrel D. Kletke & Thomas F. Peeper, *Cost of Conventional Tillage and No-till Continuous Wheat Production for Four Farm Sizes*, 2005 J. AM. SOC'Y FARM MANAGERS & RURAL APPRAISERS 69, 74 tbl. 3 (2005) (displaying prices between $27,053–137,500 in 2005 dollars for no-till planting equipment, the most expensive individual pieces of machinery shown); N. CENT. FARM MGMT. EXTENSION COMM., PURCHASING AND LEASING FARM EQUIPMENT 1 (2014) ("For long-term control of equipment, leasing is also a popular choice.").

carbon credits generated.[264] Characterizing the rights conferred by carbon credits as personal property may make sense given their incorporeal nature,[265] but if they are to carry the right to exclude others from interfering with soil storing carbon, their nature as interests in real property seems more apparent.[266]

Conversely, some carbon credits are more appropriately regarded as personal property. While soil carbon credits may confer interests in real estate, other carbon credits can be generated absent an underlying asset, such as those derived from emission reductions.[267] Such credits are contemplated under section 2(d)(2)(B) of the Act.[268] In contrast to sequestration credits, which are removal credits, credits derived from emission reductions are avoidance credits.[269] To draw on language familiar to the law of servitudes, credits derived from emission reductions do not "touch and concern the land" in the same way that removal credits derived from soil sequestration do.[270] In fact, the entire premise of avoidance credits is that they require individuals or entities to refrain from engaging in conduct relative to an *ex ante* baseline or status quo.[271] Credits of this sort can be generated based on landowners' decisions not to obtain personal property they would otherwise have purchased and used (*e.g.*, diesel fuel).[272] In this circumstance, credits appear to involve no real property interest whatsoever, as they do not "touch and concern the land" in any way.[273]

For these reasons, the legal nature of carbon credits should focus on the activity used to generate the credits. Where avoidance credits may purely be personal property, sequestration credits may carry an interest in real property where they entitle credit holders to monitor and inspect the land.[274] The difference between the two may have significant practical implications; for example, whether claims to carbon rights or credits are included in conveyance instruments, such as in a mortgage or a lease.

264. *See Kaiser Int'l Corp.*, 2006 WL 991028, at *15.

265. *But see* Kennett et al., *supra* note 249, at 183.

266. *Cf.* KNOX ET AL., *supra* note 47, at 17.

267. Growing Climate Change Solutions Act of 2021, S. 1251, 117th Cong. § 2(d)(2)(A) (2021).

268. *Id.* § 2(d)(2)(B).

269. Favasuli & Sebastian, *supra* note 38.

270. *See* THOMAS L. DANIELS & JOHN C. KEENE, THE LAW OF AGRICULTURAL LAND PRESERVATION IN THE UNITED STATES 69, 81 (Jeffrey Salyards ed., 2018) (quoting JAMES L. BROSS, THOMPSON ON REAL PROPERTY 701–02 (David A. Thomas ed., LexisNexis 2000)).

271. *Cf.* Favasuli & Sebastian, *supra* note 38.

272. *Cf. id.*

273. *See id.*; DANIELS & KEENE, *supra* note 270, at 81 (quoting JAMES L. BROSS, THOMPSON ON REAL PROPERTY 701–02 (David A. Thomas ed., LexisNexis 2000)).

274. *See* Kennett et al., *supra* note 249, at 183.

2. Disagreement About How to Ensure Permanence

i. Differing Permanence Periods

There is considerable debate among individuals and organizations working to pin down standards in the voluntary market about the most appropriate permanence period, with years ranging from ten to 100 years.[275] A 100-year permanence period is a common benchmark because "[t]he life of a CO2 molecule in the atmosphere is over 100 years[,] so for carbon credits to have an impact on atmospheric levels of carbon, they must similarly have a permanence period of at least 100 years[.]"[276] 100 years may even be on the low side, given that NASA estimates the life of carbon in the atmosphere at between 300 and 1,000 years.[277] Still, 100 years appears to be the longest market actors are willing or able to plan for.[278]

Even assuming that assurance of 100-year permanence would sufficiently offset carbon so as to meaningfully mitigate the impacts of climate change, most agricultural carbon contracts being offered at present are only five to ten years in length.[279] Depending on the terms of landowners' agreements with respect to permanence periods, they may or may not be liable for reversals after their contract has ended.[280] Short-term contracts without ongoing liability for reversals appear to be insufficient to satisfactorily address the risks to permanence. It seems doubtful these agreements truly offset an end buyer's emissions given they carry no assurance of permanence after the sale of generated credits.[281] Alternatively, shorter commitments may spur enough change in landowners' operations that after investing in necessary equipment and changing practices for five to ten years, landowners may continue to practice changes and thereby maintain permanence incidentally.[282] Also, many of the practices that qualify for generating credits produce other benefits to the land such as "improved fertility, reduced fertilizer and irrigation use, and greater resilience to stressors such as drought."[283]

Nonetheless, given that registries and end buyers may be unlikely to leave permanence to chance, requiring landowners to commit to long-term permanence

275. OLDFIELD ET AL., *supra* note 36, app. A. at 34–35 tbl. A-1.

276. TASKFORCE, *supra* note 37, at 75 (emphasis in original).

277. *See* Alan Buis, *The Atmosphere: Getting a Handle on Carbon Dioxide*, NASA (Oct. 9, 2019), https://climate.nasa.gov/news/2915/the-atmosphere-getting-a-handle-on-carbon-dioxide/#:~:text=Carbon%20dioxide%20is%20a%20different,timescale%20of%20many%20human%20lives [https://perma.cc/Q5T6-B59A].

278. *See* OLDFIELD ET AL., *supra* note 36, app. A at 34–35 tbl. A-1.

279. IOWA STATE UNIV. EXTENSION & OUTREACH, *supra* note 118, at 5.

280. *Id.* at 3 (discussing reversal liability with respect to "retention period[s]").

281. *See* KNOX ET AL., *supra* note 47, at 19 (recognizing that landowners receiving one-time payments would have little incentive to maintain sequestered carbon).

282. *Cf.* Epplin et al., *supra* note 263, at 74 tbl. 3 (displaying prices between $27,053–137,500 in 2005 dollars for no-till planting equipment, the most expensive individual pieces of machinery shown).

283. Bradford et al., *supra* note 144, at 1070.

periods would provide more confidence in the integrity of agricultural credits.[284] Permanence periods of 100 years require substantial long-term coordination and monitoring.[285] Agreements with such long-term implications on interests in real estate are likely to concern not just current landowners, but future landowners.[286]

Permanence may be most maximally pursued through easements and similar encumbrances.[287] Conservation easements, for instance, are restrictive covenants being used to secure carbon credits[288] that "limit future activities on the land to protect its conservation values."[289] These easements have their origins in the common law like other encumbrances, but are ultimately statutory creatures, having been proposed in a uniform act and adopted in many states.[290] They are generally required to be granted in perpetuity.[291] Their application can be complex; let this general understanding suffice for purposes of this discussion. Tying carbon credits to an easement that guarantees a perpetual property interest restricting use is potentially very powerful way to achieve permanence.[292]

ii. Reversals and Verification

At times, though, some reversals of sequestered carbon will inevitably happen.[293] For instance, severe flooding may result in loss of topsoil and carbon stores along with it, constituting a reversal.[294] For these cases, many protocols utilize a "buffer pool" system, which provides landowners with an insurance policy to the landowners in the form of credits retained by a registry, redeemable to compensate for reversals.[295] Buffer pool access may be limited to "unavoidable" reversals such as those due to natural disasters or other events outside of landowner control.[296] Avoidable reversals, those that occur through "negligence, gross negligence, or willful intent," however, may require compensation by

284. One prominent standard-setting registry provides 100-year permanence as an option. *See* CLIMATE ACTION RESERVE, *supra* note 171, at 20–21.

285. *See id.* at 21.

286. *See id.*

287. *See* CINDY CHIANG, JON REMUCAL & SARAH WESCOTT, CARBON OFFSETS IN CONSERVATION EASEMENTS: THE ESSENTIALS FOR LAND TRUSTS 4 (Sylvia Bates, Mary Burke, Erin Heskett, Leslie Ratley-Beach & Kelly Watkinson eds., 2020).

288. *See id.*

289. Jessica E. Jay, *When Perpetual Is Not Forever: The Challenge of Changing Conditions, Amendment, and Termination of Perpetual Conservation Easements*, 36 HARV. ENV'T. L. REV. 1, 3 (2012) (quoting ELIZABETH BYERS & KARIN MARCHETTI PONTE, THE CONSERVATION EASEMENT HANDBOOK 7 (2d ed. 2005)).

290. *Id.* at 16, 26.

291. *See id.* at 6.

292. CHIANG ET AL., *supra* note 287, at 27.

293. *Cf.* CLIMATE ACTION RESERVE, *supra* note 171, at 21, 37–38.

294. *See* Jason Clark, *Managing Soil and Soil Fertility After Flooding*, S.D. STATE UNIV. EXTENSION, https://extension.sdstate.edu/managing-soil-and-soil-fertility-after-flooding (Aug. 26, 2020) [https://perma.cc/M7JS-R3FL]; Pete Smith et al., *Agriculture, Forestry and Other Land Use (AFOLU)*, *in* CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 811, 832 (2014).

295. *See* CLIMATE ACTION RESERVE, *supra* note 171, at 21–22.

296. *See id.*

landowners.[297] This distinction may prove especially problematic in the context of working farms where land management and weather changes often go hand-in-hand.[298]

Significant uncertainties in our ability to accurately measure and verify carbon sequestration in agricultural soils raise important concerns about the integrity of carbon credits derived from row-crop agriculture.[299] Without agreed-upon confidence levels in measuring and verification, transactions in the voluntary market may be based on nothing more than elusive and unverifiable exchanges of chemicals between soils and the atmosphere.[300] Policymakers, registries, end buyers of carbon credits, landowners, and third-party verifiers, all need to be informed about the limitations of current soil science.[301] The Act provides a pathway to facilitate this transfer of information by mandating the Secretary to convene an Advisory Council that includes "representatives of the scientific research community."[302]

With or without human influence, carbon is continually passing between soils and the atmosphere.[303] Without ongoing monitoring, end buyers are left without assurance that captured carbon is maintained throughout agreed-upon permanence periods, even if uncertainties in measurement could be overcome to provide them with confidence upon purchasing credits[304] Or worse, buyers may be unconcerned with actual sequestration, instead participating in the voluntary carbon credits purely for optics, claiming emission reductions as a "green" marketing measure while being indifferent about whether the credits purchased have real impact.[305] In contrast, buyers exercising genuine corporate responsibility that want assurance their credits are of high quality may seek damages from landowners and other parties to the credit-generating transaction if verified agricultural credits would turn out to have no biochemical integrity or fall subject to reversal.[306] Ensuring quality is particularly important where credits are not retired by end buyers but instead form the basis of financial trades and derivatives.[307]

Entities working to regulate and scale the voluntary market seem to recognize the need for soil carbon credits to represent verifiable permanent changes in soil carbon concentrations.[308] And of course, the legal system is no stranger to

297. *Id.*

298. Plume, *supra* note 145.

299. *See* Amundson & Biardeau, *supra* note 34, at 11652; Emanuele Lugato, Adrian Leip & Arwyn Jones, *Mitigation Potential of Soil Carbon Management Overestimated by Neglecting N_2O Emissions*, 8 NATURE CLIMATE CHANGE 219, 219 (2018).

300. Amundson & Biardeau, *supra* note 34, at 11652; Lugato et al., *supra* note 299, at 219.

301. Bradford et al., *supra* note 144, at 1071.

302. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

303. Todd Ontl & Lisa A. Schulte, *Soil Carbon Storage*, 3 NATURE ED. KNOWLEDGE 7 (2012).

304. *See* Amundson & Biardeau, *supra* note 34, at 11652.

305. Barth, *supra* note 34; Amundson & Biardeau, *supra* note 34, at 11652.

306. *See* Barth, *supra* note 34; Smith et al., *supra* note 294, at 832.

307. *See* Lotay, *supra* note 128, at 499.

308. TASKFORCE, *supra* note 37, at 74.

scientific uncertainty. It is perfectly accustomed to navigating disputes where the science is unclear.[309] In the now-famous *Daubert* decision, for example, the Supreme Court emphasized that the legal system recognizes that where science is "subject to perpetual revision," the law's search for truth is a different endeavor in that it must resolve disputes "finally and quickly" and not hinge on "exhaustive search[es] for cosmic understanding."[310] Taking this view into account, the legal system is perfectly capable of navigating contracts and disputes involving agricultural carbon credits despite uncertainties surrounding the details of the soil science upon which credits depend.[311]

As mentioned above, related uncertainties may be as basic as what property interests in carbon rights belong to different parties.[312] While ascertaining property rights and what their holders are entitled to is among the most basic function of the legal system,[313] clear guidance from government would nonetheless be very valuable. For example, agreements to operate a credit-generating project without the knowledge and approval of landowners are likely void, since ongoing monitoring implicates the right to exclude.[314] But seeing as carbon rights are vested in landowners upon acquisition of real estate, parties may be unsure if entering a lease conveys those rights absent express agreement.[315] In light of the prevalence of leaseholds and mortgages supporting row-crop agriculture in the United States, these factors are important considerations for parties contracting with respect to carbon rights.[316]

In short, significant uncertainties about carbon-related property interests and the permanence of carbon storage necessitate the need for some form of regulation. Oversight by a governing body has the potential to provide clarity in the voluntary market, where participants are currently unable to rely on the long-term validity of carbon credits.

IV. RECOMMENDATION

So, how should we go about building an agricultural carbon credit framework that delivers meaningful climate solutions? If the Act becomes law, the

309. *See, e.g.*, Rsrv. Mining Co. v. EPA, 514 F.2d 492, 536 (8th Cir. 1975) (noting that "[a] court is not powerless to act" under circumstances of high scientific uncertainty).

310. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 596–97 (1993).

311. *See id.*

312. *See supra* Subsection III.E.1.

313. *See, e.g.*, THOMAS HOBBES, LEVIATHAN, 188–90 (1st ed. Oxford 1909) (1651).

314. Clinton Griffiths, *The Carbon Contract Conundrum*, FARM J. AG WEB (Mar. 1, 2021), https://www.agweb.com/news/business/conservation/carbon-contract-conundrum [https://perma.cc/88UP-RW3V].

315. *Id.*

316. *See* FARMLAND OWNERSHIP AND TENURE, USDA ECON. RSCH. SERV., https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/farmland-ownership-and-tenure/ (last visited Feb. 5, 2023) [https://perma.cc/8UA7-A9MQ]; AM. BANKERS ASS'N, FARM BANK PERFORMANCE REP. 4 (2020), https://www.aba.com/-/media/documents/reports-and-surveys/2020-farm-bank-report.pdf?rev=f144582c77824f91be14de33f3b625ba [https://perma.cc/25WZ-AKGJ]. Notably, the USDA is a major lender for farm loans. *See Farm Loans Overview*, U.S. DEP'T AGRIC. FARM SERV. AGENCY (Mar. 2020), https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/farm_loans_overview-factsheet.pdf [https://perma.cc/9ZAM-F5QK].

Secretary will have the power to craft appropriate regulations.[317] The following is a set of considerations for the Secretary or similarly situated policymakers. Absent some sort of oversight under this Act or a similar one, buyers and sellers will continue to sell on the voluntary markets, playing by their own rules, or by no rules at all.[318] This is essentially the status quo, which has proved ineffective for scaling the voluntary market at the rate needed to deliver meaningful climate mitigation at the time scale needed.[319]

The gaps in the soil science and other risks to permanence identified above have not prevented market participants from generating credits using agricultural projects,[320] and the USDA should likewise not be deterred.[321] Allowing the voluntary market to go forward without any guidance from regulators risks market participants spending immense amounts of time and money on efforts that fail to meaningfully mitigate the impacts of climate change.[322] It also risks allowing or encouraging markets to engage in transactions based on chemical qualities in soil that are unidentifiable, intangible, or even nonexistent.[323]

Given the high risk of reversals associated with agricultural credits, it may be that policy should instead concentrate efforts on methods which will more reliably reduce carbon concentrations in the atmosphere, such as emission avoidance and renewable energy projects.[324] At most, some argue, agricultural credits should be pursued only after efforts to reduce emissions at the source and more reliable credit-generating measures have been exhausted.[325] Reducing emissions by transitioning away from fossil fuels and preventing the clearing of lands are indeed far more effective and reliable climate solutions, and governments and companies should arguably be prioritizing those over less-reliable solutions like agricultural soil carbon sequestration and credits.[326]

There is significant room for improvement in this area; as of 2020, renewables accounted for less than 20% of energy production in the United States, and while the market has made considerable advances, participation and coordination from the government is sorely needed to address gaps like outdated energy infrastructure.[327] In addition, private- and public-sector efforts to protect and

317. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

318. *See* Van der Pol et al., *supra* note 33.

319. TASKFORCE, *supra* note 37, at 75.

320. Shankleman & Rathki, *supra* note 40.

321. Blaufelder et al., *supra* note 21 (discussing rapid growth in the voluntary carbon markets). It seems unlikely that the USDA would see the gaps in soil science as a barrier that cannot be overcome. *See, e.g.*, Bonnie, et al., *supra* note 207, at 9.

322. *See* Amundson & Biardeau, *supra* note 34, at 11652–54.

323. *See* Shankleman & Rathki, *supra* note 40.

324. *See* Amundson & Biardeau, *supra* note 34, at 11652–54.

325. *See* Shankleman & Rathki, *supra* note 40 (stating that one organization might one day support the use of offsets but only for "'residual emissions' that can't be easily cut").

326. *See* Amundson & Biardeau, *supra* note 34, at 11652–54.

327. David Blackmon, *Renewables Won't Save Us if the Electric Grid Is Not Ready*, FORBES (Sept. 30, 2020, 12:04 PM), https://www.forbes.com/sites/davidblackmon/2020/09/30/renewables-wont-save-us-if-the-electric-grid-is-not-ready/?sh=468a9c007abf [https://perma.cc/8FTX-GSBU].

restore wetlands would much more reliably serve the goals of retaining carbon in soils and ensuring permanence.[328] The Act recognizes this by including wetland restoration as a covered activity.[329] This example highlights just one area where the Program could prioritize among covered activities.[330]

But efforts to generate carbon credits based on sequestration in soil ought not and is unlikely to be abandoned.[331] Developing programs certifying carbon credits tied to sequestration in forests, where the soil is not tilled and thus does not carry as much reversal risk, could be prioritized over sequestration in row-crop operations by the USDA, should it be charged with assessing its options under the Act.[332] The Secretary would be reasonable in prioritizing verification of carbon credits derived from agricultural systems incorporating perennial plants, such as grasses, and trees, which may serve as a compromise while uncertainties surrounding row-crop agricultural credits are worked out.[333]

Policymakers should also address financial problems of carbon markets, for example, that carbon credits do not only allow purchasers to offset emissions, but also function as investment vehicles.[334] Because carbon traders engage in securitization and create derivative instruments, outsized risk not accounted for by registries and third-party verifiers can be passed on to investors and become hidden in financial asset pools.[335] Meaningful facilitation and protection of the voluntary market therefore means including in a certification program protections against uncertainties that would lead to "junk" credits with risks hidden in financial asset pools, just as junk bonds hid the risks of mortgage funds and fueled the Great Recession.[336]

The uncertainties in the soil science surrounding sequestration in soils under annual row-crop management is precisely the sort of risk that could be buried by "financial alchemy," making carbon credits appear to have greater liquidity and lower risk than they actually do.[337] Regulators should pay careful attention to the combination of risks posed by uncertainties involved with measuring and verifying sequestration in soils under annual cultivation and attendant threats to permanence.[338]

328. *Coastal Wetlands: Too Valuable to Lose*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/habitat-conservation/coastal-wetland-habitat#coastal-wetlands:-too-valuable-to-lose (last visited Feb. 5, 2023) [https://perma.cc/JFT8-JDMB].

329. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. § 2(d)(2)(J) (2021).

330. *Id.*

331. Agricultural soil sequestration is promising and delivers a series of benefits beyond reducing carbon in the atmosphere, and therefore abandoning it as one a climate solution would be imprudent. *See* Bradford et al., *supra* note 34.

332. Barth, *supra* note 34.

333. *See id.*; *Perennial Wheat*, THE LAND INST., https://landinstitute.org/our-work/perennial-crops/perennial-wheat/ (last visited Feb. 5, 2023) [https://perma.cc/6BFU-P2ZL].

334. Lotay, *supra* note 128, at 498–99.

335. *Id.*

336. *Id.* at 492.

337. Amundson & Biardeau, *supra* note 34, at 11652; Lotay, *supra* note 128, at 498–99.

338. *See* Amundson & Biardeau, *supra* note 34, at 11652; Lotay, *supra* note 128, at 498–99.

Achieving permanence of sequestered carbon is essential to genuinely offsetting emissions and supporting end buyers' emission reduction plans.[339] Short-term contracts with one-time payments do little to guarantee permanence, since landowners have no further obligations beyond the duration of the agreement.[340] Policymakers should therefore determine what minimum amount of time verifiers should require monitoring of sequestration projects, since what is verified in year five may not remain in year six.[341] Additionally, policymakers should require market participants to expressly discuss with landowners monitoring timeframes, given that end buyers and registries may lack the ability to monitor carbon concentrations without agreements expressly granting rights to do so.[342] This recommendation is underscored by the fact that rights to use land and exclude others from land are fundamental property rights that landowners should not be presumed to relinquish but for express indications to the contrary.[343]

Buffer pools, by employing what amounts to insurance protecting against reversals, provide greater assurance of permanence than do protocols without them, and therefore should be incentivized to protect end buyer purchases.[344] Contracts should address buffer pools and permanence periods, and regulators should permit remote monitoring and regular soil tests.[345] To incentivize landowners to maintain the carbon stores, contracts could entitle landowners to ongoing payments.[346] Another important consideration for the Advisory Council will be determining what effect landowners selling or devising their land has on carbon credits generated from soil carbon sequestration.[347] To incentivize them to maintain sequestered carbon, subsequent landowners should be able to become parties to buffer pool contracts and receive payments for continuing practices that maintain permanence.[348]

Perhaps the best solution does not yet exist and could be crafted by a careful legislature. Experiences with conservation easements provide a framework. Current statutory schemes require these easements to be made in perpetuity and conveyed to a nonprofit organization or government agency.[349] The first of these attributes may be unworkable for scaling agricultural carbon credits because

339. *See* TASKFORCE, *supra* note 37, at 74.

340. KNOX ET AL., *supra* note 47, at 19–20.

341. *See* OLDFIELD ET AL., *supra* note 36, at 5 (discussing the debate about timeframes for monitoring permanence).

342. *See* TASKFORCE, *supra* note 37, at 75 (referencing the need for monitoring throughout permanence periods); KNOX ET AL., *supra* note 47, at 7 (discussing the right to exclude as it relates to carbon rights).

343. KNOX ET AL., *supra* note 47, at 7.

344. *See* OLDFIELD ET AL., *supra* note 36, at 23.

345. The Climate Action Reserve requires projects to submit monitoring plans. CLIMATE ACTION RESERVE, *supra* note 171, at 18.

346. Marland et al., *supra* note 155, at 264.

347. Mutual assent between parties is a fundamental feature of enforceable contracts. *See Contract*, CORNELL LEGAL INFO. INST., https://www.law.cornell.edu/wex/contract (last visited Feb. 5, 2023) [https://perma.cc/J6CM-7K2X].

348. *See* Marland et al., *supra* note 155, at 264.

349. CHIANG ET AL., *supra* note 287, at 20.

perpetual restrictive encumbrances may deter landowners from participating. Meanwhile, end buyers of credits tend to be private firms[350] and thus would not be eligible to be granted conservation easements.

Drawing on the flexibility provided by protocols in the voluntary market and conservation easements, a statute could recognize a "carbon storage easement" as a new statutory form of restrictive covenant. This covenant could be devised to an end buyer for a 100-year timeframe as proposed by the Taskforce[351] instead of perpetuity, or, as some registries offer,[352] a discounted rate for fewer years. Payment schedules could be structured to encourage longer-term commitments, with larger advance payments for longer-term agreements. Alternatively, shorter-term agreements could receive payment at a discounted rate after sequestration has been verified.[353] Incentivizing purchases through tax deductions, like those offered for conservation easements, could help to encourage market activity and reporting. It would also provide an incentive for end buyers to enforce their carbon storage commitment against landowners whose lands have been burdened. Perhaps most importantly, a carbon storage easement, like other easements, could be recorded with the property's deed and "run with the land," restricting the use of future purchasers, devisees, and heirs. Unlike conservation easements, however, by not requiring covenants to exist in perpetuity, carbon storage easements could allow private parties more flexibility and impose a more tailored burden on the underlying property.

Going forward, these proposals and considerations should play into efforts to scale the voluntary carbon market and reliably include soil carbon sequestration in the portfolio of credit-generating activities.

V. CONCLUSION

As the public sector undertakes efforts to facilitate the voluntary carbon market, it should be mindful of the science behind credits. Uncertainties relating to measuring and verifying changes in agricultural practices translate to risk surrounding agricultural carbon credits.

If Congress moves forward with a certification program like that proposed in the Act, whether through this authorization or another, care should be taken to address the risks to permanence, and especially those related to credits based on carbon sequestered in soils under annual cultivation.[354] Through a coordinated approach, agriculture could become an integral climate solution.

350. Shankleman & Rathki, *supra* note 40.

351. TASKFORCE, *supra* note 37, at 75.

352. The Climate Action Reserve offers what it refers to as "tonne-year accounting," which pays on an ex-post basis for demonstrated sequestration. CLIMATE ACTION RESERVE, *supra* note 171, at 24.

353. Much like Climate Action Reserve's tonne-year accounting approach. *Id.*

354. *See* Amundson & Biardeau, *supra* note 34, at 11652; Lotay, *supra* note 128, at 498–99.