REGULATORY TAKINGS IN CLIMATE CHANGE: GEO-ENGINEERING ONE'S WAY AROUND THE FIFTH AMENDMENT

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ABSTRACT

Picture yourself as the owner of a small business located in the downtown area of a large city; your business consists of a shop and an adjoining parking lot. A new regulation has just been passed which requires any owner of property within the city limits to paint all roofs and parking areas with a new reflective coating, in order to reduce the heat which is absorbed by such structures. The idea of closing your business down for this time, along with other connected issues, scares you, and you begin to wonder if your local government truly has your best interest in mind. You and a few of your friends, who are local shopkeepers in the area, have discussed these matters, as they have similar concerns, and plan to challenge this regulation, citing certain constitutional violations.

Such regulations and laws are soon to come, as climate change consequences grow ever larger and closer. While regulations to battle these environmental changes will attempt to mitigate and/or adapt our lifestyles to these variations, other regulations will look to implement geo-engineered sciences. What will the Court's Takings Clause jurisprudence allow, or disallow, when such laws, regarding geo-engineered implementation, come to pass?

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This paper looks to discuss this question. Section I introduces this topic and lays out the foundation for the following information. Section II of this paper discusses climate change, and the ideas which have developed, under which regulations will be derived from. Section III discusses the Court's Takings Clause jurisprudence, focusing on regulatory takings, in their various forms. Section IV then posits the connections and discussions of the above ideation's interplay with one another, discussing a hypothetical regulation, and then what governances can do to prevent and defend against such claims. Finally, Section V concludes the aforementioned arguments. While this topic is broad, and the discussion not exhaustive, it gives insight into the best course of action in designing regulations and land use plans to protect from a more terrifying future, while still incorporating the protection of private land rights which the Constitution holds dear.

INTRODUCTION

It is undeniable that humans are causing the earth's climate system to change.[1] These changes include "rising sea levels, ocean warming and acidification, melting sea ice, thawing permafrost, increasing in the frequency and severity of extreme events, and a variety of impacts on people, communities, and ecosystems."[2] Rising sea levels, among other consequences of climate change, will require new and innovative solutions. In the United States, an estimated 4.4

1. *See, e.g.*, Michael Burger, Jessica Wentz & Radley Horton, *The Law and Science of Climate Change Attribution*, 45 COLUM. J. ENV'T L. 57, 60–61 (citing *State of the Climate: National Climate Report for January 2019*, NOAA NAT'L CTRS. FOR ENV'T INFO., https://www.ncdc.noaa.gov/sotc/national/ [https://perma.cc/8BDB-CUP9]); *Annual 2022 National Climate Report*, NOAA NAT'L CTRS. FOR ENV'T INFO., https://www.ncei.noaa.gov/access/monitoring/monthly-report/national/202213 [https://perma.cc/Q8WL-NLGX].

2. Burger et al., *supra* note 1, at 60.

> million acres are at risk to changing water levels by 2050.[3] Such rise (along with other climate change consequences) will endanger thousands of individuals, with domino-esque effects to everyone.[4]
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> Many articles have already been published, that "highlight the ways in which our traditional views of property are struggling under the weight of environmental pressures in general and climate change in particular."[5] A lot of these articles look specifically at sea level rise, and the connection with property rights, an issue which quickly drew the attention of the legal community in the early 21st century.[6]
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> While these discussions are worthwhile and in depth, there are new issues which require additional comment.[7] One

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3. *See* Brady Dennis, *Rising Seas Could Swallow Millions of U.S. Acres within Decades*, WASH. POST (Sept. 8, 2022), https://www.washingtonpost.com/climate-environment/2022/09/08/sea-level-rise-climate-central/ [https://perma.cc/C5FH-BUVK].

4. *See* Michael A. Hiatt, Note, *Come Hell or High Water: Reexamining the Takings Clause in a Climate Changed Future*, 18 DUKE ENV'T L. & POL'Y F. 371, 371 (2008) ("the substantial amounts of land and large number of private property threatened by large-scale sea level rise"); Maye C. Emlein, Note, *Rising to the Challenge: Managed Retreat and the Takings Clause in Maine's Climate Change Era*, 73 ME. L. REV. 169, 172 (2021) ("The inevitability of sea level rise means that we need to actively relocate people who live in coastal areas that are vulnerable to sea level rise"); *see also* discussion *infra* Section II(b).

5. Shelley Ross Saxer & Carol M. Rose, *A Prospective Look at Property Rights*, 20 GEO. MASON L. REV. 721, 723 (2013). *See, e.g.*, Hiatt, *supra* note 4; Emlein, *supra* note 4; Steven J. Eagle, *A Prospective Look at Property Rights and Environmental Regulation*, 20 GEO. MASON L. REV. 725 (2013); Devon Applegate, Note, *The Intersection of the Takings Clause and Rising Sea Levels; Justice O'Connor's Concurrence in* Palazzolo *Could Prevent Climate Change Chaos*, 43 B.C. ENV'T AFFS. L. REV. 511 (2016); Note, *infra* note 32; J. Peter Byrne, *The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time*, 73 LA. L. REV. 69 (2012); Emily Guimont, *Land Use Regulations, Climate Change, and Regulatory Takings*, 52 ENV'T L. 279 (2022); Timothy M. Mulvaney, *Foreground Principles*, 20 GEO. MASON L. REV. 837 (2013); Isaac Foote, Note, *A Taking Timebomb: Loss of Access Takings as a Barrier to Managed Retreat from Sea Level Rise*, 23 MINN. J.L. SCI. & TECH. 559 (2022).

6. *See, e.g.*, Hiatt, *supra* note 4, at 372 (introducing the paper as "examin[ing] how climate change and the resulting sea level rise will place new tensions on the interaction of the public trust doctrine and the takings clause").

7. *See* discussion *infra* Section II(b)(iii).

scholar notes that, "[s]ince comprehensive solutions seem unlikely in the short to medium term . . . increased local or mixed-level regulation is likely to result."[8] Therefore, the same idea promulgated from sea-level articles is applied to any "state and local efforts [which] deal with [the] serious environmental and natural resource problems," especially as these efforts "will clash with private property rights."[9] The conclusion that many of these articles draw, that "our current takings jurisprudence is not equipped to address the brave new world of climate change," is similarly applicable to the variety of climate change issues which are likely to arise in the future.[10]

An important tangential discussion to this note's argument is the federal-judicial assertion of preemption. The preemption idea is the understanding of "allocating decisional responsibility between the federal and state governments with respect to matters [in] which they exercise concurrent authority."[11] Preemption allows a federal court to take a plaintiff's claim, based in state law, and exercise federal question jurisdiction over it.[12] Such allowance has been particularly effective, especially due to "the administrative rulemaking process."[13] Recent decisions by the Supreme Court have decreased the idea of preempting a

8. Eagle, *supra* note 5, at 725.

9. *Id.* at 726.

10. *Compare* Emlein, *supra* note 4, at 213, *with* discussion *infra* Section IV(b). "[A]ny article that looks toward the future, trepidation is in order. Prognosticating on the environment and the effects of regulation on property rights necessarily involves assumptions about science, human nature, politics, and law. Predictions have a tendency toward 'more of the same,' but extrapolations of existing trends typically are not correct. It also is easy to focus on one type of anticipated problem to the exclusion of others." Eagle, *supra* note 5, at 726.

11. *See* Robert L. Glicksman & Richard E. Levy, *A Collective Action Perspective on Ceiling Preemption by Federal Environmental Regulation: The Case of Global Climate Change*, 102 NW. U. L. REV. 579, 579 (2008).

12. *See* Gil Seinfeld, *Climate Change Litigation in the Federal Courts: Jurisdiction Lessons from* California v. BP, 117 MICH. L. REV. ONLINE 25, 27 (2018)

13. *See* Tyler Runsten, Note, *Climate Change Regulation, Preemption, and the Dormant Commerce Clause,* 72 HASTINGS L.J. 1313, 1317 (2021). For a further discussion see Lisa Heinzerling, *Climate, Preemption, and the Executive Branches*, 50 ARIZ. L. REV. 925, 926–28 (2008).

plaintiff's state-law-based claim through federal provisions.[14] Due to this, and the attached unlikeliness "of a court overturning a state or local law on preemption grounds," both "state and local government should take this opportunity to enact their own environmentally protective legislation."[15]

With this idea in mind, that preemption will be less of a concern for state and local environmental laws, this note focuses on what concerns such governments should have, specifically when statutorily implementing geo-engineered sciences. How will such regulations be challenged under the Takings Clause, and how can these regulations be structured in a way to avoid claims or defend against them, with the purpose of a more viable future?[16] This note will answer these questions.

A. Past Discussions, Takings Clause, Climate Change

As noted, with pressing issues regarding new sciences, new governmental regulations will be required.[17] As these new regulations will be focused on "restrict[ing] private property development" the Fifth Amendment of the U.S.

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14. *See* Runsten, *supra* note 13.

15. *Id.* For an example of federal courts applying such standards and the discussion therein regarding state-law claims brough against a locality's banning of natural gas piping, see Cal. Rest. Ass'n v. City of Berkeley, No. 21-16278, 2023 U.S. App. LEXIS 9068, at *24 (9th Cir. Apr. 17, 2023). For an overview of or the original executive deference and preemption Supreme Court jurisprudence, see Chevron, U.S.A., Inc. v. Nat. Res. Def. Council, Inc., 467 U.S. 837 (1984); Auer v. Robbins, 519 U.S. 452 (2997); Nat'l Cable & Telecomm. Ass'n v. BrandX Internet Servs., 545 U.S. 967 (2005). For examples of the decrease in this deference especially in the area of climate change regulation, see U.S. Telecom Ass'n v. Fed. Commc'ns Comm'n, 855 F.3d 381, 421 (D.C. Cir. 2017) (Kavanaugh, J., dissenting); Baldwin v. United States, 140 S. Ct. 690, 690 (2020) (mem.) (Thomas, J., dissenting); Kisor v. Wilkie, 139 S. Ct. 2400, 2425 (2019) (Gorsuch, J., concurring).

16. *See* discussion *infra* Section IV.

17. *See* Eagle, *supra* note 5, at 760 ("New forms of regulation and shifts in the content of common law rules will generate novel claims of regulatory takings, confronting courts with puzzling questions of fundamental rights under unprecedented climatic conditions"); *see also* discussion *infra* Section IV(b).

Constitution[18] will act as protection to individuals, while also impeding governmental action.[19] The Fifth Amendment contains the Takings Clause, which states that "private property [shall not] be taken for public use, without just compensation."[20] The Supreme Court's Takings Clause jurisprudence is complicated and often has "irreconcilable results" based on myriad analyses which can conflict with one another.[21]

Moving forward, government regulation of land will need to focus more readily on societal impact, safety, and public welfare; these new purposes will require careful structuring of the frameworks for these regulations, specifically to protect against the analyses applied by the courts, and therefore comport with the constitutional protection given by the Takings Clause.[22] This is needed as the consequences of climate change become more dire and regulations become more purposeful to protect society.[23]

II. CLIMATE CHANGE

As mentioned above, sea level rise is one area of climate change which legal authors have explored in great depth.[24] The rising sea level, as a consequence to climate change,

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18. *See* U.S. CONST. amend. V; Applegate, *supra* note 5, at 515; *see also* discussion *infra* Section IV.

19. *See* Eagle, *supra* note 5; *see also supra* note 17.

20. U.S. CONST. amend. V.

21. First Eng. Evangelical Lutheran Church v. Cnty of L.A., 482 U.S. 304, 332 (1987) (Stevens, K., dissenting). "As it stands today, Takings Clause jurisprudence lacks both uniformity and clarity." Applegate, *supra* note 5, at 512; *see also* discussion infra Section III(b).

22. *See* Brace v. United States, 72 Fed. Cl. 337, 355–56 (2006) ("The last criterion – the character of government action – requires the court to consider 'the purpose and importance of the public interest underlying [the] regulatory imposition'") (quoting Maritrans, Inc, v. United States, 342 F.3d 1344, 1356 (Fed. Cir. 2003)); Applegate, *supra* note 5, at 532 ("Some courts . . . are focusing on examining the purposes served by a regulation and weighing its societal benefits against the harm it inflicts"); *see also* discussion *infra* Section IV(b).

23. *See* discussion *infra* Sections II(b), IV & V.

24. *See supra* notes 5–6 and accompanying text.

necessitated local governments to attempt regulatory solutions; such attempts exemplify the clash between such regulatory actions, based in climate change, and Takings claims brought against them.[25] But why is climate change happening, and what are the methods in which any action, regulatory or not, can protect against the consequences? Specifically, what are the new scientific approaches fostering such conservation, and how can they be implemented?

A. General

Climate change realization and research through governmental action started in the late 1970's, when "the Federal Government began devoting serious attention to the possibility that carbon dioxide emissions associated with human activity could provoke climate change."[26] In 1979, the National Research Council investigated the issue, stating that "the warming will eventually occur, and the associated regional climatic changes . . . may well be significant."[27]

Since then, the scientific understanding has advanced, and the Intergovernmental Panel on Climate Change (IPCC), an organization connected to the United Nations, published its first report in 1990, which concluded that "emissions resulting from human activities are substantially increasing the atmospheric concentrations of . . . greenhouse gases [which] will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface."[28]

25. *See, e.g.*, Stop the Beach Renourishment, Inc. v. Fla. Dep't of Env't Prot., 560 U.S. 702, 712 (2010).

26. Massachusetts v. EPA, 549 U.S. 497, 507 (2007).

27. CLIMATE RSCH. BD., CARBON DIOXIDE AND CLIMATE: A SCIENTIFIC ASSESSMENT 3 (1979).

28. IPCC, CLIMATE CHANGE: THE IPCC SCIENTIFIC ASSESSMENT, xi (J. Houghton, G. Jenkins & J. Ephraums eds. 1991); *see also Massachusetts*, 549 U.S. at 508–09.

> In the three decades since the IPCC's first assessment, they have published five additional reports, each one issuing a stronger warning to the world.[29] After the most recent publication,[30] Antonio Guterres, the United Nation's Secretary General, stated that this report's warning "is a code red for humanity. The alarm bells are deafening, and the evidence is irrefutable: greenhouse gas emissions from fossil fuel burning and deforestation are choking our planet and putting billions of people at immediate risk."[31] Such imminent risks include the rising of sea levels, the dissipation of wetlands, the decay of habitats, and the peril that all species are facing.[32]

B. Future Considerations, Takings Clause, Climate Change

> In 2017, the Fourth National Climate Assessment[33] "project[ed] changes in temperature and precipitation, increased frequency of droughts, floods, wildfires, and extreme storms, changes in land cover and terrestrial biogeochemistry, changes in artic conditions, sea level rise,

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29. *See* Fiona Harvey, *Major Climate Changes Inevitable and Irreversible – IPCC's Starkest Warning Yet*, GUARDIAN (Aug. 9, 2021), https://www.theguardian.com/science/2021/aug/09/humans-have-caused-unprecedented-and-irreversible-change-to-climate-scientists-warn [https://perma.cc/LLE8-JREV].

30. Working Group III's Mitigation of Climate Change, finalized on April 4, 2022. The final report, known as the Synthesis Report, is due for release in early 2023, which "integrate[s] materials contained within the Assessment Reports." IPCC, AR6 *SYNTHESIS REPORT: CLIMATE CHANGE* 2023, "forthcoming" https://www.ipcc.ch/report/sixth-assessment-report-cycle/ [https://perma.cc/Q36E-6B5F].

31. Harvey, *supra* note 29 (quoting Antonio Guterres, Sec'y Gen.,, UN, Address at New York (Aug. 9, 2021)).

32. *Necessity Takings in the Era of Climate Change*, 136 HARV. L. REV. 952, 952–53 (2023).

33. The National Climate Assessment is a "report to Congress and the President" compiled by the U.S. Global Change Research Program, mandated by the Global Change Research Act of 1990. *See Fourth National Climate Assessment: About this Report*, U.S. GLOB. CHANGE RSCH. PROGRAM, https://nca2018.globalchange.gov/chapter/front-matter-about/ (last visited Feb. 28, 2023).

and ocean acidification."[34] The new urgency[35] has brought new focus in combatting climate change, and tactics have been divided into three categories: mitigation, adaptation, and geo-engineering.[36] Mitigation and adaptation are responses "framed by policy makers and scientists as complementary but disconnected approaches."[37] Geo-engineering can be thought of as either mitigation or adaptation, "depending on the specific technology involved," or it "may even constitute a class of climate change responses that is distinct from both."[38]

Each of these classifications will require national and subnational policies which will necessarily have to interact and comport with the protections provided by the Constitution.[39]

1. Mitigation

The idea of mitigation is one of two generalized approaches used to respond to climate change; and while broad, a working definition of mitigation is a "means [of] preventing or reducing the amount of climate change that

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34. 350 Montana v. Haaland, 50 F.4th 1254, 1277 (9th Cir. 2022); *see also* James Hansen et al., *Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, *in* 8 PLOS ONE 12-1, 6 (Dec. 2013) ("[i]mpacts of special interest are sea level rise and species extermination, because they are practically irreversible, and others important to humankind.").

35. Although, many in the climate field would say such concern is anything but new, the warnings have never been more dire. *See supra* text accompanying note 20. *See* James E. Parker-Flynn, *The Intersection of Mitigation and Adaptation in Climate Law and Policy*, 38 ENVIRONS ENV'T L. & POL'Y J. 1,3 (2014) ("[H]umans must drastically reduce emissions of greenhouse gases and the destruction of carbon sinks. Such reductions must begin in the very near future.").

36. *See* Alexandre K. Magnan & Teresa Ribera, *Global Adaptation after Paris*, SCI. MAG., June 10, 2016, at 1280; Hansen et al., *supra* note 34, at 16.

37. G. Robbert Biesbroek, Rob J. Swart & Wim G.M van der Knapp, *The Mitigation-Adaptation Dichotomy and the Role of Spatial Planning*, 33 HABITAT INT'L 230, 231 (2009).

38. Parker-Flynn, *supra* note 35, at 11–12.

39. *See* discussion *infra* Section IV(b).

will occur,"[40] or as "[a]n anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases."[41] Common mitigation strategies focus directly in reducing human "CO_2 emissions to keep the atmospheric concentrations below some specified level in order to prevent more than a safe amount of global temperature change."[42] There have been a range of attempts to enforce mitigation strategies, from international agreements,[43] to State acts.[44] Yet, issues are presented in the lack of true enforcement, as exemplified by the United States "not doing much at the federal level," and China "rapidly adding more coal-fired power generation."[45] Further, "[g]lobal emissions have not been dented since 1990, and globally coal has continued to increase both in relative share and in absolute amount."[46]

In the wake of international failures, many have asserted that the "core of the global effort to cut emissions will . . . have to be built from the bottom up – through ambitious

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40. Samara Spence, Note, *Three Structural Changes for a New System of International Climate Change Mitigation Agreements Based on the WTO Model*, 44 VAND. J. TRANSNAT'L L. 1415, 1423 (2011) (citing John P. Holdren, President & Dir., Woods Hole Rsch. Ctr., Meeting the Climate-Change Challenge, Eighth Annual John H. Chafee Memorial Lecture on Science and the Environment (Jan. 17, 2008), *in* 8 MEETING THE CLIMATE-CHANGE CHALLENGE 6 (2008)).

41. IPCC, SUMMARY FOR POLICYMAKERS, *in* CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY. CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 750 (M.L. Parry, O.F. Canziani, J.P Palutikof, P.J. van der Linden & C.E. Hanson, eds., Cambridge University Press 2007).

42. Spence, *supra* note 40, at 1424.

43. *See, e.g.*, Paris Agreement, art. 4, ¶ 2, Dec. 12, 2015, T.I.A.S. No. 16-1104, 3156 U.N.T.S. 54113 (entered into force Nov. 4, 2016).

44. *See, e.g.*, California Environmental Quality Act, CAL. PUB. RESOURCES CODE § 21002.1 (Deering 1994).

45. Dieter Helm, Cameron Hepburn & Giovanni Ruta, Trade, Climate Change and the Political Game Theory of Border Carbon Adjustments 4 (CTR. FOR CLIMATE CHANGE ECON. & POL'Y, Working Paper No. 92, 2012), http://www.dieterhelm.co.uk/assets/secure/documents/Trade-climate-change.pdf.

46. *Id.* (noting that "[t]he only event that has made any substantial difference to global emissions is [some] economic crisis[es] and the associated reduction in economic growth, but even this has had only a limited effect").

national policies and creative international cooperation focused on specific opportunities to cut emissions."[47] Such policies are exactly those which will require coherence to the protections provided by the Constitution.[48]

2. Adaptation

Adaptation is the other generalized idea used to respond to climate change; often defined as "reducing the potential harmful impacts of climate change by protecting people and cities,"[49] or "adjustment[s] in natural or human systems in response to actual or expected climatic stimuli or their effects."[50] While mitigation seeks to lower the consequences of global warming, adaption, instead, seeks to "ensure that vulnerable populations, ecosystems, and social and economic systems are sufficiently able to absorb the impacts of climate change and, hopefully, thrive thereafter."[51]

Adaptation suffered and received less focus originally, as many believed that the strategy would deprive mitigation efforts of requisite resources and attention, especially as mitigation was thought of as the more pressing matter.[52] Recently, there has been a realization that adaptation is not only important, but also a necessary means to "reduc[e] the undesirable effects of climate change."[53] While parallel to mitigation, the focus of adaptation is not on curbing the

47. *See, e.g.*, Michael A. Levi, *Copenhagen's Inconvenient Truth: How to Salvage the Climate Conference*, 88 FOREIGN AFFS. 92, 93 (2009).

48. *See* discussion *infra* Section IV(c–d).

49. Spence, *supra* note 40, at 1423 (citing Holdren, *supra* note 41).

50. IPCC, *supra* note 41.

51. Parker-Flynn, *supra* note 35, at 4.

52. *See id.*; *see also* J.B. Ruhl, *Climate Change Adaptation and the Structural Transformation of Environmental Law*, 40 ENV'T L. 363, 365–66 (2010); Robin Kundis Craig, *"Stationarity is Dead" – Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENV'T L. REV. 9, 14 (2010); Rob Swart & Frank Raes, *Making Integration of Adaptation and Mitigation Work: Mainstreaming into Sustainable Development Policies?*, 7 CLIMATE POL'Y 288, 294 (2007).

53. Parker-Flynn, *supra* note 35, at 6.

cause of climate change, but on retroactively dealing[54] with the consequences already before us.[55]

Adaptation measures range in strategies, and, while the underlying focus is to "reduce vulnerability," there is also concern that "initiatives in one place may have adverse effects in neighboring places or interconnected ones."[56] Therefore, although a focus on national and subnational policies is prudent, there must also be "trans-boundary" considerations to buttress global scale effects.[57]

These policies, dealing both with the implementation and with the effect on others, are exemplifications of those which will require consistency and organization to comply with constitutional protections.[58]

3. Geo-Engineering

As explained briefly above,[59] geo-engineering is a slightly different, and more radical, strategy to combat climate change.[60] While geo-engineering is a riskier and more aggressive tactic, one clouded with many naysayers and disagreements, it may be "the only affordable and fast-acting option to avoid a global catastrophe."[61] Geo-engineering

54. Retroactivity is something of a misnomer in adaptation theory though, as generally such an approach requires proactiveness, "with research and planning preceding [any] implementation, often by many years." *Id.*; *see also* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 18–19 (2009) (discussing proactive and reactive adaptation).

55. *See supra* notes 28–32 and accompanying text.

56. Magnan & Ribera, *supra* note 36, at 1281.

57. *See id.* (focusing on an "advocat[ion] for [a] better consideration of trans-boundary effects of national adaptation strategies, and for strengthening bilateral or multilateral cooperation").

58. *See* discussion *infra* Section IV(b).

59. *See supra* notes 37–38 and accompanying text.

60. *See* Parker-Flynn, *supra* note 35, at 12 ("Geoengineering measures are not yet well understood, and may be "extremely risky.") (quoting NAT'L CLIMATE ASSESSMENT & DEV. ADVISORY COMM., NCADAC DRAFT CLIMATE ASSESSMENT REPORT 958 (2012)).

61. Ken Caldeira & David W. Keith, *The Need for Climate Engineering Research*, 27 ISSUES SCI. & TECH. 57, 57 (2010). "The time may well come . . . when

can be broadly defined as "the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change,"[62] or, more negatively put, "a freak show in otherwise serious discussion of climate science and policy."[63]

The idea of climate engineering goes as far back as at least the 1830s, when J.P. Espy, an American meteorologist, hypothesized that lighting large fires would stimulate "convective updrafts and alter the intensity and frequency of precipitation."[64] Since then, geo-engineering has had a range of upheavals with varying responses; and recently has been a focus of climate change responses.[65]

Geo-engineering methods come in many forms but are often classified into two main groups: carbon dioxide removal (CDR)[66] and solar radiation management (SRM).[67] At the risk of minimizing the science behind these methods, CDR seeks to "reduce carbon dioxide levels in the atmosphere, facilitating the escape of more outgoing long-wave radiation, thus exerting a cooling effect," while SRM

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nations judge the risk of climate change to be sufficiently large and immediate that they must 'do something' to prevent further warming. But since 'doing something' will probably involve intervening in Earth's climate system on a grand scale, the potential for doing harm is [also] great." *Id.*

62. ROYAL SOC'Y, GEOENGINEERING THE CLIMATE: SCIENCE, GOVERNANCE AND UNCERTAINTY 1 (2009).

63. David G. Victor, *On the Regulation of Geoengineering*, 24 OXFORD REV. ECON. POLS. 322, 323 (2008).

64. Philip J. Rasch, Simone Tilmes, Richard P. Turco, Alan Robock, Luke Oman, Jack Chen, Georgiy L. Stenchokov & Rolando R. Garcia, *An Overview of Geoengineering of Climate Using Stratospheric Sulphate Aerosols*, 366 PHIL. TRANSACTIONS ROYAL SOC'Y 4007, 4008 (2008). For further historical weather and climate engineering, see James Rodger Fleming, *The Pathological History of Weather and Climate Modification: Three Cycles of Promise and Hype*, 37 HIST. STUD. PHYSICAL & BIOLOGICAL SCI. 3, 3–35 (2006).

65. *See* Rasch et al., *supra* note 64, at 4007.

66. *See* ROYAL SOC'Y, *supra* note 62 (explaining that CDR methods "reduce the levels of carbon dioxide (CO_2) in the atmosphere, allowing outgoing long-wave (thermal infra-red) heat radiation to escape more easily").

67. *See id.* (explaining that SRM methods "reduce the net incoming short-wave (ultra-violet and visible) solar radiation received, by deflecting sunlight, or by increasing the reflectivity (albedo) of the atmosphere, clouds or the Earth's surface").

focuses on "reducing the amount of solar radiation absorbed by the Earth by an amount sufficient to offset the increased trapping of infrared radiation by rising levels of greenhouse gases."[68] Within each of these broad groups, many technological advancements have appeared, as programs to effectuate the outcome purposed by each method.[69]

C. Issue at Hand

This article looks to discuss the various techniques which appear above,[70] while focusing specifically on geo-engineering methods which will likely affect individual property ownership and rights.[71] While the science behind

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68. William C.G. Burns, *Geoengineering the Climate: An Overview of Solar Radiation Management Options*, 46 TULSA L. REV. 283, 286 (2010).

69. *See* Caldeira & Keith, *supra* note 61, at 58–60 (listing off research programs which the umbrella groups are further divided into). CDR is further divided into "Biomass with carbon capture and storage;" "Chemical capturing of CO2 from air;" "Increasing carbon storage in biological systems;" and "Distributed chemical approaches." *Id.* SRM is divided into "Stratospheric or mesospheric aerosols;" "Whitening marine clouds;" "Satellites in space;" and "Whitening the surface." *Id.* While the terminology for the different methods under each umbrella differ, both in number and name, they are somewhat universally agreed upon in the scientific community. *See What Is Geoengineering?*, OXFORD GEOENGINEERING PROGRAMME (2018), http://www.geoengineering.ox.ac.uk/www.geoengineering.ox.ac.uk/what-is-geoengineering/what-is-geoengineering/ [https://perma.cc/EAL7-WVPB] (Referring to CDR as "Greenhouse Gas Removal," and the methods therein as "Afforestation;" "Biochar;" "Bio-energy with carbon capture and sequestration;" "Ambient Air Capture;" "Ocean Fertilisation;" "Enhanced Weathering;" and "Ocean Alkalinity Enhancement." SRM maintained their name, but the methods therein "Albedo enhancement;" "Space reflectors;" and "Stratospheric aerosols.").

70. *See* discussion *supra* Sections II(C)(a), II(C)(b) & II(C)(c).

71. *See* Sarah Pearl, *Albedo Enhancement: Localized Climate Change Adaptation with Substantial Co-Benefits*, CLIMATE INST. (Apr. 13, 2019), https://climate.org/albedo-enhancement-localized-climate-change-adaptation-with-substantial-co-benefits/ [https://perma.cc/9E2M-N3MU] ("[I]nstallation of cool roofs are even more significant in the low-performance, outdated, and inefficient buildings that are often found in low-income areas where residents are likely to suffer most during extreme heat. Subsidizing albedo enhancement projects in these areas, thereby overcoming the ability to cover upfront costs, could thus have beneficial public health outcomes.").

these particular methods is far from complete, studies show evidence of the benefits from such advancements.[72] Additionally, while their implementation has not reached the level they likely will, hypotheses towards the legal framework surrounding such enactments is not only prudent, but crucial for their success.[73]

III. TAKINGS CLAUSE

Generally, "[t]he takings clause seems to be very straightforward; but in practice it presents many interpretive questions."[74] One such interpretive question has led to the expansion of the word "take," evolving from simply outright, physical acquisitions to include regulations which impose some burden on the land or property.[75] Balancing the interpretation of the Takings Clause weighs burdens on the government to regulate land with burdens on the owners to the use of their lands.[76]

Climate change was not a threat to such property interests when the Fifth Amendment was created, therefore such interpretation has been expanded by the Court; at each juncture the "reexamination and evolution" of Taking – specifically Regulatory Taking – jurisprudence was necessitated by some clash of government regulations and private property ownership.[77] Prior to a discussion of particular climate change challenges, an understanding of

72. *See id.* ("While [geoengineering strategies] are potentially effective and will possibly be necessary to prevent a climate catastrophe, significant research into each approach is needed.").

73. *See id.* ("Governance mechanisms also remain a significant challenge" for geoengineering accomplishment); *see also supra* notes 17–23 and accompanying text.

74. JOHN E. CRIBBET, ROGER W. FINDLEY, ERNEST E. SMITH & JOHN S. DZIENKOWSKI, PROPERTY: CASES AND MATERIALS 791 (9th ed. 2008).

75. *See id.*; *see also* Guimont, *supra* note 5, at 282.

76. *See* CRIBBET ET AL., *supra* note 74.

77. *See* Hiatt, *supra* note 4, at 387–88 & nn.92–96. Discussing the advancements made effecting particular Amendment's ratification, and the Court's adapting interpretations thereof, Hiatt uses the Second Amendment and the First Amendment as examples. *See id.* at n.92.

the intricacies which lace Takings jurisprudence provides the necessary background for the subsequent discussion.

A. Eminent Domain v. Regulatory Takings

The Court's Takings Clause jurisprudence is divided between "whether [a] State can take property using the power of eminent domain" or "whether it can regulate property pursuant to the police power."[78]

The government's exercise of eminent domain is the basic physical taking, where the government forces a party to sell its property to the government.[79] The government must show that such physical taking was (1) "done for a public purpose," and (2) "just[ly] compensate[ed]."[80] Even "using eminent domain for economic development" is allowable, although there still must be some public purpose served.[81] "Once the question of the public purpose has been decided, the amount and character of land to be taken for the project and the need for a particular tract to complete the integrated plan rests in the discretion of the legislative branch."[82]

Yet a "permanent physical occupation of an owner's property authorized by the government constitutes a 'taking' of property for which just compensation is due" regardless of how "minor" it may be.[83] The Court, in *Lucas v. South Carolina Coastal Council*, laid out the history of Regulatory

78. Kelo v. City of New London, 545 U.S. 469, 519–20 (2005) (Thomas, J., dissenting) (citing Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1014 (1992); Mugler v. Kansas, 123 U.S. 623, 668–69 (1887)).

79. *See* HENRY E. MILLS, A TREATISE UPON THE LAW OF EMINENT DOMAIN 1–2 (1982).

80. *See, e.g.*, Barr v. City & County of Honolulu, No. 05-00125, 2009 U.S. Dist. LEXIS 62807, at *4, *25 (D. Haw. July 1, 2009).

81. *Kelo*, 545 U.S. at 485–86.

82. Berman v. Parker, 348 U.S. 26, 35–36 (1954).

83. Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 421 (1982). The *Loretto* Court wrote that they "have long considered a physical intrusion by government to be a property restriction of an unusually serious character for purposes of the Takings Clause." *Id.* at 426. Such that "physical *invasion* cases are special and have not repudiated the rule that any permanent physical *occupation* is a taking." *Id.* at 432.

Takings, writing that "[p]rior to Justice Holmes's exposition in *Pennsylvania Coal Co. v. Mahon*, it was generally thought that the Takings Clause reached only a 'direct appropriation' of property, or the functional equivalent of a 'practical ouster of [the owner's] possession.'"[84] It is recognized, "however, that if the protection against physical appropriations of private property was to be meaningfully enforced, the government's power to redefine the range of interests included in the ownership of property was necessarily constrained by constitutional limits."[85] Therefore, "while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking."[86]

B. Types of Regulatory Takings

Regulatory takings can be broken down into four different types: "takings A) found under the *Penn Central* balancing test, B) resulting from the government's permanent physical invasion of private property, C) created by regulations that cause a total loss in the private property's economic value, and D) caused by building exactions."[87]

1. Penn Central

The first type of taking is derived from the 1978 case of *Penn Central Transportation Co. v. New York City*,[88] where the Court held that a New York City Law did not effectuate a taking, as the "restrictions imposed [were] substantially related to the promotion of the general welfare and" allow for "reasonable beneficial use" of the property.[89] *Penn Central* noted three factors to be weighed in balancing

84. Lucas v South Carolina Coastal Council, 505 U.S. 1003 (1992); *Id.* at 1014 (internal citations omitted) (first quoting Legal Tender Cases, 79 U.S. (12 Wall.) 457, 551 (1871); then quoting Transportation Co. v. Chicago, 99 U.S. 635, 642 (1879)).

85. *Id.* (citing Pa. Coal. Co. v. Mahon, 260 U.S. 393, 414–15 (1922)).

86. *Mahon*, 260 U.S. at 415.

87. *Guimont*, *supra* note 5, at 289.

88. 438 U.S. 104 (1978).

89. *Id.* at 138.

whether a regulation "requires compensation: (1) the 'economic impact of the regulation on the claimant,' (2) 'the extent to which the regulation has interfered with distinct investment-backed expectations,' and (3) 'the character of the governmental action.'"[90] This framework has come to be applied only to "partial takings," where regulations only partially restrict economic use of the land or property.[91]

2. Permanent Invasions

As discussed above,[92] statutes which require, in some form, a "permanent physical occupation . . . is a taking without regard to the public interests that it may serve."[93] With the considerations of the *Penn Central*, three-factor balancing test, the *Loretto* Court writes that "when the physical intrusion reaches the extreme form of a permanent physical occupation . . . 'the character of the government action' not only is an important factor in resolving whether the action works [as] a taking but also is determinative."[94] The Court, in laying out this addition to their Takings jurisprudence, made sure to be mindful of the balance from which the Takings Clause has been interpreted.[95] The Court writes that its *Loretto* holding "is very narrow," and, while it "affirm[s] the traditional rule that a permanent physical occupation of property is a taking," it does not "question the equally substantial authority upholding a State's broad power to

90. Calvert G. Chipchase, *From Grand Central to the Sierras: What Do We Do With Investment-Backed Expectations in Partial Regulatory Takings?*, 23 VA. ENV'T L.J. 43, 45 (2004) (quoting *Penn Cent. Transp. Co.*, 438 U.S. at 124).

91. *See id.* (citing Tahoe-Sierra Pres. Council v. Tahoe Reg'l Plan. Agency, 535 U.S. 302, 315(2002)); *see also infra* notes 98–103 and accompanying text (discussing total economic takings, compared to merely partial ones).

92. *See supra* note 83 and accompanying text.

93. *Loretto*, 458 U.S. at 426 (the Court writes that its "constitutional history confirms th[is] rule, recent cases do not question it, and the purposes of the Takings Clause compel its retention.").

94. *Id.* (quoting *Penn Cent. Transp. Co.*, 438 U.S. at 124).

95. *See supra* note 76 and accompanying text.

impose appropriate restrictions upon an owner's *use* of his property."[96]

3. Total Economic Loss

Unlike partial takings, discussed above,[97] "[i]f a government's regulation of private property deprives th[e] property of all economically beneficial uses, then the government has committed a taking under the Takings Clause."[98] This addition to the Court's Takings jurisprudence was laid out in *Lucas v. South Carolina Coastal Council*, where the Court wrote that "when the owner of real property has been called upon to sacrifice *all* economically beneficial uses in the name of the common good . . . he has suffered a taking."[99] Yet, this comes with a caveat, that "the government [may] assert a permanent easement that was a pre-existing limitation upon the landowner's title,"[100] therefore, such limitation "must inhere in the title itself, in the restrictions that background principles of the State's law of property and nuisance already place upon land ownership."[101] While this does not mean all such laws are unconstitutional, it does require (as such Takings jurisprudence is apt to do) that, when "a regulation . . . declares 'off-limits' all economically productive or beneficial uses of land goes beyond what the

96. *Loretto*, 458 U.S. at 441 (emphasis in the original).

97. *See supra* notes 90–92 and accompanying text.

98. Guimont, *supra* note 5, at 290 (citing *Lucas*, 505 U.S. at 1028–30).

99. *Lucas*, 505 U.S. at 1019 (emphasis in original).

100. *Id.* at 1028–29 (citing Scranton v. Wheeler, 179 U.S. 141, 163 (1900); Kaiser Aetna v. United States, 444 U.S. 164, 178–80 (1979)).

101. *Id.* at 1029. "A law or decree with such an effect must, in other words, do no more than duplicate the result that could have been achieved in the courts – by adjacent landowners (or other uniquely affected persons) under the State's law of private nuisance, or by the State under its complementary power to abate nuisances that affect the public generally, or otherwise." *Id.* (citing Bowditch v. Boston, 101 U.S. 16, 18–19 (1880); United States v. Pacific R. Co., 120 U.S. 227, 238–39 (1887)); *see also* Guimont, *supra* note 5, at 291.

relevant background principles would dictate, compensation must be paid to sustain it."[102]

4. Exactions

The Court's Takings jurisprudence additionally includes an "important protection against the misuse of the power of land-use regulation."[103] In its cases, the Court has "held that a unit of government may not condition the approval of a land-use permit on the owner's relinquishment of a portion of his property unless there is a 'nexus' and 'rough proportionality' between the government's demand and the effects of the proposed land use."[104] The Court, in *Nollan v. California Coastal Commission*, wrote that a "building restriction is not a valid regulation of land use, [rather] 'an out-and-out plan of extortion.'"[105] The Court's jurisprudence of such "extortions" has ranged from a demand for an easement allowing the public to see the ocean, in exchange for a building permit;[106] to a demand for "roughly 10%" of an individual's property, in exchange for permission to double her parking lot;[107] to a demand for monetary or property interests, in exchange for an approval to develop an individual's private land.[108]

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102. *Lucas*, 505 U.S. at 1030. The Court writes that, "[o]f course, the State may elect to rescind its regulation and thereby avoid having to pay compensation for a permanent deprivation. But 'where the [regulation has] already worked a taking of all use of property, no subsequent action by the government can relieve it of the duty to provide compensation for the period during which the taking was effective.'" *Id.* at 1030 n.17 (internal citation omitted) (citing and then quoting First English Evangelical Lutheran Church v. Cnty. of L.A., 482 U.S. 304, 321 (1987)).

103. Koontz v. St. Johns River Water Mgmt. Dist., 570 U.S. 595, 599 (2013) (citing Nollan v. Cal. Coastal Comm'n, 483 U.S. 825 (1987); Dolan v. City of Tigard, 512 U.S. 374 (1994)).

104. *Id.*; *see also* Guimont, *supra* note 5, at 291–92.

105. *Nollan*, 438 U.S. at 837 (quoting J.E.D. Assocs., Inc. v. Atkinson, 432 A.2d 12, 14–15 (1981); citing *Loretto*, 458 U.S. at 439 n.17).

106. *Id.* at 828–29.

107. *Dolan*, 512 U.S. at 379–80.

108. *See Koontz*, 570 U.S. at 601–02, 619.

The two requirements, "essential nexus" and "rough proportionality," ask, respectively, for the public purpose and the reasonable relation between the exaction and the impact.[109] In conducting the "essential nexus" analysis, the Supreme Court has looked to whether a "legitimate state interest" was connected to the conditions the regulating body imposed.[110] If such nexus exists, the Court then must conduct the second analysis, deciding if the degree between the exactions and the impacted project rises to the requisite level.[111]

C. Synopsis

Through the four methods discussed above,[112] regulatory takings can take many forms. Each of these are susceptible claims as violative of the Fifth Amendment, unless protections, preventions, and defenses are outlaid by the regulating body before enactment.[113] In fact, many of the very cases from which the Court expanded its Takings

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109. *See* Robert H. Freilich & David W. Bushek, *Public Improvements and the Nexus Factor: The Takings Equation after* Dolan v. City of Tigard, *in* EXACTIONS, IMPACT FEES AND DEDICATIONS: SHAPING LAND-USE DEVELOPMENT AND FUNDING INFRASTRUCTURE IN THE *DOLAN* ERA 3, 5, 6 (Robert H. Freilich & David W. Bushek eds., 1995).

110. *Nollan*, 483 U.S. at 837; *see also Dolan*, 512 U.S. at 386. "It is clear that 'essential nexus' in this sense [must be] related to a 'public purpose' requirement of reasonable relationship or rough proportionality." Freilich & Bushek, *supra* note 110, at 5 (citing Robert H. Freilich & Stephen P. Chinn, *Finetuning the Taking Equation: Applying it to Development Exactions*, 40 LAND USE L. & ZONING DIG., pt. I, Feb. 1988, at 3, pt. II, Mar. 1988, at 3).

111. *See Dolan*, 512 U.S. at 388. In *Nollan*, the first test was not satisfied, therefore the Court did not address the second test; this was not the case in *Dolan*, where the Court wrote that "[n]o such gimmicks are associated with the permit conditions imposed . . . in this case," unlike the "gimmickry" present in *Nollan*. *Id.* at 387. The *Dolan* Court writes that the term "rough proportionality" "best encapsulates what we hold to be the requirement of the Fifth Amendment. No precise mathematical calculation is required, but the city must make some sort of individualized determination that the required dedication is related both in nature and extent to the impact of the proposed development." *Id.* at 390.

112. *See* discussion *supra* Section III(b).

113. *See* Guimont, *supra* note 5, at 292.

Clause jurisprudence involved some sort of climate change regulation.[114] With this in mind, along with the ever-growing dangers posed by climate change,[115] regulating bodies must attempt to be vigilant in their passing of climate-change-land-use strategies, regulations, and requirements.[116]

D. Past Climate Actions through Takings Claims

Two Supreme Court cases exemplify the discussion herein, regarding climate change actions challenged for their, alleged, Takings Clause impacts.[117] The first, *Palazzolo v. Rhode Island*, decided in 2001, dealt with Petitioner's claim that Rhode Island's protective coastal wetland law was in

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114. *See id.*; *see also, e.g.*, *Koontz*, 570 U.S. at 601 ("Under the Henderson Act, permit applicants are required to provide 'reasonable assurance' that proposed construction on wetlands is 'not contrary to the public interest,' as defined by an enumerated list of criteria.") (citing FLA. STAT. § 373.414(1) (1972)); *Lucas*, 505 U.S. at 1007–08 ("[T]he South Carolina Act required owners of coastal zone land that qualified as a 'critical area' . . . to obtain a permit . . . prior to committing the land to a 'use other than the use the critical area was devoted to" in order to protect against beachfront erosion.) (citing S.C. CODE ANN. § 48-39-10 *et seq.* (1987)).

115. *See* discussion *supra* Section II(a).

116. *See* discussion *infra* Section IV(c) & (d). A tangential topic for this discussion can also be found in the public trust doctrine, while discussion of this doctrine is beyond the scope of this paper, a brief synopsis is included here. Written succinctly, "[T]he public trust doctrine refers to the common-law principle that a state holds, 'in trust for the people,' 'ownership', 'dominion' and 'sovereignty' over tidally flowed lands extending to the mean high water mark." Susko v. Borough of Belmar, 206 A.3d 979, 983 (N.J. Super. Ct. App. Div. 2019) (quoting City of Long Branch v. Liu, 4 A.3d 542, 548 (N.J. 2010)). "[T]he individualized state expansions of the classic public trust doctrine and several states' characterizations of their public trust doctrines as adaptable and evolutionary that give these doctrines as adaptable and evolutionary that give these doctrines their legal power in a world where climate change adaptation is and will become increasingly necessary." Robin K. Craig, *Adapting to Climate Change: The Potential Role of State Common-Law Public Trust Doctrines*, 34 VT. L. REV. 781, 784 (2010). For further discussion of the public trust doctrine and its use for climate change regulations, see *id.*; see also Joseph Regalia, *The Public Trust Doctrine and the Climate Crisis: Panacea or Platitude?*, 11 MICH. J. ENV'T & ADMIN. L. 1 (2021).

117. *See Tahoe-Sierra*, 535 U.S. at 302; Palazzolo v. Rhode Island, 533 U.S. 606 (2001).

violation of the Takings Clause.[118] The Court's analysis therein partially hinged on "the important principle that a landowner may not establish a taking before a land-use authority has [had] the opportunity, using its own reasonable procedures, to decide and explain the reach of a challenged regulation."[119] The *Palazzolo* Court uses a *Lucas*-esque analysis to find that Petitioner's claim, that all economic value was taken from his property due to the regulation, fails as the property retained substantial developmental value.[120]

Palazzolo aids in clarifying "vexing and long-standing issues" of "property owner's expectations when a regulation destroys [the] economically beneficial use of her land, and what criteria courts may consult to gauge whether an owner's expectations are reasonable."[121] The Supreme Court's majority opinion did not thoroughly discuss a *Penn Central* analysis, but Justice O'Connor, in her concurrence, specifically notes that the "character of the governmental action" prong of *Penn Central* specifically looks to "[t]he purposes served, as well as the effects produced, by a particular regulation."[122] In *Tahoe-Sierra*, the Court

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118. *See Palazzolo*, 533 U.S. at 610–12; *see also* J. David Breemer & R.S. Radford, *The (Less?) Murky Doctrine of Investment-Backed Expectations after* Palazzolo*, and the Lower Courts' Disturbing Insistence on Wallowing in the Pre-*Palazzolo *Muck*, 34 SW. UNIV. L. REV. 351, 352–53 (2005).

119. *Palazzolo*, 533 U.S. at 620. This discussion was based mainly on the State Supreme Court's ruling on the "ripeness" of Petitioner's claim, for more discussion involving the ripeness doctrine and its overlap with *Palazzolo*, see *id.* at 618 ("[A] takings claim must be ripe. The Court held that a takings claim challenging the application of land-use regulations is not ripe unless 'the government entity charged with implementing the regulations has reached a final decision regarding the application of the regulations to the property at issue.'" (quoting Williamson Cnty. Reg'l Plan. Comm'n v. Hamilton Bank of Johnson City, 473 U.S. 172, 186 (1985))).

120. *See Palazzolo*, 533 U.S. at 631–32 (citing *Lucas*, 505 U.S. at 1019, 1029; Keystone Bituminous Coal Ass'n v. DeBenedictis, 480 U.S. 470, 497 (1987)).

121. Breemer & Radford, *supra* note 119, at 354 (citing *Palazzolo*, 533 U.S. at 630–32).

122. *Palazzolo*, 533 U.S. at 634 (O'Connor, J., concurring) (citing *Penn Cent. Transp. Co.*, 438 U.S. at 124, 127). "[A] use restriction on real property may constitute a 'taking' if not reasonably necessary to the effectuation of a substantial public purpose, or perhaps if it has an unduly harsh impact on the owner's use of the property." *Penn Cent. Transp. Co.*, 438 U.S. at 127.

analyzed development-moratoria passed by an inter-state agency to protect "the ecologically fragile lake that straddles their common border," Lake Tahoe.[123] The Court examined the land-use regulations, and applied a *Penn Central* analysis to Petitioner's claim, that such regulation effectuated a taking.[124] Notably, the Court emphasizes that this is not a case where the government has appropriated private property for its own use, rather that "the interference with property rights 'arises from some public program adjusting the benefits and burdens of economic life to promote the common good.'"[125] In conclusion, the Court does not hold that such moratoria create a taking, distinctively due to the duration of the restrictions, and the "fairness and justice" if one was found.[126]

Both cases above aid in the discussion to follow, that specific structuring of the government regulations, purporting some climate-protective actions, is critical to the defense against takings claims; thereby safeguarding the regulation from being constitutionally violative.[127]

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123. Gregory M. Stein, *Takings in the 21st Century: Reasonable Investment-Backed Expectations after* Palazzolo *and* Tahoe-Sierra, 69 Tenn. L. Rev. 891, 927 (2002); *see also Tahoe-Sierra*, 535 U.S. at 306–07, 320.

124. *See Tahoe-Sierra*, 535, U.S. at 325–26. "Land-use regulations are ubiquitous and most of them impact property values in some tangential way – often in completely unanticipated ways. Treating them all as *per se* takings would transform government regulation into a luxury few governments could afford. By contrast, physical appropriates are relatively rare, easily identified, and usually represent a greater affront to individual property rights." *Id.* at 324.

125. *See id.* at 324–25 (quoting *Penn Cent. Transp. Co.*, 438 U.S. at 124); *see also* Eastern Enterprises v. Apfel, 524 U.S. 498, 522 (1998). Such indication is representative of climate change regulations, whose purpose is protective action, by the government, for the public good. *See supra* note 123 and accompanying text; *see also* discussion *supra* Section II(a).

126. *See Tahoe-Sierra*, 535 U.S. at 342 (quoting *Palazzolo*, 533 U.S. at 628).

127. *See generally* Lara DuMond Guercio, *Climate Change Adaptation and Coastal Property Rights: A Massachusetts Case Study*, 40 B.C. ENV'T AFFS. L. REV. 349 (2013) (discussing these cases, among others, as representative of climate change challenges due to legal claims against them).

IV. METHODS AND MADNESS

Understanding the *methods* in which courts will evaluate such claims is illustrated in detail below, through additional case examples; the *madness* revolving around Takings jurisprudence can be potentially remedied with specific frameworks when localities create climate-protective regulations – specifically those which implement geo-engineered sciences, the next step in combative-climate-change actions.

A. Regulatory Takings Claims, Climate Change, Jurisprudence

Although regulatory taking claims can be brought in regard to a wide array of technical claims, many have some connection to climate change, as the government action, often, purposes to aid the environment.[128] This consideration is often misconstrued, to wit, the *Penn Central* Court wrote:

> "Taking" jurisprudence does not divide a single parcel into discrete segments and attempt to determine whether rights in a particular segment have been entirely abrogated. In deciding whether a particular government action has effected a taking, this Court focuses rather both on the character of the action and on the nature and extent of the interference with rights in the parcel as a whole.[129]

Regarding this issue in light of environmental protections, in one case, involving a wetland protective regulation,[130] the Massachusetts Supreme Court overruled the lower decision

128. *See supra* notes 114–17 and accompanying text.

129. *Penn Cent. Transp. Co.*, 438 U.S. at 130–31.

130. *Carbon Sequestration in Wetlands*, MINN. BD. WATER & SOIL RES., https://bwsr.state.mn.us/carbon-sequestration-wetlands [https://perma.cc/MB4W-GC3B] ("The U.S. Global Change Research Program estimates that terrestrial wetlands in the continental United States store a total of 13.5 billion metric tons of carbon, much of which is within soils deeper than 30 cm.")

that such restriction amounted to a taking, stating that the important point to "look at, [is] the effect of the restriction on the plaintiff's entire parcel, not just" the wetland portion.[131] Continuing their reasoning, the Massachusetts Court wrote that "[a]s long as 'the restrictions [are] reasonably related to the implementation of a policy . . . expected to produce widespread public benefit and applicable to all similarly situated property,' they need not produce a reciprocal benefit."[132]

Even challenges to specific zoning ordinances, purposed to restrict land development and thereby preserve the environment, have been met with an equal standard.[133] In *Agins v. Tiburon*,[134] the Supreme Court wrote that "[t]he determination that government action constitutes a taking is, in essence, a determination that the public at large, rather than a single owner, must bear the burden of an exercise of state power in the public interest."[135] Therefore, in cases involving similar environmental issues, it is hopeful that, "this balance would always tip in favor of the public interest because the private uses of the [land] should be based on the property in its natural condition, not on the land in [some] altered condition."[136]

Of course, courts evaluate each claim and weigh the facts and their analysis on a case-by-case basis.[137] In *San Diego Gas & Electric Co. v. San Diego*,[138] the Supreme Court reviewed a California Statute which established an open-space plan, to conserve open-space land within its

131. Moskow v. Comm'r of Dep't of Env't Mgmt., 427 N.E.2d 750, 753 (Mass. 1981).

132. *Id.* (quoting *Penn. Cent. Transp. Co.*, 438 U.S. at 134 n.30).

133. *See infra* note 137 and accompanying text; *see also* Carl F. Dierker, *Addressing the Taking Issue in Wetlands Protection*, *in* WETLAND PROT.: STRENGTHENING THE ROLE OF THE STATES 589–90 (1985).

134. 447 U.S. 255 (1980).

135. *Id.* at 260; *see also* Euclid v. Ambler Co., 272 U.S. 365, 395–97 (1926).

136. Dierker, *supra* note 133, at 590–91.

137. *See* Guimont, *supra* note 5, at 293 (citing *Penn Cent. Transp. Co.*, 438 U.S. at 124).

138. 450 U.S. 621 (1981).

jurisdiction.[139] The Court wrote that, when a state court has held that there has been a taking, and the state court must have some further proceedings "to determine the compensation that must be paid," such status "has been regarded as a classic example of a decision not reviewable" by the Supreme Court.[140] This evidences that both litigants must be careful in preparing for their "day in court," as missteps and underly-cautious appeals may result in delays.[141]

B. How a Court Will Evaluate Such Claims

"To date the Supreme Court has established four clear rules that identify situations that amount to a taking and one clear rule that defines situations that do not. The [C]ourt has held that regulations simply intended to prevent or eliminate a nuisance cannot be considered a taking."[142] These four rules are: (1) "where the landowner has been denied 'all economically viable use' of the land;" (2) "where the regulation forced the landowner to allow someone," or something, "else to enter onto the property;" (3) "where the regulation imposes burdens or costs on the landowner that do not bear a 'reasonable relationship' to the impacts of the project on the community; and" (4) "where the government can equally accomplish a valid public purpose through

139. *See id.* at 625.

140. *Id.* at 632–33; *see also* discussion *infra* Section IV(b).

141. *See* discussion *infra* Section IV(b).

142. *APA Policy Guide on Takings*, AM. PLAN. ASS'N (Apr. 11, 1995), https://www.planning.org/policy/guides/adopted/takings.htm [https://perma.cc/R59Z-HHFX]. There "is perhaps no more impenetrable jungle in the entire law than that which surrounds the word 'nuisance.'" WILLIAM L. PROSSER, LAW OF TORTS § 88, 592 (2d ed. 1964). While an in-depth discussion of nuisance is outside the purview of this note, briefly, "[t]he law of 'nuisance' seeks to balance a property owner's right to use his property 'as he chooses in any lawful way' against his duty not to use it in a way that 'injure[s] another.'" Crosstex N. Tex. Pipeline, L.P. v. Gardiner, 505 S.W.3d 580, 590–91 (Tex. 2016) (quoting Gulf, Colo. & Santa Fe Ry. Co. v. Oakes, 58 S.W. 999, 1000 (Tex 1900)). For a further discussion of nuisance law and climate change, see Douglas A. Kysar, *What Climate Change Can Do About Tort Law*, 41 ENV'T L. 1 (2011).

regulation or through a requirement of dedicating property, government should use the less intrusive regulation."[143]

The first step for any court, when hearing a claim regarding alleged regulatory takings, is to ascertain the "type" of taking that is being alleged; what facts are present to show that the taking falls into an identifiable "category."[144] Once that is ascertained, the court will follow whichever analysis is applicable regarding the facts presented in the claim at issue.[145]

Many examples point to hypothesize what geo-engineered regulatory actions may look like in the future.[146] The tricky connection to be made is how such actions may result in potential takings claims.[147] Geo-engineering may have "inequitable effects on" various communities. For example, "stratospheric aerosols injections in the Midwest United States might result in decreased crop outputs in the region. In addition, a weather pattern, ecosystem balance, or wildlife population modified as an effect of geoengineering could yield a disproportionate effect somewhere outside the source area."[148]

1. SAID SO: A Hypothetical

How would such geoengineered effects relate to a takings claim? Following the above example, say a federal regulation is adopted, titled "Stratospheric Aerosol Injector

143. AM. PLAN. ASS'N, *supra* note 142; see *also* discussion *supra* Section III(b).

144. *See* discussion *supra* Section III(b); *see also supra* note 127 and accompanying text; *e.g.*, Guimont, *supra* note 5, at 293 ("If an alleged taking does not involve a categorical taking under *Loretto* or *Lucas* and its facts do not involve exactions, then the case will be evaluated ad hoc under the *Penn Central* factors.").

145. *See* discussion *supra* Section III(b); *see also, e.g.*, Guimont, *supra* note 5, at 293.

146. *See, e.g.*, *What New Yorkers Can Do: Mitigation, Adaptation, and Resilience*, N.Y. DEP'T OF ENV'T CONSERVATION, https://www.dec.ny.gov/energy/43384.html [https://perma.cc/BUN6-82HM].

147. *See Geoengineering: Pats I, II, and III: Hearing Before the H. Comm. on Sci. & Tech.*, 111th Cong. 8 (2010) ("[T]here are currently no regulatory frameworks in place aimed at geoengineering specifically.").

148. *Id.*

Duty and Scientific Obligation," ("SAID SO") which mandates that every 50 acres across the upper Midwest region have some "stratospheric aerosol injector."[149] A farmer in the region, who owns 100 acres, files suit in federal court alleging that SAID SO results in a taking of his land because the regulation imposes a physical occupation, where two stratospheric aerosol injectors will have to be built.[150] The farmer cites *Loretto*, arguing that such "permanent physical occupation authorized by the government is a taking without regard to the public interests it may serve."[151] In response, the government alleges that SAID SO does not convey a *Loretto* taking, instead the regulation is analogous to *Lucas*, as the action is a "conservation measure designed to reduce" climate change consequences, and the physical invasion must be weighed by the "economic deprivation" to the property in question.[152] Accordingly, much of a court's analysis will hinge upon the descried "mitigation [of] 'harm' to the adjacent parcels or secur[ed] 'benefit' for them, depending upon the observer's evaluation of the relative importance of the use that the restraint favors."[153]

Like all takings claims, the brunt of any court's consideration is the balancing between the purposes of the government's regulation with the property owner's right to their free use of their land.[154] And, again like all claims, much of the court's interpretation and analysis will depend on the issues raised by the plaintiff, the facts they use to support their claims, and the resolution they are seeking.[155]

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149. *See id.* While this example may not be scientifically sound, speculation on future sciences is outside the purview of this article, and difficult to do. Regulatory action implementing and mandating some geo-engineered sciences is likely to occur in the future. *See supra* notes 60–65 and accompanying text.

150. *See Loretto*, 458 U.S. at 426; *see also* discussion *supra* Section III(b)(ii).

151. *Loretto*, 458 U.S. at 426.

152. *See* Guimont, *supra* note 5, at 290; *see also* Lucas, 505 U.S. at 1046 (Blackmun, J., dissenting); discussion *supra* Section III(b)(iii).

153. *Lucas*, 505 U.S. at 1025 (majority opinion).

154. *See supra* note 76 and accompanying text.

155. *Compare Lucas*, 505 U.S. at 1009 (not challenging "the validity of the Act as a lawful exercise of South Carolina's police power, but contend[ing] that the Act" destroyed all economic value of his property), *with San Diego*, 450 U.S. at 623

> In the supposed case here, involving the SAID SO Act, a court is likely to inspect the facts presented in the complaint and attempt to distinguish which analysis it should follow to ascertain whether this alleged "taking" is such under the Fifth Amendment; to do so, a court will first look to *Loretto* and *Lucas* to see if the allegations involve "categorical takings;" and then to *Nollan* and *Dolan* to see if such an act involved exactions.[156]
>
> Without a deeper hypothetical case at hand, it is difficult to speculate what facts might be raised and therefore which direction a court would take its analysis; further, a court is likely to review any discussion through *Penn Central*'s leading precedent for regulatory takings.[157] To reiterate the factors considered from *Penn Central*, a court will weigh: "the 1) economic impacts of the government regulation upon the regulated party, 2) reasonable, investment-backed expectations that the property owner had for the regulated property, and 3) character of the government regulation."[158] None of these factors are dispositive on their own, and each will be balanced against the others; often, courts weigh these factors differently, which has drawn extensive criticism.[159]

("Appellant . . . asks this Court to rule that a State must provide a monetary remedy to a landowner whose property allegedly has been 'taken' by a regulatory ordinance.").

156. *See* discussion *supra* Section III(b); *see also* Guimont, *supra* note 5, at 293.

157. *See Penn Cent. Transp. Co.*, 438 U.S. at 124; *see also* Chipchase, *supra* note 90, at 67 ("Penn Central again provides the starting point.").

158. Guimont, *supra* note 5, at 293 (citing *Penn Cent. Transp. Co.*, 438 U.S. at 124).

159. *See id.* "[T]he courts madly misunderstand the Penn Central formulation." Chipchase, *supra* note 90, at 56. *Penn Central*'s "imprecise standard allows the second prong of the inquiry – the measure of the claimant's investment-backed expectations – to turn on the judge's individual opinion as to the worth of the claimant's expectations rather than on an objective evaluation of the evidence produced." *Id.* at 57; *see also id.* at 68–71 (discussing different cases where the Court gave *Penn Central* factors different weight and importance in its analysis). One legal scholar described *Penn Central* as no "more than legal decoration for judicial rulings based on intuition." John D. Echeverria, *Making Sense of* Penn Central, 39 ENV'T L. REP. 10,471, 10,472 (2009). "The reason by which Ptolemy justified his geocentric universe was literally convoluted. 'Over time, the epicycles had constantly to be redrawn to account for new and divergent data, but there was an

Regardless of this, and because the Court has not decreed a different test to be applied, the following discussion will highlight how a court may weigh the *Penn Central* factors in light of climate change and with that acknowledged purpose of the government regulation being complained of.[160]

2. Penn Central v. SAID SO

A reminder, written by the Supreme Court of California regarding the *Penn Central* factors:

> This list is not a comprehensive enumeration of all the factors that might be relevant to a takings claim, and we do not propose a single analytical method for these claims. Rather we simply note factors that the high court has found relevant in particular cases. Thus, instead of applying these factors mechanically, checking them off as it proceeds, a court should apply them as appropriate to the facts of the case it is considering.[161]

With that information, and reminder that these factors are not dispositive, the analysis below posits, potentially, how a court may analyze regulatory takings claims regarding geo-engineered implementations, through *Penn Central*.

a. Economic Impact

The economic impact test "provid[es] a rough measure of harm;" analogizing that a "regulation depriving a property

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enduring belief that the refinements represented a progressive approach to reality.' Likewise, in the 35 years since Penn Central was decided, courts have patched its flaws with increasingly complex tests." Steven J. Eagle, *The Four-Factor* Penn Central *Regulatory Takings Test*, 118 PENN ST. L. REV. 601, 603 (2014) (footnotes omitted) (quoting William A. Edmundson, *The Antinomy of Coherence and Determinacy*, 82 IOWA L. REV. 1, 13 (1996)).

160. *See* discussion *infra* Section IV(b)(ii)

161. Kavanau v. Santa Monica Rent Control Bd., 941 P.2d 851, 860 (Cal. 1997).

> owner of use, exclusion, or transfer rights and a formal condemnation of a property interest is not straightforward, an 'economic impact' test is useful as a course screen for distinguishing many clear-cut takings."[162] Therefore, it follows that the greater the economic impact, the more the regulation seems to be a taking, and vice versa.[163]
>
> The common court approach to analyzing this factor has been to "calculate the difference between the fair market value of the property as burdened by the regulation and the hypothetical value of the property without the regulation."[164] While there is no strict marker or amount which denotes severe enough economic impact, "diminutions well in excess of 85 percent" are typically required to constitute a claim.[165]
>
> In *1902 Atlantic Ltd. v. United States*,[166] the United States Claims Court evaluated an alleged temporary taking after the United States Army Corps of Engineers denied plaintiffs a permit to use land near wetlands.[167] In its evaluation, the Claims Court found that the economic impact "represent[ed] about an 88% reduction from the purchase price."[168] And yet, no regulatory taking was found, specifically, as the Claims Court analyzed the other factors and found that the "Corps must consider 'all factors which may be relevant' . . . including 'conversation, economics, aesthetics, general

162. Eagle, *supra* note 159, at 618.

163. *See* Guimont, *supra* note 5, at 294 ("If there is no economic impact, or if the economic impact is slight, then the alleged regulatory taking can be distinguished from the Takings Clause's doctrinal origins and likely defeated on those grounds.").

164. *Id.*; *see also* Eagle, *supra* note 159, at 618 ("Since 'economic impact' is also measured with respect to the relevant parcel, these concepts are inextricable intertwined in important questions, such as the extent to which losses regarding temporary investments constitute takings.").

165. *See* Walcek v. United States, 49 Fed. Cl. 248, 271 (2001) (collecting cases and amounts of diminution).

166. 26 Cl. Ct. 575 (1992).

167. *See id.* at 576–78.

168. *Id.* at 579.

environmental concerns, historic values . . . and, in general, the needs and welfare of the people.'"[169]

Therefore, two ideations are promoted from the above discussion. First, the plaintiff must show substantial impact to the economic "value" of their property, as effected by the regulation.[170] While this, like the factors themselves, are not dispositive, greater showing equates to greater likelihood that a taking will be found.[171] Second, even high economic impact can be mitigated through strong factual evidence that the impact results from service to the "welfare of the people," and "general environmental concerns."[172]

b. Investment-Backed Expectations

"[A] state statute that substantially furthers important public policies may so frustrate distinct investment-backed expectations as to amount to a 'taking.'"[173] While economic impact and the inquiry of investment-backed expectations may spark the same idea in the minds of a neophyte reader, investment-backed expectations concern "fairness and reliance;" requiring a claimant to demonstrate that their "'expectations' . . . are both subjective held and objectively reasonable."[174]

169. *Id.* at 580 (quoting 33 C.F.R. § 320.4); *see also* discussion *infra* Section IV(b)(ii)(3).

170. *See supra* notes 164–65 and accompanying text.

171. *See supra* note 163 and accompanying text.

172. *See 1902 Atlantic Ltd.*, 26 Cl. Ct. at 580; *see also supra* notes 150–53 and accompanying text.

173. *Penn Cent. Transp. Co.*, 438 U.S. at 128 (citing *Mahon*, 260 U.S. at 393).

174. Eagle, *supra* note 159, at 620. In *Agins*, the Court wrote that, because appellants were able to build some, but not all, of the houses they wished to, they were "free to pursue their reasonable investment expectations" therefore "it cannot be said that the impact of general land-use regulations has denied appellants the 'justice and fairness' guaranteed by the Fifth and Fourteenth Amendments." *Agins*, 447 U.S. at 262–63 (citing *Penn Cent. Transp. Co.*, 438 U.S. at 124).

In *Commonwealth Edison Co. v. United States*,[175] the Federal Circuit Court of Appeals used three factors to determine if a party's expectations were reasonable.[176]

First, was the company operating in a highly regulated industry? Second, did the company know of the problem at the time it engaged in the activity? Third, in the light of the regulatory environment at the time of the activities, could the possibility of the assessments have been reasonably anticipated?[177]

If all of these factors are met, it is likely that a court will find that the claimant did not have reasonable investment-backed expectations.[178]

While speculation on these claims is difficult, taking the above factors into consideration, it is highly likely that all would be met. Take, for instance, the above SAID SO hypothetical;[179] farming operates in a highly regulated industry, with government oversight at the federal and state level.[180] In terms of climate change, undoubtably the claimant would know of the problem facing them, and likely also know of government regulations behind mitigation and/or adaptation, far before engagement in any activity.[181] Finally, reasonable anticipation of such regulations in the face of growing climate worries is likely to be found, especially as more governmental research, international agreements, and news reports come forth to warn the public of such dangers.[182]

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175. 271 F.3d 1327 (Fed. Cr. 2001).

176. *Id.* at 1348; *see also* Guimont, *supra* note 5, at 294–95.

177. *Commonwealth Edison Co.*, 271 F.3d at 1348.

178. *See* Guimont, *supra* note 5, at 295.

179. *See* discussion *supra* Section IV(b)(i).

180. *See, e.g.*, *About USDA OIG: What we do*, U.S. DEP'T AGRIC., OFF. INSPECTOR GEN., https://usdaoig.oversight.gov/about/ig [https://perma.cc/U5K4-FB6D].

181. *See* discussion *supra* Section II(b).

182. *See, e.g.*, Scott Neuman, *Airline Passengers Could be in for a Rougher Ride, Thanks to Climate Change*, NPR (Apr. 6, 2023), https://www.npr.org/2023/04/06/1166993992/turbulence-climate-change [https://perma.cc/TCS8-ZUQ6].

c. Character of the Government's Action

When the nature of the government's action "is to promote a substantial public benefit as a valid exercise of the state's police powers or to abate a nuisance, a taking is less likely to be found."[183] Therefore, the bigger the public benefit, the more likely a court is to not find a taking; when the regulation also benefits the property it is burdening, as part of the public, the "reciprocal characteristic to the regulation does not favor a taking."[184]

If the character of the regulation "targets a specific property," "further[s] the government's own commercial interests," or contains "a series of ostensibly separate regulatory actions [which] impose[] foreseeable harm on specific property for the single purpose of benefitting other specific property" a court is far more likely to find a taking than if the regulation purports to benefit the public as a whole.[185]

It is undeniable that regulations effectuating climate change responses will have benefits to the entire public.[186] While specific geo-engineered responses may appear to target specific property, there is only a soupcon of science which may be used to suggest any such targeting; rather, it is more likely that geo-engineered responses would cover vast areas, applied to a region on the whole in the unbiased practice of science.[187]

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183. Guimont, *supra* note 5, at 295. "A 'taking' may more readily be found when the interference with property can be characterized as a physical invasion by government, than when interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good." *Penn Cent. Transp. Co.*, 438 U.S. at 124 (internal citation omitted) (citing United States v. Causby, 328 U.S. 256 (1946) (as an example of a physical invasion where flights over claimant's land destroyed the use of it)).

184. *See id.*; *see also* Echeverria, *supra* note 159, at 10,473.

185. Eagle, *supra* note 159, at 621–22.

186. Whether these regulations do in fact create any substantial change in climate change, with geo-engineered responses or other mitigation/adaptation techniques is beyond the purview of this article. *See* discussion *supra* Section II(b)(iii).

187. *See supra* notes 59–69, 146–48 and accompanying text.

3. SAID SO through other Regulatory Takings

Although the ad hoc application and analysis of takings jurisprudence depends on the facts and case presented, it is prudent to postulate how other regulatory taking designs might affect geo-engineered regulations.[188]

Exactions[189] may be the quickest to resolve, as claims must posit specific factual scenarios and typically only involving an individual landowner, rather than the public.[190] Because exactions require government officials to force or demand individuals to do something in exchange for property rights, scenarios are limited where the regulations implementing geo-engineering carry such disposition. That being said, if such exaction does take place, the exaction must "1) bear an essential nexus to the anticipated externalities of the development project and 2) be roughly proportional to the cost of those anticipated externalities."[191] Therefore, even if exaction claims are brought, the government can mitigate such action through careful tailoring of demands for actions and mitigation of heavy costs which may shift the burden unconstitutionally against the property owner.[192]

Both *Loretto* and *Lucas* style takings give governments the ability to avoid takings claims being brought against them.[193] A court will look to impose the "hard lines" created by these cases, either, respectively, where there is a permanent, physical invasion, or where the regulation deprives the property of all economically beneficial uses.[194] If the facts of the case do not represent clear, distinct showings of such events transpiring, a court is unlikely to resolve a clear-cut taking, preferring instead to rely on *Penn*

188. *See* discussion *supra* Section III(b)(ii–iv).

189. *See supra* notes 104–12 and accompanying text.

190. *See* Guimont, *supra* note 5, at 304 (citing Daniel S. Huffenus, Dolan *Meets* Nollan*; Towards a Workable Takings Test for Development Exactions Cases*, 4 N.Y.U. ENV'T L.J. 30, 33 (1995)).

191. *Id.*

192. *See id.* at 304–05; *see also* Huffenus, *supra* note 190, at 53.

193. *See* discussion *infra* Section IV(c).

194. *See* discussion *supra* Section III(b)(ii–iii).

Central's factors; regardless, governments should attempt to avoid such clear delineations due to the dangers associated with direct, *per se* takings.[195]

C. Government Preventing Such Claims

Local, state, or federal governments can construct ways where their regulations avoid more direct conflicts with property ownership rights, thereby avoiding immediate takings claims.[196] This can be done myriad ways, and the most effective would be an incorporation of multiples of these tactics, thereby insulating the regulation to the highest degree.[197]

Government regulations "should reflect and explicitly refer to the comprehensive plan's articulations of the local government's climate change goals."[198] Such a reflection should further be founded upon a plethora of recorded factual findings, and government officials should attempt to allow for as much public participation and publication as possible; thereby creating an effectual notice for landowners, guarding against due process claims.[199]

Further, as discussed above, climate change itself effectuates a certain reasonable notice for property owners, enough that

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195. *Compare* discussion *supra* Section IV(b)(ii), *with* discussion *infra* Section IV(c); *see also* Guimont, *supra* note 5, at 297–98.

196. *See* Guimont, *supra* note 5, at 296.

197. *See id.* "A local government can build different measures into its comprehensive planning, zoning, and building codes to reduce the risk of a regulatory takings claim under *Penn Central* and support defenses to such a claim." *Id.*

198. *Id.* at 296–97.

199. *See id.* at 297; *see also* AM. PLAN. ASS'N, *supra* note 142 ("Regulations affecting the use and development of land should be adopted only after a review process offering the opportunity for significant participation by affected governmental entities and persons, including property owners."). "Economic analyses of regulations conducted in the context of the comprehensive planning process (or in other context) should recognize the economic benefits of the regulations to other property owners and the community at large, as well as any economic burden to a particular property owner(s)." AM. PLAN. ASS'N, *supra* note 142.

reasonable investment-backed expectations should not be overly broad, depending on the property at issue.[200]

There is also a question as to whether a landowner can truly have reasonable investment-backed expectations for a piece of property that will be drowned by rising sea levels, washed away by a super hurricane, have its water source dry up, or be burned to the ground in a climate-change-fueled wildfire. Depending on the property in question, it is likely these climate-change-caused conditions will be predictable or even expected.[201]

Due to this, the government's role will be to "proactively and systematically" inform landowners that such expectations must be attenuated to the reality of our future.[202]

In attempting to avoid *Loretto* and *Lucas* style takings,[203] there are few tools in the government's belt for which to mitigate a *per se* ruling against them.[204] Because *Loretto* applies when government action causes a permanent, physical invasion, even when the invasion is minimal, government officials may find it more effective to compensate landowners when such amount is equally minimal before litigation ensues.[205] If possible, the other alternative, especially if the invasion is greater than easily compensable, is to limit the amount of time from which the government will implement their invasion; thereby avoiding the *per se*, categorical rule under *Loretto*.[206]

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200. *See* Guimont, *supra* note 5, at 297.

201. *Id.*

202. *See id.*; *see also, e.g.*, Just v. Marinette Cnty., 201 N.W.2d 761, 767–68 (Wis. 1972) ("In the instant case we have a restriction on the use of a citizens' property, not to secure a benefit for the public, but to prevent a harm from the change in the natural character of the citizens' property.").

203. *See supra* notes 193–95 and accompanying text.

204. *See* Guimont, *supra* note 5, at 297–98.

205. *See Loretto*, 458 U.S. at 423–26; *see also* Guimont, *supra* note 5, at 298.

206. *See Loretto*, 458 U.S. at 424; *see also* Guimont, *supra* note 5, at 298. While doing so will "evade a categorical taking" applied by *Loretto*, the government will not insulate themselves completely from a partial taking and claims arising from *Penn Central*, although mitigation thereof can also be found. *See* Guimont, *supra* note 5, at 298; *see also* discussion *supra* Section IV(b)(ii).

Lucas applies when the regulation deprives private property of all of its economically beneficial uses, therefore requiring compensation.[207] A paramount way to avoid *Lucas* claims is to, prior to adopting regulation, conduct an in-depth economic report of the consequences of the regulation, compared with financial reports from the projected-affected property owners.[208] Further ways to avoid such litigation is to grant variances, or other flexible land-use devices to allow the property owner to maintain some economic use of the land, therefore not entirely depriving the property of benefit.[209] Because *Lucas* carries with it a specific exception: that, "[i]f the challenged land use regulation is not 'newly legislated or decreed' and does nothing more than duplicate 'the restrictions that background principles of the State's law of property and nuisance already place upon land ownership,' then the regulation does not amount to a taking."[210] Therefore, while complicated and controverted, if the government can pose their regulation in a "background principle," it can systematically avoid such litigation.[211]

Lastly, exactions can be mitigated, as discussed above,[212] by "carefully tailor[ing] exactions on a case-by-case basis, pursuant to findings 'based on evidence in the record regarding the specific type and magnitude of the anticipated externality that would justify denial of the requested permit.'"[213] This evidence should be sourced to scientific studies, surveys, and actual site determinations; attempting to explicitly show that the exactions satisfy both elements of

207. *See Lucas*, 505 U.S. at 1019; *see also* Guimont, *supra* note 5, at 298; *supra* notes 177–79 and accompanying text.

208. *See* Guimont, *supra* note 5, at 298–99.

209. *See id.* at 299; *see also* AM. PLAN. ASS'N, *supra* note 142 (laying out a deeper discussion of variances and other tools, along with resources for further understanding of those topics).

210. Guimont, *supra* note 5, at 299 (quoting *Lucas*, 505 U.S. at 1029).

211. For further discussion of "Utiliz[ing] Lucas' Background Principles Exception" see Guimont, *supra* note 5, at 299–300; *see also Palazzolo*, 533 U.S. at 616, 626.

212. *See supra* notes 189–92 and accompanying text.

213. Guimont, *supra* note 5, at 304 (quoting Huffenus, *supra* note 190, at 53).

the test.[214] This is another reason for in-depth analysis, both scientifically and financially, prior to adoption of any regulations.

D. Government Defending Against Such Claims

Implementing the avoidance techniques enumerated above gives governances the best chance to not only keep litigation away, but also to build defenses in case litigation is brought anyway.[215] The paramount idea which governances hold forth in their minds prior to adopting any statutes is that, although these local governments "are well-equipped to create meaningful climate change mitigation and resilience" through regulations, "the specter of regulatory takings claims looms over" their heads.[216] Therefore, regulations should be constructed with this purpose, and should carry the weight of protecting the public from consequences which would be more dire had there not been such protection.[217]

When such purpose is at the forefront of the regulator's agenda, and when such purpose is conveyed clearly, through public messages, explicit statements, and direct communication, the regulation is stronger and the analysis easier when weighting public safety against private uses, among other aspects.[218] As this is the basis of any court's Fifth Amendment analysis – pitting the government's purpose against private property rights – the ability for the government to tip the scales in their favor works to defend against claims and potentially win them, once brought.[219]

214. *See* AM. PLANNING ASS'N, *supra* note 142.
215. *See* discussion *supra* Section IV(c).
216. Guimont, *supra* note 5, at 305.
217. *See supra* notes 26–32 and accompanying text.
218. *See* Guimont, *supra* note 5, at 301–05.
219. *See id.* at 304; *see also supra* notes 9–11, 13–16 and accompanying text.

V. CONCLUSION

In conclusion, as evidenced in the above argument,[220] the challenges which Federal, State, and local regulations or attempted land use plans will likely face when pushing for climate change strategies all fall under the Court's Takings Clause jurisprudence.[221] Such jurisprudence will need to encapsulate these strategies in a more direct, and rigorous way, giving more weight to the societal need of them; thereby, tipping the scale of balance in favor of government regulation, rather than the protection afforded to private property ownership.[222]

While geo-engineered sciences are far from perfected, the push to incorporate them, more readily and consistently, has already started; the next step will likely be through governmental shifts and regulations implementing their use at a higher degree.[223] When such implementation clashes with private property rights, the incorporating government leaves itself vulnerable to takings claims, and therefore the structure and writing of the regulation must be done with precision in order to avoid such claims.[224] This is critical in making sure that these regulations last and thus the implementation of the geo-engineered sciences can last and have its desired effect, of mitigating or allowing for an adaptation of climate-change.[225]

"[W]e are the first generation to feel the impact of climate change and the last generation that can do something about it."[226] Geo-engineering sciences and methods provide opportunities for protection, mitigation, and adaptation of

220. *See* discussion *supra* Section IV.

221. *See* discussion *supra* Section III.

222. *See* CRIBBET ET AL., *supra* note 74; *see also* discussion *supra* Section II(c).

223. *See* discussion *supra* Section II(b)(iii).

224. *See* discussion *supra* Section IV(c).

225. *See* discussion *supra* Section II.

226. Barack Obama, President, United States, Remarks by the President at the U.N. Climate Change Summit (Sept. 23, 2014), *in* OFF. PRESS SEC'Y, Sept. 2014 (available at https://obamawhitehouse.archives.gov/the-press-office/2014/09/23/remarks-president-un-climate-change-summit [https://perma.cc/5EUW-T7TQ]).

climate change consequences; by implementing these sciences through government regulations, the needs of the public must outweigh the needs of private ownership; structured regulations to avoid and defend against takings claims are a crucial step in this process and in preventing further consequences from climate change.[227]

227. *See* discussion *supra* Sections II & IV.