WITHOUT A GRAIN OF SALT: EVALUATING INTERNATIONAL PERMITTING SCHEMES IN LIGHT OF INDUSTRIAL-GRADE DESALINATION

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I. Introduction

"When the well's dry, we know the Worth of Water"[1]

—Benjamin Franklin

Sadly, Mr. Franklin's assertion is true. Potable water availability has diminished due to climate fluctuation, population growth,[2] human activities, and agricultural use.[3] Decreasing potable water sources under a classic supply-and-demand scheme will subsequently increase the cost of available potable water. For example, a two-degree average global temperature rise will likely cost between $13.7 and $19.2 billion for water supplies and flood management.[4] This cost will only increase—in the last century alone, global water use grew at more than twice the rate of the global population,[5] suggesting that per capita use is increasing as well.

Economic impact is not the only concern. The Secretary General of the United Nations warned that "[o]ur experiences tell us that environmental stress, due to lack of water, may lead to conflict and would be greater in poor nations . . . ."[6] More than 1.4 billion people live in river basins where water use exceeds minimum recharge levels, leading to desiccation of rivers and depletion of groundwater.[7]

To battle the fear that potable water will "run out,"[8] countries have developed different techniques to increase available supplies of fresh water.[9] Such techniques include water conservation programs,

1. Benjamin Franklin, Old Poor Richard's Almanack (1746); The Oxford Dictionary of American Quotations 688 (Hugh Rawson & Margaret Miner eds., 2d ed 2006).

2. Future per capita water availability may be more a function of population fluctuation than climate change. Today's population might experience water stress by the end of the century, including areas that have adequate freshwater supplies. Esther S. Parish et al., *Estimating Future Global Per Capita Water Availability Based on Changes in Climate and Pollution*, 42 Computers & Geosciences 79, 84-85 (2012).

3. 1 The United Nations Educ., Scientific, & Cultural Org., The United Nations World Water Development Report—Managing Water Under Uncertainty and Risk, 24-25 (2012) [hereinafter Water Development Report].

4. This estimation is under-representative, as it fails to account for other uses of water, such as food, energy, and health-related consumption. *See id.* at 30.

5. 38 Food & Agric. Org. of the United Nations, Coping with Water Scarcity 11 (2012).

6. Ban Ki-moon discussed the impending problem of water scarcity for a growing population. *See* Andrew Martin, *Can Israel Find the Water It Needs?*, N.Y. Times, Aug. 10, 2008, at BU7.

7. The United Nations Development Programme, Human Development Report 2006—Beyond Scarcity: Power, Poverty and the Global Water Crisis, at vi (2006).

8. Water Development Report, *supra* note 3, at 2.

9. *See* Aaron Schwabach, *Using International Law to Prevent Environmental Harm from Increased Use of Desalination*, 34 Tex. Int'l L. J. 187, 188 (1999).

water reclamation, wastewater purification, developing drought-tolerant crops, and utilizing water transfers from unpopulated regions.[10] But fully utilizing existing freshwater resources will likely not meet the increasing demand from population growth and per capita use.[11] At this coming tipping point, those nations that cannot economically utilize traditionally-acquired or recycled water will turn their attention to the 97.3% of earth's water that exists in the ocean.[12]

This vast volume of seawater may provide potable water from a process called "desalination."[13] As the word suggests, "desalination" removes salt from seawater.[14] While not historically new,[15] Part II of this article explains why nations are increasingly using desalination at industrial scales. While interest in obtaining desalted water is rising in regions where water supply is limited by political and arid conditions, interest from less arid countries (e.g., the United States) is rising as well.[16]

Nevertheless, implementing industrial-grade desalination does not come without concern. Part III describes these underlying concerns in detail. Reliance on traditional energy sources causes desalted water to be more expensive to produce than traditional freshwater supplies,[17] and regulatory and oversight problems prove to be significant sources of concern as the relatively new process poses serious environmental threats.[18] These include greenhouse gas emissions caused by energy consumption, saline waste byproducts, and negative effects on marine ecosystems from consuming and processing seawater.[19]

As many nations share river basins and coastlines, these environmental concerns reach transnational magnitudes.[20] For example, in-

10. *Id.*

11. *Id.* at 189.

12. *Id.*

13. *See* HEATHER COOLEY ET AL., DESALINATION, WITH A GRAIN OF SALT: A CALIFORNIA PERSPECTIVE 1 (Ian Hart ed., 2006) [hereinafter CALIFORNIA PERSPECTIVE].

14. *Id.* at 10 box 1.

15. *See, e.g.*, Rhett B. Larson, *Innovation and International Commons: The Case of Desalination Under International Law*, 2012 UTAH L. REV. 759, 759-60.

16. NICOLE T. CARTER, CONG. RESEARCH SERV., R40477, DESALINATION AND MEMBRANE TECHNOLOGIES: FEDERAL RESEARCH AND ADOPTION ISSUES 6 (2015).

17. *Id.*

18. *Id.* at 9.

19. *See, e.g.*, Angela Haren Kelley, *Seawater Desalination: Climate Change Adaptation Strategy or Contributor?*, 38 ECOLOGY L. CURRENTS 40, 44-45 (2011).

20. An "international watercourse" is defined to include both "surface water and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus[,]" parts of which are situated in other states. Salman M.A. Salman,

ternational disputes have emerged over use of the Colorado River,[21] the Mekong River,[22] and the Jordan River.[23] Desalination has become a key issue in regional "hydropolitics" and "hydrodiplomacy,"[24] and is addressed expressly in legal instruments governing some of the most contested international basins. And yet, while nations do not use industrial-grade desalination uniformly, no broad-ranging regulatory scheme exists to address potential disputes.

To address the lack of international regulation underlying industrial desalination, scholars have proposed various governing schemes. After briefly introducing them, Part IV argues why these governing schemes fail to properly address innovative technologies like desalination. One such scheme called the "rights-based scheme" uses principles from international water and environmental law to allow desalination implementation only when the use is reasonable, and only when a nation cooperates with its neighbors to avoid harm to their ecosystems.[25] Neighboring countries under this scheme would have a right to file suit for failed cooperation or damage to their ecosystem.[26] Dissatisfied with the litigious nature of the rights-based scheme, the other scheme called the "district scheme" creates international water districts or commissions to regulate and manage water development within each member nation's jurisdiction.[27]

Both governing schemes, however, fail to provide the flexibility required for regulating and encouraging desalination—a relatively new and sensitive market. The rights-based scheme forces nations to litigate disagreements, causing cost internalization and a subsequent fear of liability, leading many to cease large-scale implementation.[28] Nations also claim different hierarchies of the rights and duties under

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The United Nations Watercourses Convention Ten Years Later: Why Has Its Entry into Force Proven Difficult?, 32 WATER INT'L 1, 5 (2007).

21. Larson, *supra* note 15, at 767-68.

22. *Id.* at 772-73.

23. *Id.* at 770-71.

24. *See* Arun P. Elhance, *Hydropolitics: Grounds for Despair, Reasons for Hope*, 5 INT'L NEGOTIATION 201, 201-03 (2000); Aaron T. Wolf, *Shared Waters: Conflict and Cooperation*, 32 ANN. REV. ENV'T & RES. 241, 269 (2007). Due to the scarcity and necessity of potable water, "hydropolitics" and "hydrodiplomacy" are conceptually concerned with state and non-state entities that conflict and cooperate in international river basins to deal with the global population's welfare. *See* Anthony Turton, *Hydropolitics: The Concept and Its Limitations*, *in* HYDROPOLITICS IN THE DEVELOPING WORLD: A SOUTHERN AFRICAN PERSPECTIVE 13, 15-16 (Anthony Turton & Roland Henwood, eds.).

25. Larson, *supra* note 15, at 778; Salman, *supra* note 20, at 4-7.

26. Larson, *supra* note 15, at 780; Salman, *supra* note 20, at 5-7.

27. Larson, *supra* note 15, at 802.

28. *Id.* at 780-81.

the rights-based scheme, creating confusion to the scheme's functioning.[29] As for the district scheme, history has demonstrated its impracticability. Districts or commissions normally require unanimous votes, making difficult decisions on managing water close to impossible.[30] As such, neither scheme is the best approach to an inter-jurisdictional environmental standard for desalination.

To better address regulating new technologies like desalination in a global market, Part V argues for nations to incorporate tradable permit schemes. These schemes are newly-developed instruments for addressing global climate change throughout the industrialized world.[31] This paper argues for one type of tradable permit scheme—the cap-and-trade system oft discussed by modern environmentalists and policymakers. Cap-and-trade constrains aggregate emissions of regulated sources by creating a limited number of tradable emission allowances each source must secure and surrender in equal number to their emissions.[32] This encourages the sources to reduce emissions at the cheapest price, thereby increasing flexibility to local conditions.[33] Although incorporating cap-and-trade for desalination is novel, it is not far-fetched.[34]

Once nations form individualized and regional cap-and-trade schemes, an overarching international desalination agreement may come from "linking" each individual scheme. This "linkage" occurs when one country's regulatory authority allows its regulated sources to use emission allowances or reduction credits from another country's regulated entities to meet its compliance obligations.[35] By broadening the market for allowances and credits, the available market becomes more liquid, effectively reducing price volatility and lessening market power concerns.[36] This kind of regulatory scheme incentivizes nations to develop desalination technology with the correct

29. Salman, *supra* note 20, at 8-9.

30. James L. Huffman, *Comprehensive River Basin Management: The Limits of Collaborative, Stakeholder-Based, Water Governance*, 49 NAT. RESOURCES J. 117, 142 (2009).

31. Judson Jaffe et al., *Linking Tradable Permit Systems: A Key Element of Emerging International Climate Policy Architecture*, 36 ECOLOGY L.Q. 789, 789 (2009) [hereinafter *Linking Tradable Permit Systems*].

32. *Id.* at 791.

33. *Id.* at 792.

34. One of the largest concerns of industrial-grade desalination is its potential for greenhouse gas emissions. As tradable permitting schemes are used to decrease these emissions, introducing such schemes to limit greenhouse gas emissions could serve as a fluid intermediary to limit other emissions like chemical waste and saline waste concentrate.

35. *Linking Tradable Permit Systems*, *supra* note 31, at 791.

36. Market liquidity refers to the requisite market depth that enables individuals to engage in intercourse without adversely affecting prices. Price volatility measures the degree to which

environmental constraints and creates the flexibility required to compete with more traditional water sources.

II. Technological Ingenuity Increases Industrial Desalination

The technology underlying the desalination process is not new: Travelers on the high seas used a simple flame and container to boil salt water and catch pure water vapor to condense into fresh water.[37] While history has witnessed its use on a micro-scale, only some nations have incorporated desalination on a large scale.[38] This inconsistency is mainly attributable to the current technology's high production cost. Nonetheless, innovative technologies have begun to lower its production costs so that it may be better positioned to compete with those acquiring water through more traditional sources. This technology may be the future of producing potable water to the masses.

Naturally, nations with a more pressing need for freshwater have been more willing to incorporate desalination.[39] After suffering years of drought conditions, Israel began implementing desalination to provide freshwater for agricultural and consumptive use.[40] Australia, also suffering some of the worst droughts in its recorded history,[41] has turned to the Perth Seawater Desalination Plant to produce up to thirty-eight million gallons of water per day.[42] China is heavily investing in desalination because a staggering 400 of its cities, with coastal areas suffering the harshest conditions, face water scarcity.[43]

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prices fluctuate over time. Market power refers to the ability of large buyers and sellers to influence market prices though actions in that market. *Id.* at 800 n.50.

37. *See* California Perspective, *supra* note 13, at 11.

38. *Id.* at 11-12, 19.

39. *See* Martin, *supra* note 6.

40. *See id.* Desalination currently provides about 40% of the Israel's total water needs; that number will hit 80% once its new Sorek Desalination Plant—capable of producing seven million gallons of potable water for Israelis every hour—operates at full capacity. Ben Sales, *Water Surplus in Israel? With Desalination, Once Unthinkable Is Possible*, Jewish Telegraphic Agency (May 28, 2013, 3:46 PM), http://www.jta.org/2013/05/28/news-opinion/israel-middle-east/water-surplus-in-israel-with-desalination-once-unthinkable-is-possible.

41. Seth Mydans, *THE CLIMATE DIVIDE: AUSTRALIA; Prone to Drought, but Moving Ahead on Desalination*, N.Y. Times, Apr. 3, 2007, at F4.

42. *Id.*

43. Two national government-led entities hold responsibility for desalination research and project development; they have completed or begun fifty-seven desalination projects. Of these, the largest operating project in China—the Tianjin Seawater Desalination plant for Beijing Power Plant—produces about fifty three million gallons per day. *See* Jennie Peng, *Market Report: Developing Desalination in China*, WaterWorld, http://www.waterworld.com/articles/2011/01/ market-report-developing-desalination.html (last visited Feb. 15, 2015).

Even nations with greater access to traditional freshwater sources have implemented industrial-grade desalination. Although the United States has viewed desalination inconsistently,[44] the 112th Congress recently extended the Water Desalination Act, authorizing appropriations for the main desalination research program of the Department of the Interior.[45]

A number of methods exist for removing salt from seawater. The two most predominant processes are thermal distillation and reverse osmosis.[46] Thermal distillation heats seawater to separate out dissolved minerals so purified vapor can be condensed into potable water.[47] Heat—the main component for this process—requires large amounts of energy, making it less feasible economically than reverse osmosis,[48] a process that pushes seawater through a permeable membrane to remove minerals and produce fresh water.[49] While this process requires less energy than distillation, its membranes are prone to accumulating material deposits that reduces its performance over time, effectively increasing energy demands on the whole system.[50] As these processes rely heavily on the energy market, and while the forecasted rate of converting seawater normally exceeds traditional

44. In the 1960s, then-Senator John F. Kennedy supported the idea of large-scale commercial desalination. Shortly thereafter the Saline Water Conversion Act of 1971 created the Office of Water Research and Technology. *See* The Saline Water Conversion Act of 1971, Pub. L. No. 92-60, 85 Stat. 159 (1971). Nevertheless, President Reagan cut federal funding for nonmilitary desalination research in 1980. CALIFORNIA PERSPECTIVE, *supra* note 13, at 12.

I must confess: This article's motivation stems from concerns closer to home. Shortly after moving to California, I noticed the state's water quandary. A brief inquiry only stoked my curiosity. NASA's recent study, presented at the American Geophysical Union December 16, 2014, was shocking: Eleven trillion gallons of water were a calculated requirement to recover from the state's continuing drought. Press Release, NASA Analysis: 11 Trillion Gallons to Replenish California Drought Losses (Dec. 16, 2014), http://www.nasa.gov/press/2014/december/nasa-analysis-11-trillion-gallons-to-replenish-california-drought-losses/#.VOpZZMnK9Vc. But the more sobering finding was that California's largest river basins are decreasing at a faster on average rate than residential and municipal use alone. *Id.*

45. CARTER, *supra* note 16, at 2.

46. In the United States, close to 70% of desalination plants use reverse osmosis technology. *Id.* at 1; Angela Haren Kelley, Comment, *A Call for Consistency: Open Seawater Intakes, Desalination, and the California Water Code*, 4 GOLDEN GATE U. ENVTL. L.J. 277, 281 (2011).

47. CARTER, *supra* note 16, at 13; CALIFORNIA PERSPECTIVE, *supra* note 13, at 16.

48. *See* CARTER, *supra* note 16, at 1, 7.

49. *Id.* at 7.

50. *Id.* Energy costs for both processes represent more than one-third of the cost of freshwater produced by desalination. *See* Michael Pappas, *Unnatural Resource Law: Situating Desalination in Coastal Resource and Water Law Doctrines*, 86 TULANE L. REV. 81, 86 (2011). Reverse osmosis uses 44% of its cost for energy, and distillation uses up to 60% of its cost for energy. *Id.* at 86 n.14.

water transfers, desalination's reliance on this volatile market is a major concern for nations seeking to industrialize desalination.

However, by incorporating new technologies to conserve energy and promote efficiency, desalination may soon be economically superior to more traditional water sources. Engineering developments and renewable energy project coupling have decreased reliance on traditional forms of energy.[51] Utilizing such techniques to augment traditional energy sources already exists at international levels: Australia uses wind farms to power its desalination plants,[52] and small-scale initiatives in Saudi Arabia and Oman focus on coupling renewable energy with conventional desalination plants.[53] The United States' National Research Council also recommended that desalination facilities be coupled with renewable energy.[54]

Lowering desalted water prices to rates comparable to traditional sources will lead to greater implementation. Although the perceived future of industrial-scale desalination has been hazy, nations view this process as a potentially feasible means to combat the increasing thirst of its populace. Once economically stable and competitive, the ocean's the limit for international industrial-grade desalination, posing both beneficial and detrimental effects—nations will produce increasing volumes of potable water at the expense of environmental harm. And while beginning to implement such innovative technologies to meet a basic human need, nations must be willing to address the process's wide-ranging environmental effects.

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51. Advances in membrane technology has produced nanocomposite membranes that have the potential to reduce energy use within the reverse osmosis process by 20%; nanotube membranes may yield 30-50% energy savings. CARTER, *supra* note 16, at 13.

52. Mydans, *supra* note 41; Norimitsu Onishi, *Arid Australia Sips Seawater, but at a Cost*, N.Y. TIMES, Jul. 10, 2010, at 8.

53. Sara Hamdan, *Abu Dhabi Company Searches for Greener Method of Desalination*, N.Y. TIMES (Jan. 23, 2013), http://www.nytimes.com/2013/01/24/world/middleeast/abu-dhabi-company-searches-for-greener-desalination.html.

54. *See* NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., DESALINATION: A NATIONAL PERSPECTIVE 142-43 (2008). Many desalination proponents investigated renewable energy supplies and co-location with power plants that use seawater to cool nuclear reactors. Using the cooling water from the power plant for desalination reduces its reliance on energy because the water comes in at a higher temperature. Another large benefit to co-location comes from the avoidance of construction costs by sharing intake and discharge facilities. CARTER, *supra* note 16, at 8.

Other technologies that desalination integrates to reduce energy prices include geothermal energy generation, wind energy generation, off-peak electricity use, and operation in areas of limited electric generation. *See, e.g.*, Marcos S. Miranda & David Infield, *A Wind-Powered Seawater Reverse-Osmosis System Without Batteries*, 153 DESALINATION 9, 9-10 (2002); Dan Weiner et al., *Operation Experience of a Solar- and Wind-Powered Desalination Demonstration Plant*, 137 DESALINATION 7, 8 (2001).

III. Industrial Use and Environmental Concern

Industrial-grade desalination will only exacerbate existing environmental degradation. Studies on large-scale desalination have found that the process causes environmental harm by way of impingement and entrainment, chemical byproducts, greenhouse gas emissions, and saline waste concentrate.[55] Of these environmental harms associated with desalination, many already view "impingement" and "entrainment" as significant concerns.[56] Open seawater intakes withdraw large volumes of water through pipes extending into oceans, estuaries, and rivers.[57] Large organisms like fish and marine mammals are injured or killed when they become "impinged," or trapped, on the screens of the intake pipes.[58] Smaller organisms like plankton and larvae pass through the screens but are killed as they become "entrained" in the desalination plants' infrastructure (that contains variances in salinity, pH, and temperature).[59] The United States has acted to change the process, but many plants still plan to use open seawater intakes.[60]

Another consequence of desalination includes introducing harmful chemical and biological contaminants into the converted freshwater and surrounding ecosystem.[61] Although the nature of freshwater product varies depending on the desalination process and seawater quality, chemical and organic contaminates nonetheless remain in the freshwater product.[62] To aggravate this concern, pretreat-

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55. *See* Kelley, *supra* note 46, at 283-84.

56. *See id.* Many state and federal agencies recognize that open seawater intakes devastate marine ecosystems. A single power plant using an open seawater intake might impinge a million adult fish in just a three-week period or entrain three to four billion smaller fish and shellfish in a given year. *Id.* at 284 (citing Riverkeeper, Inc. v. U.S. Envtl. Prot. Agency, 358 F.3d 174, 181 (2nd Cir. 2004)).

57. Kelley, *supra* note 19, at 45.

58. *Riverkeeper*, 358 F.3d at 181.

59. *Id.*

60. *See* Kelley, *supra* note 19, at 46. In 2010, the California State Water Resources Control Board passed a policy phasing out open seawater intakes for cooling power plants. However, thirteen of the twenty proposed desalination plants in California plan to use open seawater intakes to withdraw water. *Id.*

61. *Id.* at 43.

62. Reverse osmosis allows for small, uncharged molecules to pass through the permeable membrane. Electrodialysis only removes charged ions, so any uncharged molecules would not be removed. Distillation allows for any vaporized molecules to come into the water product. Examples of chemical contaminants include: Arsenic, Boron, and Bromine—all incredibly dangerous carcinogens. Organic contaminates can also be transported through the membrane process in a similar fashion as chemical contaminates. Bureau of Reclamation, *Water Quality of the Product, Desalinated Water*, U.S. Dep't Interior, http://www.usbr.gov/research/AWT/environmental-quality.html (last visited Feb. 11, 2015).

ing intake water and maintaining efficient desalination systems involve the use of harmful chemicals[63] and algal toxins. These pass through the process, producing noxious and neurotoxic substances that adversely affect drinking water standards.[64]

Studies also indicate that extensive development of industrial-grade desalination could lead to "greater dependence on fossil fuels, an increase in greenhouse gas emissions, and a worsening of climate change."[65] For example, a 2012 case study determined that Abu Dhabi's current desalination operations emit thirty million metric tons of carbon dioxide, only to hit 101 million metric tons by the year 2030.[66]

A final concern comes from disposing desalination's main by-product—saline waste concentrate.[67] Although there is no danger that increased desalination will increase the salinity of the ocean as a whole, dumping salt concentrate back into the source water may kill marine life living within miles offshore.[68] Brackish water desalination proves more problematic as saline concentrate is discharged into the river from where the source water was drawn.[69] Currently, around sixty percent of the world's total desalination capacity comes from countries bordering the Persian Gulf, a shallow and enclosed sea susceptible to adverse environmental effects and evaporation, posing a drastic concern for salinity levels in the area.[70]

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63. Schwabach, *supra* note 9, at 196-97.

64. CARTER, *supra* note 16, at 11.

65. CALIFORNIA PERSPECTIVE, *supra* note 13, at 7.

66. Mohamed A. Dawoud & Mohamed M. Al Mulla, *Environmental Impacts of Seawater Desalination: Arabian Gulf Case Study*, 1 INT'L J. ENV'T & SUSTAINABILITY, no. 3, 2012, at 22, 31 fig. 4.

California's water sector used 19% and 32% of the state's total use of electricity and natural gas in 2001. Its proposed desalination projects would increase that energy use by a 5% minimum over the 2001 levels. CALIFORNIA PERSPECTIVE, *supra* note 13, at 72.

67. While innovative disposal techniques have been researched, much uncertainty still exists as to effective and environmentally friendly disposal processes. New techniques include land application, evaporative ponds, and deep well injection. The EPA is authorized to manage the disposal and reuse of saline waste concentrate, *see* CARTER, *supra* note 16, at 11-12 (citing Part C of the Protection of Underground Sources of Drinking Water, 42 U.S.C. §§ 300h to 300h-5 (2012) as the statutory guidance on the EPA's authority), which may lead to further regulatory oversight.

68. Detrimental effects would result even with a slight change in salinity. *See* generally W. D. CLARKE ET AL., BIOLOGICAL EFFECTS OF EFFLUENT FROM A DESALINATION PLANT AT KEY WEST, FLORIDA (1970) (providing the U.S. Federal Water Quality Administration with in depth findings of environmental consequences to salinity variances).

69. Schwabach, *supra* note 9, at 197. Congress authorized money in 1980 for mitigating fish and wildlife losses associated with the operation of a desalination plant in Yuma, Arizona that discharges saline concentrate into the Colorado River. *Id.*

70. *Id.* at 199.

Even in its infancy, industrial-grade desalination has attendant environmental concerns. Although these concerns have been met with regional[71] and national regulation,[72] countries other than the United States have less extensive water protection regimes, and those that have them often fail to enforce their own laws.[73] As a consequence, industrial-grade desalination might broaden environmental concern to the point of international dispute.

IV. THE PROPOSED GOVERNING SCHEMES DO NOT PROVIDE THE REQUISITE FLEXIBILITY FOR INDUSTRIAL-GRADE DESALINATION

To address potential international disputes arising from desalination's environmental harm, scholars have proposed the use of customary international law and two preexisting water governance schemes. However, normative expectations of nations mitigating entrainment and impingement or saline concentrate discharge have not developed through customary international law.[74] And while some scholars have proposed a model for international water resource management by incorporating soft customary international law, others disfavor the model, viewing collaborative governance and adaptive management as a better tool for international environmental compliance. Nevertheless, both proposals fail to ensure flexibility to industrial-grade desalination that both limits harm and encourages the industry to employ new, cost-effective technologies.

A. *Customary International Law Has Not Created Normative Expectations*

Customary international law, a set of normative expectations developed through observation of the states as international actors, has witnessed little development for land-based discharges of waste into the ocean.[75] Of those expectations that deal with land-based dis-

71. California Water Code Section 13142.5(b) and the California Ocean Plan sets forth a program of implementation, including discharge limitations and monitoring, to ensure that water quality objectives are met. The California Environmental Quality Act requires developers to mitigate impacts that are identified as "significant." CAL. WATER CODE § 13142.5 (West 2013).

72. The construction and operation of a large desalination plant requires an environmental impact statement in accordance with the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4370f (2012). Wastes from plants are controlled by the Clean Water Act. 33 U.S.C. §§ 1251-1388 (2012).

73. Schwabach, *supra* note 9, at 200.

74. *Id.* at 205.

75. *Id.*

charges, the agreements vary between purely global and regional control.[76]

Some global agreements address water pollution from land-based sources.[77] For example, the United Nations Convention on the Law of the Sea (UNCLOS)[78] provides that "states shall . . . reduce and control pollution of the marine environment . . . from land-based sources"[79] and should "harmonize their policies . . . at the appropriate regional level."[80] Member states are required to adopt and enforce these policies.[81] To develop specific international standards for implementing UNCLOS's relevant article, the United Nations Environmental Programme[82] introduced the Montreal Guidelines. These guidelines, however, are voluntary in nature and are viewed by nations as a weak tool for compliance.[83] Due to this weakness, a subsequent agreement called Agenda 21 urged member nations to implement, strengthen, and extend the Montreal Guidelines at regional levels.[84] This progression, along with many auxiliary struggles at international, normative negotiations (i.e., cap-and-trade) illustrates how nations are unwilling to enter into an across-the-board pollution program. Global discord also suggests that the success of protecting coastal waters depends to a large extent on specifically regionalized conditions.[85]

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76. *Id.*

77. *Id.*

78. United Nations Convention on the Law of the Sea arts. 194, 197, Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS].

79. *Id.* art. 207(1).

80. *Id.* art. 207(3).

81. *Id.* art. 213.

82. The United Nations Environmental Programme, established in 1972, states that it "acts as a catalyst, advocate, educator and facilitator to promote the wise use and sustainable development of the global environment." They are the voice for the environment within the United Nations system. *The Voice of the Environment*, UNITED NATIONS ENV'T PROGRAMME, http://www.unep. org/About (last visited Dec. 10, 2013).

83. United Nations Environment Programme, Montreal, Apr. 11-19, 10985, *Guidelines on Protection of the marine Environment Against Pollution from Land-Based Sources*, UNEP/WG. 120/3 (Part IV), reprinted in 14 ENVTL. POL'Y & L. 77 (1985) [hereinafter Montreal Guidelines]; *see* Yoshifumi Tanka, *Regulation of Land-Based Marine Pollution in International Law: A Comparative Analysis Between Global and Regional Legal Frameworks*, 66 HEIDELBERG J. INT'L L. 535, 544, 547 (2006).

84. U.N. GAOR, 46th Sess., Agenda Item 21, U.N. Doc. A/CONF.151/26 Chapter 17, ¶¶ 17.24-25 (1992) [hereinafter Agenda 21].

85. This certainly makes sense, as no long-term study on large-scale desalination has been published that has found a given plant's global reach. If a given plant adversely impacts nothing around its territory, why seek to regulate plant at all? One might be quick to answer: "to level the playing field." But desalination is still in a tentative development phase. Perhaps when large

In contrast to an overarching global agreement, nations have met to develop regional conventions to better address shared conditions. Of the conventions, the Paris,[86] Helsinki,[87] and Mediterranean[88] conventions address land-based pollution by utilizing a "black list/grey list" approach.[89] Parties to each convention must seek to eliminate discharges listed on the "black list" and reduce discharges listed on the "grey list."[90] Each convention's "black list" only covers highly toxic substances like radioactive waste.[91] While some cover thermal discharges into the marine environment,[92] each convention's "grey list" does not explicitly cover salt waste concentrate discharge or entrainment and impingement.[93] As such, the regional agreements fail to regulate the relevant environmental harm associated with desalination.

Although global and regional discussions surrounding land-based pollutions exist, neither global expectations nor regional conventions properly address industrial-grade desalination. As the UNCLOS and subsequent agreements suggest, global customary international law does not properly address the importance of local ecosystem condi-

nations regularly use desalination at large-scale will the attitude toward conformity change. *See infra* Part V(B).

86. Convention for the Prevention of Marine Pollution from Land-Based Sources, Apr. 4, 1974, 1546 U.N.T.S. 120 [hereinafter Paris Convention].

87. Convention on the Protection of the Marine Environment of the Baltic Sea Area, Mar. 22, 1974, 1507 U.N.T.S. 166 [hereinafter Helsinki Convention].

88. Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources, May 17, 1980, 1328 U.N.T.S. 105 [hereinafter Athens Protocol]. The Protocol builds upon and extends the protections found in the Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution arts. 4(2), 8, 15, Feb. 16, 1976, 1102 U.N.T.S. 27.

89. *See* Athens Protocol, *supra* note 88, Annex I-II; Helsinki Convention, *supra* note 87, Annex I-II; Paris Convention, *supra* note 86, Annex A.

90. However, these conventions do not appear to have anticipated an increase in desalination plant discharges. Schwabach, *supra* note 9, at 207.

91. *See* Athens Protocol, *supra* note 88, Annex I-II; Helsinki Convention, *supra* note 87, Annex I-II; Paris Convention, *supra* note 86, Annex A. It should be noted that each agreement's black list varies. For example, radioactive substances are listed in the "black list" in the Athens Protocol whereas these substances are listed in the "grey list" in the Helsinki Convention.

92. *See, e.g.*, Athens Protocol, *supra* note 88, Annex II, § A.9.

93. *See generally* Athens Protocol, *supra* note 88, Annex I-II; Helsinki Convention, *supra* note 87, Annex I-II; Paris Convention, *supra* note 86, Annex A, part I.

The Athens Protocol contains a catch-all provision that covers "[s]ubstances which, though of a nontoxic nature, may be come harmful to the marine environment . . . owing to the quantities in which they are discharged." Athens Protocol, *supra* note 88, Annex II, § A.13. However, both the Helsinki and Paris conventions contain catch-all provisions that are limited to substances having adverse effects on the taste and/or smell of products for human consumption from the sea. Helsinki Convention, *supra* note 87, Annex II, § B.13; Paris Convention, *supra* note 86, Annex A, Part II.5.

tions, and regional conventions only focus on highly toxic substances like radioactive waste, thereby failing to account for salt waste concentrate discharge or entrainment and impingement.

B. The Rights-Based Adversarial Model Disincentivizes Industrial-Grade Desalination

To better address water rights apportionment and environmental harm associated with desalination, scholars have sought to incorporate principles from international water rights and environmental law to create a model for international water resource management.[94] The so-called "rights-based adversarial model" (RAM) uses three primary principles: the reasonable use of water; the duty to avoid harm; and the duty to cooperate.[95] Under this model, liability would attach to a nation that "misuses" desalination, compelling it to internalize the cost of pollution.[96] However, potential liability and pitfalls associated with the RAM's functioning serve as a great disincentive to investing in innovative technologies like desalination.

All three RAM principles form a part of the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourse (Watercourse Convention).[97] The right of reasonable use and the duty to avoid harm originate from the principle of territorial integrity.[98] The reasonable use of water principle grants states sovereignty over natural resources within their own territory.[99] Several factors, including population, hydrology, social and economic needs, and conservation, determine if a nation reasonably uses its water.[100] The duty to avoid harm prohibits a ratifying-nation from

94. Larson, *supra* note 15, at 777-78.

95. *See, e.g.*, Salman M. A. Salman, *The Helsinki Rules, the UN Watercourses Convention and the Berlin Rules: Perspectives on International Water Law*, 23 WATER RESOURCES DEV. 625, 632-34 (2007). An articulation of these principles appears in the Watercourse Convention. *See* Convention on the Law of Non-Navigational Uses of International Watercourses, G.A. Res. 51/229, arts. 6, 8, 20-21, 99th plen. mtg., U.N. Doc. A/RES/51/229 (July 8, 1997) [hereinafter Watercourse Convention].

96. *See* Larson, *supra* note 15, at 777-81.

97. Watercourse Convention, *supra* note 95 pmbl.

98. The consensus is that territorial integrity constitutes customary international law. *See* Larson, *supra* note 15, at 779; *see also* PHILIPPE SANDS, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 235-36 (2d ed., Cambridge Univ. Press 2003) (1995). Prior historical declarations, including the New York Resolution in 1958; the Helsinki Rules in 1966; and the Athens Resolution in 1979; do not have binding effect *per se* because they are neither signed nor ratified by states. Their guidance stems from expertise and acquiescence in a number of bilateral and multilateral treaties. *See* Salman, *supra* note 20, at 1-2.

99. *See* Larson, *supra* note 15, at 779; *see also* SANDS, *supra* note 98.

100. Watercourse Convention, *supra* note 95, arts. 5-6.

causing environmental harm to its neighbors.[101] These two principles compete against one another, as the duty to avoid harm compels states to avoid significant harm but still act with "due regard" to the right of reasonable use.[102] The third principle—the obligation of "good neighborliness"—forces cooperation with neighboring states when implementing national strategies that may have international environmental impacts.[103] All three principles have achieved the status of customary international law.[104]

The interwoven nature between the right to reasonable use and the duty to avoid harm causes significant confusion amongst conflicting nations. As each nation seeks to meet its local needs while minimizing impact on its local ecosystem, each nation will assert different goals, either favoring desalination implementation or environmental protection. Those interested in implementing desalination contend that the specific mention of the obligation to not cause harm means that the Convention favors neighboring states.[105] Neighboring states claim the opposite—that the Convention subordinates the no harm rule to the concept of reasonable use.[106] This conflict creates unpredictability, serving most importantly to disincentivizing nations from developing industrial-grade desalination. To make things worse, nations simply do not know if their use will be considered reasonable or harmful. Nations also view "good neighborliness" as granting neighboring nations a right to veto a project, further disincentivizing nations from planning desalination for fear of such a veto.[107]

Functionally, the RAM enables neighboring states to file a claim when they experience extraterritorial damage stemming from a neighbor's unreasonable use of shared resources.[108] However, filing such suits under the RAM will create entrenched interests and expectations based on nations' rights and duties.[109] As more claims are decided,

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101. Larson, *supra* note 15, at 779.

102. Watercourse Convention, *supra* note 95, art. 7.

103. Larson, *supra* note 15, at 779.

104. *Id.*; *see* SANDS *supra* note 98, at 249-50.

105. *See* Salman, *supra* note 20, at 8-9.

106. Scholars claim that confusion amongst nations is a primary reason for the stalling of the signatory process to make the convention binding. *See id.* at 9.

107. However, the Convention does not grant vetoing power. Rather, it requires a nation to notify its neighbors when a project may cause "significant adverse effects." The Convention lays out detailed provisions for nation-to-nation cooperation, encompassing failures to notify, duties to consult and negotiate, and duties of good faith payments to rights of the other state. *See id.* at 10.

108. Larson, *supra* note 15, at 780.

109. *See id.* at 795. For example, the United States may deliver 1.5 million acre-feet of water to Mexico under the 1944 Rivers Treaty. But adherence to Mexico's right to a certain water

nations will use precedent to prove the contested use as either reasonable or harmful. While these decisions might create a standard for implementing industrial-grade desalination, such a standard would negate the need for a reasonable use principle that forces courts to consider each particular situation. But more importantly, the standards also lack the capacity to adapt to technological ingenuity.

The pivotal downfall to this model is its inability to bind a nation to a particular action. Non-compulsory decisions such as these are often viewed cynically.[110] The model only "compels" nations to meet, compile a fact-finding report to help establish methods to reduce environmental harm, and act in accordance with the report in good faith. Using only a "good faith" standard may never lead to a sound resolution—a nation may do what it wishes after considering the fact-finding report in what it believes is good faith.[111]

The RAM seeks to ensure fairness, but the relationship between the right to reasonable use and the duty to avoid harm would create confusing and likely inconsistent precedent. Concern for the model's ambiguity and lax enforcement create a large disincentive to development. Nations may never take the risk of implementing new and economically unstable technologies for fear of internalizing expensive litigation costs.

C. *The Collaborative Governance-Adaptive Management Model Is Impractical*

Scholars critical of a hindsight approach like the RAM have proposed an alternative, called the "collaborative and adaptive management model" (CAM), in which nations form a unitary power to manage international water basins.[112] This model stresses collaborative governance, adaptive management, and shared benefits.[113] However, the CAM does not properly address extraterritorial application. Nations have highly divergent interests, and a unitary power made up

quantity and the United States' obligation to the Treaty show that the countries are incapable of responding to how desalination would change their relationship when the disputing countries have different definitions of what is now "fair" under the Treaty. *Id.*

110. Patricia Wouters, *Foreword: A New Generation of Local Water Leaders,* 18 COLO. J. INT'L ENVTL. L. & POL'Y 513, 519 (2007).

111. *See id.* at 518-19. So long as a nation complies with the Convention's preliminary matters, the nation may continue operations even in the face of litigation so long as it declines jurisdiction. China refused to sign the Watercourse Convention and has been criticized for acting unilaterally with developing international rivers. *See* Larson, *supra* note 15, at 797.

112. *See* Larson, *supra* note 15, at 802.

113. *Id.* at 800.

of each nation's representatives makes unanimous decisions on difficult matters impossible.

Rather than compelling cost internalization to individual nations like the RAM, the CAM uses collaborative governance to create a special district or commission to oversee spillover goods like water and air that moves between jurisdictions.[114] By focusing governance at the basin level, neighboring nations would establish a joint-governance institution to regulate and manage water development, protection, and conservation.[115] However, the success of these joint-governance institutions depends on their perceived legitimacy by neighboring states. Most efforts at these collaborative governance schemes have included stakeholders[116] and required unanimity for a decision.[117] Governing structures risk credibility without unanimity, and stakeholders would likely take their grievances to court when unanimous decisions are not reached.[118] On the other hand, governance structures that require unanimity will never resolve serious decisions implicating multiple nations' interests because any stakeholder may veto a proposal.[119]

Adaptive management is a decision-making process that allows a managing entity to change its decision when unpredictable events arise.[120] Because desalination is a rapidly developing industry, scholars believe that adaptive management could provide the necessary flexibility. Yet, while flexibility is required for evolving technologies like desalination, using adaptive management will be difficult "not [the] least because it would require governments and policymakers to admit to and learn from failures and mistakes in a very public process."[121]

To combat the concern for collaborative governance legitimacy, the CAM proposes that stakeholders within the managing entity

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114. *See* Robert D. Cooter, The Strategic Constitution 106 (2000).

115. The district or commission's member states would likely share the cost of maintaining the district. Larson, *supra* note 15, at 802.

116. The term "stakeholder" is widely used in water management literature and agreements. The term implies, if not actually confers, legal standing to participate in decision-making of the government or sue in court if their status is not adequately reflected in the government's decision. *See* Huffman, *supra* note 30, at 140.

117. *See id.* at 142.

118. *Id.*

119. *See id.* at 144-46.

120. *See* Larson, *supra* note 15, at 800.

121. Gabriel Eckstein, *Water Scarcity, Conflict, and Security in a Climate Change World: Challenges and Opportunities for International Law and Policy,* 27 Wis. Int'l L.J. 409, 453 (2009).

adopt the concept of shared benefits, viewing water as a commodity.[122] The nation with the most efficient use for desalination would have rights to the water, but neighboring nations would be entitled to compensation for such use.[123] However, sharing monetary gains comes at the expense of foregone future uses, and benefit-sharing risks marine ecosystem integrity that may not be adequately addressed.

Creating an interjurisdictional government would exploit each nation's divergent interests. The CAM model suffers an irreconcilable problem: Creating a collaborative government without the required unanimity for decisions would seldom occur,[124] but creating a collaborative government requiring unanimity in decisions would consistently result in stalemates.[125]

V. TRADABLE PERMITTING SCHEMES PROPERLY PROVIDE FOR INTERNATIONAL DESALINATION COMPLIANCE

Tradable permitting schemes are a historically new way to regulate pollution emissions[126] and are considered "preferred instrument[s] for addressing global climate change throughout the industrialized world."[127] By encouraging companies to reduce emissions at the cheapest price, these schemes increase flexibility to local conditions[128] and allow nations to trade or sell their permits to comply with the capped target. Thus, to best control desalination's environmental harm all the while stimulating technological ingenuity, nations

122. *See* A. Dan Tarlock & Patricia Wouters, *Are Shared Benefits of International Waters an Equitable Apportionment?*, 18 COLO. J. INT'L ENVTL. L. & POL'Y 513, 527 (2007). This is best illustrated with an example: In 1961, the United States and Canada signed the Columbia River Treaty that allowed downstream users to share in the benefits of upstream allocations. In the Treaty, Canada agreed to forego certain development on the river and offered flood control measures to the United States in exchange for payment from the United States' revenues derived from electricity sales and water storage for Canadian users. *See* Treaty Between the United States of America and Canada Relating to Cooperative Development of the Water Resources of the Columbia River Basin, U.S.-Can., Jan. 17, 1961, 15 U.S.T. 1555.

123. *See* Larson, *supra* note 15, at 803.

124. Why limit your sovereignty to a greater entity when you cannot veto its decision entirely adverse to your interest?

125. Would you veto a decision granting your neighbor the power to desalt water when it has adverse environmental impact on your territory? While shared benefits might dissuade a veto, history illustrates that shared benefits prevent future, more beneficial uses.

126. The theory dates back to the early twentieth Century by an economist named Arthur Cecil Pigou. Richard Conniff, *Blue Sky Thinking*, SMITHSONIAN, Aug. 2009, at 80.

127. *Linking Tradable Permit Systems*, *supra* note 31, at 789. Nonetheless, secured industries normally prefer a standard-based regulatory scheme. *See* Bruce Yandle & Stuart Buck, *Bootleggers, Baptists, and the Global Warming Battle*, 26 HARV. ENVTL. L. REV. 177, 190 (2002).

128. *Linking Tradable Permit Systems*, *supra* note 31, at 797.

should consider incorporating a tradable permitting scheme—cap-and-trade[129]—at regionalized levels that are "linked" together to form a singular international regulatory scheme.

Cap-and-trade schemes might also empower preexisting desalination plants to voluntarily reduce entrainment and impingement, salt concentrate, and toxic disposal processes by incorporating "early action credits" that recognize reductions in the form of tangible credits that may be acquired when the market opens.[130] One problem with regional cap-and-trade schemes is that each cap-and-trade market will likely be constrained to the point of ineffectual regulation.[131] But linkages might well solve this problem. Linkage occurs when one authority allows its regulated entities to use emission allowances from other schemes to meet its members' obligations.[132] This would open the market to greater liquidity and subsequent regulatory compliance. Therefore, linked regional tradable permitting schemes would lead to international desalination entrainment and impingement, salt waste concentrate, and toxic dumping control.

A. *Framing Industrial-Grade Desalination Within Cap-and-Trade*

The idea behind a cap-and-trade scheme is fairly simple: a regulatory authority sets a "cap" that equals the annual allowable emissions of a sustainable pollutant.[133] The authority should set the cap low enough to prevent an oversaturation of allowances or "rights" that flood the market,[134] but high enough to ensure that trading credits are competitive with other means of reductions.[135] The authority then as-

129. Incorporating cap-and-trade within desalination might seem irrational due to the difficulty of quantifying the effects of entrainment, impingement, and salt concentrate disposals, but environmental impact studies demonstrate that calculations and monitoring systems do exist. *See, e.g.*, IRIS SAFRAI & ALON ZASK, ENVIRONMENTAL REGULATIONS FOR DISCHARGING DESALINATION BRINE TO THE SEA AND ITS POSSIBLE IMPACTS, *available at* http://www.ildesal.org.il/main.php?location=education&action=environmental (providing an in depth study and dispersion model for discharge stemming from the Ashkelon Seawater Desalination Plant); WateReuse Association Desalination Committee, Desalination Plant Intakes—Impingement and Entrainment Impacts and Solutions (Mar. 2011) (unpublished white paper) (on file with WateReuse Association) (listing comprehensive, multi-year studies that have calculated and published concrete calculations of annual impingement and entrainment).

130. *See Linking Tradable Permit Systems*, *supra* note 31, at 794.

131. *See id.* at 791-94.

132. *Id.* at 791.

133. Joseph Lam, *Coupling Environmental Justice with Carbon Trading*, 12 SUSTAINABLE DEV. L. & POL'Y, Winter 2012, at 40.

134. *Id.* at 43.

135. Cap-and-trade, while normally discussed in light of greenhouse gas (GHG) emissions, exists in other contexts as well: Water diversions in the Murray-Darling Basin in Australia were controlled through a cap-and-trade scheme that began in 1995. The cap used for the diversion of

signs or "allocates" resource use rights to those who fall within the scope of the established cap.[136] The buying and selling of these allowances occurs between plants when the resource rights are allocated to their highest-valued users from lower-valued users who trade their rights for profit and exit production.[137] If these rights are clearly specified and there are no undue restrictions on trading, any allocation should result in an efficient distribution of those rights.[138] This scheme is also transferable to industrial-grade desalination by incorporating mechanisms that exist in other cap-and-trade schemes.

Critics might argue that cap-and-trade is ill suited to regulate desalination for three reasons. First, the scheme appears to be unworkable. To form a successful scheme between countries, each nation would want to limit its neighboring nations' desalination use to avoid environmental degradation resulting from a neighbor's desalination industry.[139] Setting a cap would thus require calculating how much a particular ecosystem could sustain from identified desalination plants' intakes and emissions—calculating that impact would be difficult, as each ecosystem would require its own impact study.[140] Second, desalination is not bound to seawater but may be used in river basins or groundwater recovery plants. The difficulty in including seawater with river basin desalination is the vast difference between each ecosystem.[141] Thus, an even distribution between the desalination plants would be unreasonable. Finally, a seawater desalination plant's isolated location would negate environmental concern from a neighboring country, making it unfair to limit its pollution under any cap-and-trade.

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water is referred to as a "diversion or extraction limit." *See* B. Timothy Heinmiller, *The Politics of "Cap and Trade" Policies*, 47 NAT. RESOURCES J. 445, 449-53 (2007). New Zealand established a cap-and-trade system to control its fisheries, requiring the country's regulators to set a yearly cap for each fishery. The aggregate cap is expressed as the "total allowable catch." *See* RÖGNVALDUR HANNESSON, THE PRIVATIZATION OF THE OCEANS 91 (2006).

136. Heinmiller, *supra* note 135, at 450.

137. *Id.* at 450-51; Lam, *supra* note 133.

138. This comes from the Coase Theorem. *See* R. H. Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1, 15 (1960).

139. If nation X uses seawater desalination and its neighbors do not, the neighboring nations have incentive to limit nation X's use, but nation X will have no incentive to form a scheme to limit only its use.

140. An additional concern stems from those who generally disfavor cap-and-trade: Once a baseline cap is calculated, allocating allowances to each plant will be a game of "very high stakes," with each desalination plant vying to claim the greatest number of allowances. Heinmiller, *supra* note 135, at 456.

141. Desalination pollutants cause exponentially greater harm to river basins than they do to ocean ecosystems. River basin ecosystems are landlocked and are more sensitive to increases in salinity.

To avoid all of these issues, nations should negotiate regional cap-and-trade schemes to include plants that *only pollute shared ecosystems*. Such a regional scheme minimizes concern for limiting off-site desalination pollution and setting a proper cap. When nations share a particular ecosystem, each nation has an interest in decreasing environmental harm from abroad. Negotiating nations could consequently share the cost for the ecosystem's environmental impact study, further decreasing development costs for future desalination plants. While industrial-grade desalination's youth makes calculating intake and discharge impact difficult, current impact studies demonstrate that calculation is possible,[142] and setting caps has less to do with technical expertise than in depth political negotiation.[143] Impact calculations and international negotiations also allow nations to determine the geographic area to be protected, freeing desalination plants outside the area from the cap's regulatory scope.[144]

In addition to identifying the proper ecosystem to be protected, regional cap-and-trade schemes also allow member nations to create yearly or seasonal caps for future environmental compliance. Established caps may be modified very limitedly or on a year-to-year or season-to-season basis to respond to changing conditions.[145] Neighboring nations could set an initial cap and require a subsequent yearly or seasonal cap adjustment. Initial allocation methods have proven to be problematic with existing cap-and-trade schemes regulating other environmental concerns, but evidence suggests a wide range of initial allocations is possible.[146] These include lotteries, historic use (early action credits factor into this allocation device), auctions, government-established eligibility criteria, or some combination thereof.[147] As po-

142. SAFRAI & ZASK, *supra* note 129. Using cap-and-trade schemes will also incentivize innovation to calculate and monitor desalination's environmental impact.

143. The cap on GHG emissions for developed countries under the 1997 Kyoto Protocol took five years of negotiations and was only a politically expedient starting point for emissions control rather than a scientific assessment of atmospheric conditions. *See* MICHAEL GRUBB ET AL., THE KYOTO PROTOCOL: A GUIDE AND ASSESSMENT 69 (1999). Such calculation has certainly proven difficult for many environmental concerns, but many policymakers are hopeful the future will bring metrics to gauge environmental impact. *See* Alexandra Dapolito Dunn & Sarah Stillman, *Advancing the Environmental Rule of Law: A Call for Measurement* 21 SW. J. INT'L L. 283 (2015).

144. These negotiations would likely include the distinction between seawater and river basin desalination. While river basin desalination is not the topic of this paper, increased use of river basin desalination may also incorporate an analogous (but more stringent) cap-and-trade scheme.

145. Tom Tietenberg, *The Tradable Permits Approach to Protecting the Commons: What Have We Learned?*, *in* THE DRAMA OF THE COMMONS 197, 206 (Elinor Ostrom et al. eds., 2002).

146. *Id.* at 207-08.

147. *Id.* at 208.

litical negotiations develop the baseline cap and allocation process, member nations would determine who is best served to oversee compliance and what mechanisms ought to be used to inspect regulated plants.[148]

To ensure the success of regionalized cap-and-trade for industrial-grade desalination, negotiating nations should expressly provide that early *voluntary* reductions would be legally recognized in a later-developed scheme[149] viz-à-viz "early action credits." Generally, early action credits occur when a desalination plant's *voluntary* action to limit its pollution results in legal entitlement to additional allowances that can be used once a cap-and-trade scheme commences.[150] Once nations recognize these credits, desalination plants in the design or planning phase that fall within the cap would be incentivized to reduce intake and discharge emissions they believe are economically feasible.[151] While these credits are not without their attendant concerns,[152] they provide incentives for developed and developing plants to reduce environmental degradation while the nations negotiate a proper cap.

Environmental degradation unique to industrial-grade desalination prompts regionalized cap-and-trade systems where neighboring nations share a common ecosystem. Using the particular ecosystem as the basis for a cap-and-trade scheme minimizes the concern for regulating desalination plants that have no impact on the targeted ecosystem. Regionalized schemes also enable each member nation to properly police an initial cap and any limitation or modification for yearly or seasonal caps. Interested nations should act now to recognize early action credits to ensure success of the scheme and integrity of the targeted ecosystem.

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148. SAFRAI & ZASK, *supra* note 129. Each nation would likely oversee seawater desalination plants within their jurisdiction.

149. Why expend money to invest in technology that may never get subsidized?

150. Nicholas DiMascio, Note, *Credit Where Credit is Due: The Legal Treatment of Early Greenhouse Gas Emissions Reductions*, 56 DUKE L.J. 1587, 1598-1604 (2007).

151. *Id.*

152. Some claim that voluntary reduction is irrational because cap-and-trade schemes calculate their baseline cap once they enact the scheme. If a plant reduced their pollution before this calculation, they may get a lower threshold than they would have without reducing anything. This concern, however, would be met if the cap-and-trade authority held the correct procedure and granted additional permits for the voluntary reduction. This requires a prospective explanation where the authority explicitly describes the procedures to each plant.

Another issue with early action credits is verifiability. Such credits would require an international registry or database where desalination plants would have to properly quantify their reductions. But national do registries exist, and early action credits have been discussed in the United States for greenhouse gas reductions. For a general discussion of the benefits and pitfalls to early action credits, *see id.*

B. *Linking Regional Cap-and-Trade Schemes for International Compliance*

While regional schemes provide the appropriate oversight of stressed ecosystems, disjunctive systems will not survive on their own. Cap-and-trade schemes require a large enough market to promote efficient trading. One way to open the market is the concept of linkages. This might also lead to a global cap-and-trade architecture that combats environmental harm stemming from desalination.

Once a nation or region enacts a scheme, they may combine their schemes with others via linkages. This occurs when a scheme's authority allows their regulated entities to use allowances from other schemes to meet compliance obligations.[153] Direct linking occurs when one scheme accepts another's allowances.[154] But nations can link their schemes indirectly as well, occurring when two schemes are linked through a third but commonly shared scheme.[155] The process of linking is directive, so it may be done unilaterally by an individual scheme or bilaterally with schemes agreeing to recognize the other's allowances.[156] To combat exchange disparities, each scheme may set an exchange rate that can be applied for intra-scheme trading.[157] For instance, the European Union's Emission Trading Scheme recognizes allowance trading by any member state,[158] and the United States' Regional Greenhouse Gas Emission Initiative allows its sources to use allowances from other countries' schemes to meet their obligations.[159]

While linkage has its attendant problems,[160] linking regional schemes has the potential to create both short- and long-term results. Short-term results include opening the market and creating greater liquidity without harmonizing emerging and existing schemes,[161] and long-term results might include a singular global scheme that regulates

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153. *Linking Tradable Permit Systems*, *supra* note 31, at 791.

154. *Id.* at 796.

155. *Id.* at 798.

156. *Id.* at 795.

157. If the price of allowances is lower in one scheme, then regulated entities in other schemes will have incentives to purchase those allowances. This reduces the price of allowances in the other schemes while increasing the price of credits in the market-competitive scheme. *See id.* at 797.

158. *Id.* at 798.

159. *See* Regional Greenhouse Gas Initiative subpart XX-10.3(b)(1) (2007).

160. These include regular market problems in buying and selling, reducing authority over the design and impacts of a scheme, and difficulty in setting future baseline caps. *Linking Tradable Permit Systems*, *supra* note 31, at 799-801.

161. *See id.* at 808.

desalination or climate change as a whole or a large set of direct links that joins each regional scheme.[162]

Opening a regional scheme's market for trading creates greater liquidity, efficient trading, and innovative compliance. These linkages, however, serve a greater purpose. They provide an international structure for overall pollution reduction. This may come from establishing multilateral links or from an international agreement regulating desalination.

VI. Conclusion

By incorporating technologies to combat energy use and promote efficiency, industrial-grade desalination may soon be feasible. Even in its infancy, desalination has attendant environmental concerns, so any increase in its use will only exacerbate the very real issues to the point of international disputes. While scholars have looked to customary international law and water governance schemes to solve such looming disputes, normative expectations mitigating waste discharge have not arisen through customary international law, and the proposed schemes fail to ensure flexibility to those interested in industrial-grade desalination that both limits harm and encourages the industry to employ new technologies.

Instead, cap-and-trade schemes encourage reducing emissions at the cheapest price, thus increasing flexibility to local conditions and allowing nations to trade their permits to efficiently comply with capped reductions. Tapering cap-and-trade to a regional scale allows countries to properly determine environmental impact and ensure subsequent regulatory compliance. Although regional schemes might fail by themselves, linking the regional schemes opens the market for liquid trading and provides an international structure for overall desalination pollution reduction.

When all is said and done, industrial-grade desalination will create regulatory frustration. Those interested in implementing desalination at large scales are either unconcerned about harm to other nations or so apprehensive of the lack of existing limits that they do not act. As such, nations need to strike a reasonable, fruitful balance to ensure environmental compliance without stifling technological evolution. As this paper discussed, narrowing environmental regulation to a regional level enables nations to properly detect environmental harm. With this knowledge, nations might consider negotiating

162. *See id.*

better treaties to enact strict but appropriate standards for desalination in the particular region.

And still, better treaties will not be enough. Desalination's infancy at large-scale implementation creates difficulty with any type of strict standard. Current technology makes industrial-scale desalination economically inferior to more traditional sources, so forcing any standardized compliance on such a delicate market will smother its implementation and consequent innovation. Thus, utilizing cap-and-trade will create a market for pollution and will allow early adopters to reap the benefits of voluntary reduction. This will lead to market efficiency, implementation, but most critically—increased sources of available potable water to the masses.