Feeling Salty? Regulating Desalination Plants in the United States and Spain

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Introduction

What if local governments could promote a "drought proof" water source? More than ninety-six percent of the Earth's water is in the oceans.[1] This is approximately 352,670,000,000,000,000,000 gallons of seawater.[2] However, only fresh water can sustain life and support most industry and agriculture.[3] As John F. Kennedy observed more than fifty years ago, "if we could ever competitively, at a cheap rate, get fresh water from salt water . . . it would be in the long-range interests of humanity which would really dwarf any other scientific accomplishments."[4] As such, desalinated seawater has great potential to provide local water supplies.

One hundred and twenty countries that span the globe have desalination plants, including the United States, Spain, Saudi Arabia, Israel, and Australia.[5] Regionally, the Middle East accounts for 53.4% of desalination processing, followed by North America (17%) and Europe (10.1%).[6]

There are, however, several logistical challenges to developing desalination plants. First, the desalination plant's water intake from the sea can harm or destroy marine life.[7] Second, extracting fresh water produces concentrated salt brine as a byproduct. If a desalination plant discharges this brine into the ocean, it can disrupt the salt levels in the neighboring watershed.[8] Many countries' desalination regulations try to balance the need for sustainable, long-term water solutions, current water shortage problems, and the logistical challenges of operating desalination plants.[9]

In addition to desalination's potential negative impact on marine life, it also raises energy and cost concerns, in large part because half of a desalination plant's operating costs relate to energy.[10] For example, the average desalination plant uses 15,000 kilowatts of electricity for every one

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1. U.S. Geological Survey, *The Water Cycle: The Oceans*, USGS, http://water.usgs.gov/edu/watercycleoceans.html (last visited May 17, 2015).

2. National Ocean and Atmospheric Administration, *How much water is in the ocean?*, NATIONAL OCEAN SERVICE (Mar. 11, 2014), http://oceanservice.noaa.gov/facts/oceanwater.html.

3. *Freshwater Systems, Overview*, WWF, www.worldwildlife.org/industries/freshwater-systems.

4. Gerhard Peters & John T. Woolley, *John F. Kennedy: The President's News Conference*, THE AMERICAN PRESIDENCY PROJECT (April 12, 1961), http://www.presidency.ucsb.edu/ws/?pid=8055.

5. *Desalination Worldwide*, HBFRESHWATER.COM (2010), http://hbfreshwater.com/desalination-101/desalination-worldwide.

6. *Id.*

7. Impingement happens when marine life (such as fish, marine mammals, and turtles) becomes trapped in the screens that intake water into a desalination plant. Entrainment occurs when smaller marine organisms (such as larvae and plankton) die when they are drawn into these same screens. *See* 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, 284 (2010-11).

8. *See id.* at 283.

9. *See generally* Water, *Renewable Energy Desalination: An Emerging Solution to Close MENA's Water Gap*, WORLDBANK.ORG, http://water.worldbank.org/node/84110 (last visited May 17, 2015).

10. *Id.*

million gallons of fresh water produced,[11] while a similar process with wastewater (or "brackish" water re-use) consumes up to 8,300 kilowatts to produce the same volume of fresh water.[12] Fluctuations in energy prices, therefore, can significantly impact the market price of desalinated drinking water.[13] This, in turn, means that the energy cost alone of operating a desalination plant may deter governments from considering desalination as a long-term water supply solution.

With resource management, environmental, and energy concerns in mind, this Note will analyze how the United States and Spain's regulations and policy approaches affect desalination plant development. Both countries have highly populated dry regions that suffer from droughts, which creates a need for regulations that anticipate water shortages and help secure alternative water supplies.

Through a comparative analysis, this Note outlines each country's approach to regulating desalination plants. Desalination plants can only serve as a part of long-term water solutions if they can meet each country's national and local environmental standards. Part I describes recent water shortages in the United States and Spain, focusing specifically on Southern California in the United States and the Catalonia region in Spain. Part I also explains the emergency measures each country uses to supplement water management regulations during droughts. Part II describes desalination's history and methods.

Part III outlines federal and California state laws that impact desalination plants in the United States. This section also details regulations and directives that Spain's desalination plants must follow. Part IV compares the Carlsbad Desalination Project in the United States to Spain's Llobregat Desalination Plant in Barcelona in order to highlight differences in the two countries' regulatory approaches. Part V concludes with recommendations for how to incorporate effectively desalination into both countries' regulatory regimes.

I. Water Shortages: Why is Desalination Important Now?

In the last century, water use increased at twice the rate of global population growth.[14] According to U.N. Secretary General Ban Ki-Moon, water

11. Heather Cooley, *Desalination and Energy Use . . . Should We Pass the Salt?*, PAC. INST. (May 28, 2013), http://pacinst.org/desal-and-energy-use-should-we-pass-the-salt/. For context, 15,000 kilowatts of electricity could power a million fifteen-watt light bulbs at the same time. *See* Union of Concerned Scientists, *How is Electricity Measured?*, UCSUSA.ORG, http://www.ucsusa.org/clean_energy/our-energy-choices/how-is-electricity-measured.html#.VYnyUaYhy2c (last visited June 23, 2015).

12. Andrew Herndon, *Energy Makes Up Half of Desalination Plant Costs: Study*, BLOOMBERG (May 1, 2013, 12:00 AM), http://www.bloomberg.com/news/2013-05-01/energy-makes-up-half-of-desalination-plant-costs-study.html.

13. *Id.*

14. United Nations Department of Economic and Social Affairs, *International Decade for Action 'Water for Life' 2005-2015*, UN.ORG (last updated Nov. 11, 2014), http://www.un.org/waterforlifedecade/scarcity.shtml.

shortages will affect half of the global population by 2030.[15] With this prediction in mind, countries like the United States and Spain will need to develop resource strategies that address their short- and long-term water conditions.

A. A Drought in California, United States

Recent statistics demonstrate the urgency of the water crisis in California, both for state residents and for businesses. Although historically average rainfall in California has been twenty-two inches annually,[16] 2014 was one of California's driest years on record, with an average rainfall of only 12.08 inches.[17] In 2014, the U.S. Drought Monitor labeled most of the state as experiencing an "exceptional" or "extreme" three-year drought,[18] affecting approximately 37 million people.[19] As a result of the drought, California's agricultural sector is expected to lose $1.5 billion in revenues and incur $454 million in additional pumping costs.[20] Additionally, a report by the University of California Davis estimated that the drought could cause the state to lose 17,100 seasonal and part-time agricultural jobs.[21]

This is not California's first "mega-drought" and it is unlikely to be the last. Over the past thousand years, the state's lands suffered from droughts that regularly lasted ten to twenty years, with one drought spanning 240 continuous years.[22]

More recently, California's urban development has complicated the state's ability to respond to water crises. As California Supreme Court Justice Racanelli explained, "while over 70 percent of the [state's] stream flow lies north of Sacramento, nearly 80 percent of the demand for water supplies originates in the southern region of the state."[23] Thus, California's earliest communities endured water shortages similar to the current

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15. *See Water scarcity by 2030: True for every second person on earth, UN says*, RT.COM, http://rt.com/news/water-shortage-un-population-901/ (last updated Oct. 11, 2013).

16. Veronica Rocha, *California Drought: We Need 11 Trillion Gallons of Water in the Bank*, LA TIMES, Dec. 17, 2014, http://www.latimes.com/local/lanow/la-me-ln-california-drought-11-trillion-gallons-20141216-story.html.

17. California Department of Water Resources, *DWR Increases 2015 Allocation to Water Contractors*, WATER.CA.GOV (Jan. 15, 2015), http://www.water.ca.gov/waterconditions/.

18. Mark Svoboda & Brian Fuchs, *U.S. Drought Monitor: California*, NAT'L DROUGHT MITIGATION CTR. (last updated May 14, 2015, 8:00 AM), http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?CA.

19. *Id.*

20. *See* Richard Howitt et al., *Economic Analysis of the 2014 Drought for California Agriculture*, CTR. FOR WATERSHED SCIENCES, UNIV. OF CAL., DAVIS, i, ii, https://watershed.ucdavis.edu/files/biblio/DroughtReport_23July2014_0.pdf.

21. *Id.*

22. Paul Rogers, *California drought: Past dry periods have lasted more than 200 years, scientists say*, SAN JOSE MERCURY NEWS, (Jan. 25, 2014), http://www.mercurynews.com/science/ci_24993601/california-drought-past-dry-periods-have-lasted-more.

23. United States v. State Water Resources Control Bd., 182 Cal. App. 3d 82, 98 (1986).

drought, though California's modern population distribution and growth continue to exacerbate and complicate the problem.

In an effort to address the water management problem at the state level, California passed emergency drought legislation in March 2014: Senate Bills 103 and 104.[24] Senate Bill 103 authorized $687.4 million in funding for several initiatives to provide relief to workers affected by the drought, fund awareness campaigns, promote bond fund projects to manage and capture water more efficiently, and secure emergency drinking water supplies.[25]

At a more local level, some cities adopted more stringent water regulations and incentive programs to encourage water conservation. For example, the city of San Diego currently has mandatory water restrictions that address residents' excessive irrigation, car washing services, and even how restaurants and hotels operate.[26] The city coupled those restrictions with tax incentives intended to promote water conservation, such as rebates for residents who replace grass landscaping in their homes with sustainable landscape turf.[27] Additionally, although these initiatives led to a six percent drop in the county's water use since 2007, the San Diego Water Authority is still looking to make regional investments in other supply sources, which include independent water transfers from the Colorado River and the construction of the Carlsbad Desalination Project.[28]

B. Spain's "Water Wars" in the North and South

Spain, which is marked by arid terrain, also faces frequent droughts that impact residents and businesses.[29] For example, between September 2013 and May 2014, the country's southeast region experienced its lowest rainfall levels in the last 150 years,[30] which caused forest fires from Catalonia in the north to Andalucía in the south.[31] Further, the lack of rainwater has a direct impact on Spanish agriculture and exports. A recent drought resulted in a loss of €377 million ($446 million)[32] in production, and cost Spain 11,000 jobs.[33] Spain is one of the top worldwide olive oil producers,

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24. *See* Office of Governor Edmund Brown Jr., *Governor Brown Signs Drought Legislation*, CA.GOV (March 1, 2014), http://www.gov.ca.gov/news.php?id=18432.

25. *Id.*

26. City of San Diego, *Drought Alert: Mandatory Water Use Restrictions Effective November 1, 2014*, SANDIEGO.GOV, http://www.sandiego.gov/water/conservation/drought/prohibitions.shtml (last visited May 17, 2015).

27. *Id.*

28. *Id.*

29. Neena Rai, *Spanish Drought Prompts Fears of Widespread Olive Oil Shortage*, WALL ST. J. (Aug. 15, 2014, 7:30 AM ET), http://online.wsj.com/articles/spanish-drought-prompts-fears-of-widespread-olive-oil-shortage-1408102214.

30. *Id.*

31. Laura Edgecumbe, *Spain's Troubled Waters*, EL PAÍS (Mar. 22, 2013), http://blogs.elpais.com/trans-iberian/2013/03/spains-troubled-waters.html.

32. *Euros to U.S. dollars exchange rate for January 12, 2015*, EXCHANGE-RATES.ORG (Jan. 12, 2015), http://www.exchange-rates.org/Rate/EUR/USD/1-12-2015.

33. L. Pérez y Pérez & J. Barreiro-Hurlé, *Assessing the socio-economic impacts of droughts in the Ebro River Basin*, 7 SPANISH J. OF AGRIC. RES. 269, 269 (2009), https://

yet Spain's farmers forecasted a forty percent drop in oil output compared to the 2013 harvest.[34]

Despite record high rainfall over the past year, Spain's northern regions still have drought protection plans in effect.[35] Generally, the Basque and northern region have a much more temperate climate, while Spain's southern and eastern regions experienced record low rainfalls in 2013.[36] Nevertheless, the local Basque government is aware of climate change's impact and expects a rise in average temperatures as well as more intense droughts in the region's future.[37]

As a result, there is a trade-off between the water conservation efforts in northern Spain and the national government's desire to distribute water to even drier regions with projects like the Ebro River inter-basin transfer.[38] For example, as recently as 2008, Spain's Catalonia region in the north experienced a drought, leaving Barcelona with forty percent less rain than usual.[39] The local government took dramatic steps in an effort to respond to this water shortage. Most notably, it spent €22 million ($25 million) to import 23 million liters of water into Barcelona.[40] The local government also imposed emergency measures including turning off civic fountains and beach showers, limiting landscape irrigation,[41] banning the filling of swimming pools, and promoting water management campaigns at schools.[42] All the while, southern regions such as Murcia and Valencia have also attempted to secure additional water supplies,[43] leading some observers to label this time as the "water wars" between the north and south.[44] Against this backdrop of intrastate tension over water supplies, perhaps it is no wonder that Spain looked to desalination as a potential support for a secure water future.

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modelosinputoutput.wordpress.com/2009/06/19/assessing-the-socio-economic-impacts-of-drought/.

34. Rai, *supra* note 29.

35. *Worst Drought in 150 Years Hits Southern and Eastern Spain*, THINKSPAIN.com (May 19, 2014), http://www.thinkspain.com/news-spain/24355/worst-drought-in-150-years-hits-southern-and-eastern-spain.

36. *Id.*

37. *See generally* Elhuyar Fundazio, *URA - The Basque Water Agency, Best Water Management For Its Transparency*, BASQUERESEARCH.COM (Dec. 20, 2013), http://www.basqueresearch.com/berria_irakurri.asp?Berri_Kod=4853&hizk=I#.VEO4x-dmnRw.

38. Alberto Garrido & M. Ramón Llamas, *Water Management in Spain: An Example of Changing Paradigms*, ISSUES IN WATER RESOURCE POL'Y 125, 132–33 (2008), http://www.rac.es/ficheros/doc/00640.pdf.

39. *See* Graham Keeley, *Drought Ignites Spain's 'Water War'*, THE GUARDIAN (April 6, 2008, 04:57 EDT), http://www.theguardian.com/world/2008/apr/06/spain.

40. *See* Graham Keeley, *Barcelona Forced to Import Emergency Water*, THE GUARDIAN (May 14, 2008, 03:40 EDT), http://www.theguardian.com/world/2008/may/14/spain.water.

41. *Id.*

42. Keeley, *supra* note 40.

43. Sue Lloyd-Roberts, *Spain Sweats Amid 'Water Wars'*, BBC NEWS (Aug. 18, 2008, 18:58 UK), http://news.bbc.co.uk/2/hi/europe/7569022.stm.

44. *Id.*

II. Desalination: History and Methods

Desalinating seawater is not a new idea. By 1852, there was a patent recorded in England for a desalination process.[45] The initial demand for desalinated water came from ship crews concerned with running out of drinking water on the high seas.[46] Though modern desalination aims principally to obtain freshwater, earlier producers were also interested in collecting the salt byproduct.[47] Apart from using desalinated water for individual use, it was also treated for military and commercial operations.[48] As early as 1928, Curaçao experimented with the first serious national investments in desalination plants.[49] Even today, Curaçao brewers use desalinated water to produce local beer.[50]

A. History: United States

The United States federal government gained an interest in desalination during World War II.[51] The Saline Water Conversion Act of 1952 allocated public funds for desalination research after the war,[52] and by 1961, one of the first demonstration plants opened in Texas.[53] These demonstration plants provided water for the City of Freeport and for Dow Chemical's industrial operations.[54]

Though research funding for desalination dropped during the 1980s, the 1996 Water Desalination Act authorized an additional $30 million for research and $25 million for demonstration projects.[55] However, even with additional government funding, interest in investing in desalination shifted from public to private investors over time.[56] While there are still questions about desalination's cost-effectiveness that may discourage public investors, private markets recognize the urgency and the potential economic benefits of securing new water alternatives.[57] Today, funding for most desalination projects comes from venture capital firms or private,

45. Kelley, *supra* note 7, at 280.

46. *Id.*

47. Heather Cooley et al., *Desalination, with a Grain of Salt: A California Perspective*, ii, 11 (2006), http://pacinst.org/wp-content/uploads/sites/21/2015/01/desalination-grain-of-salt.pdf [hereinafter *Grain of Salt*].

48. *Id.* at 10.

49. *Id.* at 11.

50. *Id. See also* James Henderson, CARIBBEAN & THE BAHAMAS 452 (James Alexander ed., 2005).

51. Hari J. Krishna, *Introduction to Desalination Technologies*, TEX. WATER DEV. BD. 1, 1 (2004), https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R363/C1.pdf.

52. *Id.*

53. *See History of Texas Operations*, DOW.COM (2014), http://www.dow.com/locations/texas/freeport/about/history.htm. *See also* Krishna, *supra* note 51, at 1.

54. Dow, *supra* note 53.

55. *See also Grain of Salt*, *supra* note 47, at 12.

56. *See e.g.*, Carlsbad Desalination Project, *News*, CARLSBADDESAL.COM, http://carlsbaddesal.com/news (last updated Oct. 19, 2014) [hereinafter *Carlsbad Project News*].

57. *See* John F. Thye, Desalination: Can it be Greenhouse Gas Free and Cost Competitive? 12 (May 9, 2010) (unpublished Masters Project, Yale University) (on file with author).

municipal, state, or sovereign wealth funds.[58]

There are approximately 300 desalination plants in the United States, each with different levels of capacity and output.[59] Those with the greatest capacity are in Florida, Texas, Arizona, and California,[60] including the Tampa Bay Seawater Desalination Plant,[61] the El Paso Inland Desalination Plant,[62] and the Yuma Desalting Plant.[63] Each of these plants provides additional potable water to some of the country's driest regions.

In California, there are a half-dozen desalination plants. These are close to cities such as Sand City, Marina, and Cambria.[64] There are also at least fifteen proposals to build more desalination plants in the state.[65] With the potential for many new desalination plants, it is an open question how state regulators will incorporate desalinated water into the state's local resources.

Critics of desalination in California point to the Charles E. Meyer Desalination Facility as a failed project.[66] In response to the 1986 drought, the City of Santa Barbara authorized constructing this $34 million plant.[67] However, the plant shut down in 1991 due to subsequent and abundant rainfall.[68] Today, there is discussion about reopening the Meyer Facility as an emergency measure during the current drought, though refurbishing it would take up to two years and would cost $20 million.[69]

The Meyers plant was built to respond to severe water shortages, and its development two decades ago serves as a benchmark for changes in desalination plant regulations in California, and what the state's priorities are now when evaluating desalination proposals. In contrast, although the

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58. *Id.*

59. Mark Koba, *How the Pacific Could be California's Drought Fix*, CNBC (Feb. 13, 2014, 4:03 PM ET), http://www.cnbc.com/id/101410845.

60. *Grain of Salt*, *supra* note 47, at 23. *See also* Jefferey M. Sellers, *Desalination Policy in a Multilevel Regulatory State*, INST. OF LEGAL RES. OF UNAM, 173, 180 (2008), *available at* http://www.usc.edu/dept/polsci/sellers/Recent%20Projects/Assets/Sellers%20ch%2014.pdf.

61. The Tampa Bay Seawater Desalination plant produces up to 25 million gallons of drinking water per day. Tampa Bay Water, *Water Supply*, TAMPABAYWATER.ORG, http://www.tampabaywater.org/tampa-bay-seawater-desalination-plant.aspx (last visited May 17, 2015).

62. *See, e.g.*, El Paso Water Utilities, *Water: Setting the Stage for the Future*, EPWU.ORG, http://www.epwu.org/water/desal_info.html (last visited May 17, 2015).

63. *See, e.g.*, U.S. Department of Interior, *Yuma Area Office*, USBR.GOV, http://www.usbr.gov/lc/yuma/facilities/ydp/yao_ydp.html (last visited May 17, 2015).

64. Koba, *supra* note 59.

65. Alisa Odenheimer & James Nash, *Israel Desalination Shows California Not to Fear Drought*, BLOOMBERG (Feb. 12, 2014, 9:21 PM ET), http://www.bloomberg.com/news/2014-02-13/israel-desalination-shows-california-not-to-fear-drought.html.

66. City of Santa Barbara, *Desalination: Project Status*, SANTABARBARACA.GOV, http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/desalination.asp (last visited May 17, 2015).

67. *Id.*

68. *Id.*

69. Patrick Healy, *Drought Prompts Santa Barbara to Consider Mandatory Conservation, Other Measures*, NBC LOS ANGELES (April, 8, 2014, 1:01 PM PDT), http://www.nbclosangeles.com/news/local/Santa-Barbara-Nears-Move-to-Mandatory-Water-Conservation-254292221.html.

upcoming Carlsbad Plant will use the same process as the Meyers Facility to desalinate seawater,[70] the region's approach to desalination appears to have evolved.

For example, the contracts the Meyers facility and the Carlsbad Plant secured from city governments reflect different approaches to desalination. The Meyers Facility had an initial five-year water purchase agreement in which the City of Santa Barbara would purchase a certain amount of water each year.[71] In contrast, the upcoming Carlsbad Plant secured a thirty-year water purchase agreement with the San Diego County Water Authority.[72] To satisfy this thirty-year water purchase agreement, it is very unlikely the Carlsbad Plant will operate on "standby mode" as did the Meyers Facility after the drought ended.[73]

B. History: Spain

As in the United States, Spain gained an interest in desalination after armed conflict. Spain's support of desalination as an industry began in the Canary Islands.[74] After the Spanish Civil War, the government saw investing in desalination as a way to boost tourism in the region.[75] In 1964, Spain installed its first desalination plant on the island of Lanzarote.[76] Because fresh water is so scarce, Lanzarote still secured eighty-one percent of its water from desalination in 2004.[77]

Once the desalination process was successful in the Canary Islands, many Spanish companies began developing desalination plants in mainland Spain.[78] In 2005, the Spanish government supported this trend by instating the Spanish Water Resources National Plan, which called for promoting desalinated water production.[79] In practice, this meant endorsing twenty-eight desalination plant projects in eleven provinces.[80] Rather than diverting water from northern provinces, these new desalination plants

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70. *Compare* City of Santa Barbara, *supra* note 66, *with* Carlsbad Desalination Project, *FAQs*, CARLSBADDESAL.COM, http://carlsbaddesal.com/process-faqs (last visited May 16, 2015).

71. City of Santa Barbara, *supra* note 66.

72. *Carlsbad Project News*, *supra* note 56.

73. WATER RESOURCES DIVISION, PUBLIC WORKS DEPARTMENT, CITY OF SANTA BARBARA, COUNCIL AGENDA REPORT, 1, 1 (May 6, 2014), *available at* http://services.santabarbaraca.gov/CAP/MG116858/AS116862/AS116876/AS116887/AI121087/DO121103/DO_121103.PDF.

74. *See* MIT Technology Review, *Desalination in Spain*, ICEX.TECHNOLOGY REVIEW.COM, http://icex.technologyreview.com/articles/2009/01/desalination-in-spain/3/ (last visited May 17, 2015) [hereinafter MIT Technology Review].

75. *Id.*

76. *Id.*

77. Ana Manero, Comparative Water Management Practices in California and Spain (Jan.16, 2008) (Unpublished Minor Thesis, Universitat Politècnica de Catalunya), 92, 95, *available at* http://upcommons.upc.edu/pfc/bitstream/2099.1/6053/11/10.pdf.

78. *See* MIT Technology Review, *supra* note 74.

79. P. Palomar & I.J. Losada, *Desalination in Spain: Recent developments and recommendations*, 255 DESALINATION 97, 97 (May 2010), *available at* http://www.sciencedirect.com/science/article/pii/S0011916410000305.

80. *Id.* at 98.

would provide water to Spain's Mediterranean coast, where the country faces its greatest water shortages.[81]

Today, the country's production of desalinated water continues to increase.[82] As environmental researchers Palomar and Losada explained, "the temporal irregularity in river flow and the excessive exploitation and pollution of underground waters . . . make it necessary to search for alternative water sources to meet the water demands of the tourist populations and the irrigated agriculture [in Spain]."[83] While in 2000 there were 750 desalination plants in Spain with a capacity of 1.2 Mm^3/day (or 317 million gallons/day), by 2005 there were approximately 950 plants producing 1.5 Mm^3/day (396 million gallons/day).[84] Notably, private corporations rather than the government built most of these small plants.[85]

Supporters of desalination in Spain look to Barcelona, which has Europe's largest functioning desalination plant. The Llobregat Desalination Plant serves twenty percent of city residents[86] and produces 52.8 million gallons per day.[87] The Llobregat Plant even won the 2010 Global Water Award for its design and technological achievement.[88]

However, there are also desalination projects in Spain of the same magnitude as the Barcelona Desalination Plant that failed. For example, the Torrevieja Desalination Project could produce 320,000 m^3/day (84 million gallons/day), compared to the Barcelona plant's capacity of 240,000 m^3/day (63 million gallons/day).[89] A $400 million investment, developers envisioned the Torrevieja plant would supply water to upcoming apartment projects and tourism sectors.[90] Yet the 2007 economic decline in Spain's construction industry deflated water demand.[91] As Andrés Cala explained, "[n]ow, after nearly a decade, the result is a graveyard of part-built or idled plants, while completed plants are operating below capacity. Actual water output is less than 20 percent of the volumes originally envisioned."[92] In short, experience with desalination in Spain and the United States suggests that water production capacity and demand are the main factors that determine whether a desalination plant is a sustainable operation.

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81. *Id.* at 97.
82. *Id.*
83. *Id.*
84. *See id.*
85. *Id.*
86. MIT Technology Review, *supra* note 74.
87. Energy Recovery Inc., *SWRO desalination: Long-term solution for water shortages*, FILTRATION+SEPARATION.COM (Nov. 2, 2010), http://www.filtsep.com/view/13658/swro-desalination-long-term-solution-for-water-shortages/.
88. MIT Technology Review, *supra* note 74.
89. *See* Palomar & Losada, *supra* note 79, at 98.
90. Andrés Cala, *Spain's Desalination Ambitions Unravel*, N.Y. TIMES, Oct. 9, 2013, http://www.nytimes.com/2013/10/10/business/energy-environment/spains-desalination-ambitions-unravel.html?pagewanted=all&_r=1&.
91. *Id.*
92. *Id.*

C. Methods: How Do You Remove Salt from Sea Water?

Although artificial methods are the main subject of this Note, desalination is also a climatological process.[93] Through evaporation and condensation, the hydrologic cycle separates water from the salt in oceans and lakes to produce freshwater vapor.[94] In many ways, desalination plants recreate this through industrial processes.

Several desalination methods exist, each varying in cost depending on the energy they require to produce potable water,[95] but two methods are most common: thermal distillation and membrane filtration. Thermal distillation essentially boils water in large volumes, which separates the salt from the resulting water vapor.[96] There are different ways to accomplish this at a large scale. For example, multi-stage flash distillation (MSF) uses low-pressure separation chambers,[97] while other methods use compression to generate the heat necessary to produce purified vapor.[98] Generally, the more salt the water contains, the more energy is necessary to produce the desalinated water.[99]

The second method is membrane filtration. Reverse osmosis, a type of membrane filtration, is the most common method used in California's desalination plants.[100] After seawater enters a series of permeable membranes, the osmosis process filters seawater until there is an equal salt concentration on either side of the membrane.[101] Reverse osmosis applies an additional pressure to the membrane diffusion. This causes the water to go against its natural flow and separate from the salt.[102] Yet, with time, reverse osmosis membranes can develop an additional "biofilm" that grows on the membranes.[103] To counteract biofilms, operators have to apply even more pressure to the membranes to force the water against its natural flow.[104] This requires additional energy.[105] Though new desalination technologies focus on lowering energy costs,[106] reverse osmosis remains the "gold standard" for large-scale desalination.[107]

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93. *See Grain of Salt*, *supra* note 47, at 10.
94. *Id.*
95. *See generally* Herndon, *supra* note 12.
96. Robin Kundis Craig, *Symposium - Water Supply, Desalination, Climate Change, and Energy Policy*, 22 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 227, 236 (2010).
97. *Id.*
98. *Id.*
99. *See* Herndon, *supra* note 12. *See also* Craig, *supra* note 96, at 238.
100. *See* Matthew Lewis, *Comment: Thirsty for Change: Desalination As a Practical and Environmentally Friendly Answer to California's Growing Water Shortage*, 44 U.S.F. L. REV. 933, 936 (2010).
101. *Id.*
102. *Id.*
103. Cheryl Katz, *New Desalination Technologies Spur Growth in Recycling Water*, E360.YALE.EDU (June 3, 2014), http://e360.yale.edu/feature/new_desalination_technologies_spur_growth_in_recyling_water/2770/.
104. *Id.*
105. *Id.*
106. *Id.*
107. *Id.*

III. What Laws Apply to Desalination Plants?

National and local laws limit how desalination plant developers can treat seawater.[108] From property rights in desalinated water to construction and environmental restrictions, how a country chooses to regulate desalination impacts its use as a water supply. The following section explains the frameworks that the United States and Spain use to manage desalinated water within their borders.

A. Desalination and U.S. Federal Law

In the United States, desalination plant developers must comply with federal environmental standards. Apart from state laws, the Federal Water Pollution Act (Clean Water Act) regulates how to withdraw water for industrial purposes.[109] This includes "once-through-cooled" power plants.[110] As the name suggests, these types of plants take in seawater to cool equipment at electrical plants.[111] Thus, although desalination plants intake water for a different purpose, they arguably create the same harm to the environment and to marine life, and their design and construction could be subjected to similar environmental requirements.[112]

Furthermore, plants' certification and reporting processes could encounter a serious hurdle if endangered species inhabit the area of a plant's proposed location. Specifically, the Endangered Species Act includes a "jeopardy clause,"[113] which requires developers to modify a project if it will jeopardize the existence of an endangered species. If there is no way to mitigate this concern, it could end the entire project.[114] Thus, ensuring a proposed plant will meet environmental standards is instrumental to whether the project will receive the necessary permits to begin construction.

Beyond endangered species, U.S. plants must also follow federal fishery protection laws. The Fish and Wildlife Coordination Act authorizes the Secretary of Agriculture and Secretary of Commerce to coordinate with state and federal agencies "to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic

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108. An example of these limits is the NPDES permit process in the U.S. involving both state and federal actors. *See* U.S. Environmental Protection Agency, *State Program Status*, WATER.EPA.GOV, http://water.epa.gov/polwaste/npdes/basics/NPDES-State-Program-Status.cfm (last updated Sept. 9, 2014) [hereinafter *State Program Status*].

109. Federal Water Pollution Act (Clean Water Act), 33 U.S.C.A. §§1251–1376 (2014). *See also* Kelley, *supra* note 7, at 279.

110. Kelley, *supra* note 7, at 287–88.

111. *Id.*

112. *Id.*

113. 16 U.S.C. § 1536(a)(2) specifies: "Each Federal agency shall . . . insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species."

114. Lewis, *supra* note 100, at 949–50.

sewage, trade wastes, and other polluting substances on wildlife."[115] The seawater intake process and the salt brine byproduct from desalination could trigger federal investigations on the impact of these processes on fisheries near plants. Therefore, federal law addresses concerns about salinity levels and urban development, but also identifies particular wildlife that could be harmed by the project.

B. Desalination and California State Law

Given how diverse water sources are throughout the United States, different regions of the country have developed different regimes for property interests in water. While many East Coast states follow a riparian or reasonable use water regime, most West Coast states, like California, follow some type of prior appropriation or concessionary water system.[116] This section addresses how California law today legally defines desalinated water and how other state laws may influence related property rights.

1. How Does California Define Desalinated Water?

Article X, Section 2 of the California Constitution states, "the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable . . . ."[117] Because California has a "mixed doctrine" water regime, its laws protect a combination of riparian, prior appropriation, and permit rights to water.[118] Riparian rights involve having permission to extract water from a source as long as it is for a reasonable use. By contrast, prior appropriation rights allocate a specific water quantity to a user in a "first come, first served" process[119] that respects prior, historical rights in the water source. This means that California must uphold the water rights it already recognizes despite the constitutional mandate to maximize benefit from its water resources.[120] Given that practically all the water resources in the western United States are already assigned to a user or even over-appropriated,[121] the state must look to other resources outside of natural streams, lakes, and aquifers to address demand.

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115. U.S. Fish and Wildlife Service, *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service, Fish and Wildlife Coordination Act*, FWS.GOV, https://www.fws.gov/laws/lawsdigest/FWCOORD.HTML (last visited May 17, 2015).

116. *See generally* ROBERT W. ADLER ET AL., MODERN WATER LAW: PRIVATE PROPERTY, PUBLIC RIGHTS, AND ENVIRONMENTAL PROTECTIONS 87–171 (Robert C. Clark et al. eds., 2013).

117. Cal. Const. art. X § 2.

118. ADLER, *supra* note 116, at 254.

119. Jeff Guo, *It is Actually Illegal in Colorado to Collect the Water that Falls on Your Home*, WASH. POST, Mar. 24, 2015, http://www.washingtonpost.com/blogs/govbeat/wp/2015/03/24/it-is-actually-illegal-in-colorado-to-collect-the-rain-that-falls-on-your-home/.

120. *See* ADLER, *supra* note 116, at 102 ("California judicially recognized appropriative rights and has not yet cut off unused riparian claims, although it has by constitutional amendment limited those rights to 'reasonable' rather than potentially unlimited use . . . .").

121. *See* Brandon Scarborough, *Buy That Fish a Drink*, 25(2) PERC REPORT (2007), http://perc.org/articles/buy-fish-drink.

In terms of property rights, desalinated water does not fit into the legal categories that developed for water in the West, most of which is appropriated—that is, water from a limited, natural source that the state allocates to specific users.[122] For example, under an appropriation system, water in a state stream that does not already have a property interest attached to it is considered un-appropriated. Thus, the state can assign this water to a new user. A basic assumption of the prior appropriation system is that water is a limited resource, which leaves decisions about allocating water rights to the state.[123]

On the other hand, desalinated freshwater is "newly" developed water that is not from a traditional water source. According to the Colorado Water Institute, developed water is "produced or brought into a water system through the efforts of people, where it would not have entered the water system on its own accord."[124] Because desalination plants produce water that would not otherwise enter the system, such water is developed water, and different from un-appropriated water.[125] Given that desalinated water falls outside the legal categories of the West's appropriation regime, the state does not allocate rights to desalinated water through permits.[126] This is a potential benefit for desalination processors, who are not burdened by other users claiming superior interests in the desalinated water.

California courts, however, may also consider whether the seawater desalination plants collect is subject to the state's public trust doctrine. In *National Audubon Society v. Superior Court of Alpine County*, the California Supreme Court explained, "[t]he state as sovereign retains continuing supervisory control over its navigable waters . . . . This principle . . . prevents any party from acquiring a vested right to appropriate water in a manner harmful to the interests protected by the public trust."[127] Desalination plants collect seawater from the Pacific Ocean, which is navigable.[128] Thus, extracting seawater may mean extracting water from a public resource. Applying this reasoning, California may limit a desalination plant's right to take seawater if the state finds that collecting the water is against the public interest. The court in *National Audubon* also found that the state could reconsider a water right after it had already allocated it to a

122. *Id.*

123. *Id.*

124. R. Waskom & M. Neibauer, *Glossary of Water Terminology*, COLOSTATE.EDU (last updated Aug. 5, 2014), http://www.ext.colostate.edu/pubs/crops/04717.html.

125. *Id.*

126. The State Water Resources Control Board is a key state entity in the permit process. Adler, Craig, and Hall explain, "The State Water Resource Board conducts both adjudicatory and regulatory functions regarding water resources in California . . . but its decision are subject to review in state court . . . . The Board is unusual in its authority to address both water quantity and water quality issues . . . ." ADLER, *supra* note 116, at 255.

127. Nat'l Audubon Soc'y v. Superior Court, 33 Cal. 3d 419, 445–46 (1983) ("The State has an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible.").

128. *See* ADLER, *supra* note 116, at 283-84 (discussing early federal admiralty jurisdiction as based on navigability of coastal and tidal waters).

party, regardless of how long the appropriator had previously held the right.[129] Furthermore, the case discussed the balance between protecting water rights and safeguarding resources for the public benefit.[130]

In short, taking seawater from California's coast could create uncertainty in the desalination process as to whether a plant will have access to seawater in the future. As long as the desalination's harm to the coasts does not trigger public trust concerns, however, developers may market a new water source without worrying about other owners with superior rights. In fact, desalination supporters may argue that, during a drought, providing desalinated water to California residents is in the public interest.

2. Desalination Under California Regulations

Though desalinated water was not a part of California's original water regime, there are several state laws that regulate its production. Section 13142.5(b) of California's Porter-Cologne Water Quality Control Act explains, "[F]or each new or expanded coastal powerplant or other industrial installation using seawater for cooling, heating, or *industrial processing*, the *best available* site, design, technology, and mitigation measures feasible shall be used to minimize the intake and mortality of all forms of marine life."[131] Several desalination plants in California fall under the limitations of the Porter-Cologne Act. First, many desalination plants use seawater to produce potable water. Second, desalination plants provide this freshwater supply through large-scale treatment of the seawater, using this water as a part of industrial processing. Third, the statute's concern for marine life is also a concern with desalination plants because of their intake processes.[132]

If a desalination plant falls under the Porter-Cologne Act, the statute's "best available" language applies to its design and operations.[133] Thus, developers should consider the best practices the state approved for past desalination projects, but also any design or technology changes that could impact the best characteristics available for a new plant. The state may require a different or even higher standard for the new plant compared to older projects under the assumption that, as time passes, the best available site, design, technology, and mitigation measures may change. This analysis is also site-specific.[134] In sum, the Porter-Cologne Act provides a progressive standard for desalination that adapts as technology improves.

Apart from the Porter-Cologne Act, desalination plant proposals must follow the California Safe Drinking Water Act (CSDWA), the California

129. *Id.* at 447 ("In exercising its sovereign power . . . in the public interest, the state is not confined by past allocation decisions that may be incorrect in light of current knowledge or inconsistent with current needs.").

130. *Id.* at 445.

131. *See generally* CAL. WATER CODE §§ 13000–14076 (Westlaw 2011) (emphasis added).

132. *See also* Kelley, *supra* note 7, at 279–80.

133. *See id.* at 279.

134. Christopher Garrett, *The Carlsbad Desalination Project– A Case Study of Permitting and Approvals*, WATER L. & POL'Y MONITOR, 5 (Oct. 1, 2014).

Coastal Act (CCA), and the California Environmental Quality Act (CEQA). If a developer wants to provide consumers with desalinated water, the developer must comply with CSDWA, which stresses that every California citizen has the right to pure and safe water.[135] Furthermore, the CCA authorizes the California Coastal Commission (CCC) to assist in establishing local coastal plans and granting coastal development permits.[136] For practical reasons, most developers build seawater desalination plants close to the ocean, which means the CCC can oversee the project.[137] Developers then must keep in mind state quality control standards for water, while also considering the desalination plant's long-term impact on coastal development.

Additionally, CEQA may require a lead agency to produce an Environmental Impact Report (EIR) on a future desalination project.[138] This agency determines if the desalination plant is a "growth-inducing" project.[139] Because desalination plants provide another water source, they can also encourage increased urbanization.[140] Though CEQA does not identify the lead agency for desalination projects, the EIR requirement adds an environmental analysis to the permit approval process at the state level.

A final example of how state regulations can shape desalination projects is the potential amendments to California's Ocean Plan.[141] The Ocean Plan's purpose is to outline a water quality control standard that limits waste discharged into the ocean.[142] This is relevant to desalination plants looking to dispose of salt brine left over after processing the seawater.

Currently, the State Water Board can oversee salt brine discharges by deciding whether or not to issue a National Pollutant Discharge Elimination System (NPDES) permit to a desalination plant.[143] The NPDES permit process aims to "control . . . water pollution by regulating point sources that discharge pollutants into waters of the United States."[144] Though the

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135. CAL. HEALTH & SAFETY CODE § 116270 (West 2005), *available at* http://law.justia.com/codes/california/2005/hsc/116270-116293.html.

136. *See* CAL. PUB. RES. CODE § 30001(a) (Deering 2015); Lewis, *supra* note 100, at 935.

137. *See* California Coastal Commission, *What We Do*, COASTAL.CA.GOV (2014), http://www.coastal.ca.gov/whoweare.html

138. CEQA specifies, "All lead agencies shall prepare, or cause to be prepared by contract, and certify the completion of, an environmental impact report on any project which they propose to carry out or approve that may have a significant effect on the environment . . . . The environmental impact report shall include . . . [t]he growth-inducing impact of the proposed project." CAL. PUB. RES. CODE § 21100(a), (b)(2)(B)(5) (1994). *See* Lewis, *supra* note 100, at 939.

139. Lewis, *supra* note 100, at 939.

140. *Id.*

141. *See generally* State Water Resources Control Board, *California Ocean Plan*, CAL. ENVTL. PROTECTION AGENCY, 1 (2012), http://www.swrcb.ca.gov/water_issues/programs/ocean/docs/cop2012.pdf.

142. *Id.*

143. *Id.* at iv.

144. U.S. Environmental Protection Agency, *NPDES Home*, WATER.EPA.GOV (last updated Sept. 18, 2014), http://water.epa.gov/polwaste/npdes/.

NPDES is a federal requirement that the Environmental Protection Agency (EPA) oversees, some authorized states (including California) can issue these permits.[145] These permits typically have conditions on how a plant may dispose of salt brine.[146] Nevertheless, there are no uniform statewide requirements to inform these conditions,[147] creating ambiguity about brine-disposal standards required for a desalination plant to receive an NPDES permit.[148]

Through new monitoring and reporting requirements, the Ocean Plan amendments seek to clarify the State Water Board's authority over desalination plants and their brine discharges.[149] Overall, the State Water Board is in charge of preserving, enhancing, and restoring the quality of California's water resources to ensure its proper allocation and efficient use.[150] As with the Porter-Cologne Act, regulatory changes through statewide initiatives like the Ocean Plan are very likely to change the standard the state uses to evaluate desalination plant proposals.

In sum, there is a complex web of federal and state requirements that leaves unclear which agency has the final authority over whether a desalination project in California may move forward, a difficulty often referred to as the "chicken and egg" problem.[151] In practice, the chicken and egg permit problem leads to a very long and detailed approval process.[152] By analyzing the Carlsbad Desalination Project's permit process, Part IV will discuss what it means to coordinate compliance across federal, state, and city authorities in California.

C. Desalination & Spanish National Law

Under Spain's 1985 Water Act, water is a state-owned asset.[153] This establishes the default rule that the government can decide how to allocate and distribute all the water within Spain's borders.[154] As Professor Antonio Enid Irujo noted, "[n]obody [in Spain] has a 'right' to be granted a use of waters. This would be contradictory with the constitutionally guar-

145. *See State Program Status*, *supra* note 108.

146. State Water Resources Control Board, *Ocean Standards: Desalination Facilities and Brine Disposal*, SWRCB.CA.GOV (last updated Aug. 26, 2014), http://www.swrcb.ca.gov/water_issues/programs/ocean/desalination/ ("Currently, the Water Boards regulate brine discharges from these types of facilities through the issuance of National Pollutant Discharge Elimination System (NPDES) permits that contain conditions protective of aquatic life.").

147. *Id.*

148. *Id.*

149. *Id.*

150. State Water Resources Control Board, *About the Water Board*, SWRCB.CA.GOV (last updated Aug. 26, 2014), http://www.swrcb.ca.gov/about_us/.

151. ADLER, *supra* note 116, at 515.

152. *See* Garrett, *supra* note 134, at 1.

153. *See generally* Ley de Aguas (B.O.E. 1985, 189), *available at* http://www.boe.es/boe/dias/1985/08/08/pdfs/A25123-25135.pdf.

154. *Id.*

anteed position of the owner of the public hydraulic domain, the State."[155] Thus, the 1985 water regime establishes a concessionary approach to water rights, where the State approves who can use the country's water resources and in what way.

Though the State owns the country's water resources, the 1985 Water Act allows local agencies to participate in enforcing the Act's water regime. As a UNESCO report explains, "[u]nder the Act, river basins crossing territories of multiple autonomous communities [in Spain] are managed by 15 river basin agencies known as hydrographic confederations."[156] In short, water management in Spain involves both national and local authorities.

Originally, the 1985 Water Act did not mention desalinated water.[157] The Act only outlined natural freshwater sources such as streams, lakes, and aquifers as state assets.[158] However, a 2005 amendment added Article 2(e), which specified that potable water produced from seawater was indeed a part of the State's property interests.[159] Where the law in the United States remains unclear as to who ultimately controls desalinated water rights, Spain's national law begins with the assumption that water sources are state-owned assets. The property interests in desalinated water are then clearly tied to Spain's national interests through the 1985 Act.

After several amendments, Spain's 1985 Water Act now has an entire section dedicated to desalinated water requirements.[160] These amendments were the result of increased water demands, changes in technology, and a need to include alternative water supplies in the country's water regime after a major drought.[161] Under Article 13 of Spain's current legislation, the general water regime of the 1985 Act will still apply to desalinated water.[162] Furthermore, if a desalination plant's purpose is for the State's general interest (as opposed to purely private interests), then

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155. Antonio Embid Irujo, *International Conference on: Water Management in Federal and Federal-Type Countries, Spain Report* 37, n.78 (2008), *available at* http://www.forumfed.org/en/global/thematic/water_papers/Antonio%20Embid%20en_final.pdf.

156. UNESCO, *Europe and North America* in "Case Study Volume: Facing the Challenges" 59, *available at* http://webworld.unesco.org/water/wwap/wwdr/wwdr3/case_studies/pdf/Case_Studies_EuropeNorthAmerica.pdf#page=16. *See also* Garrido & Llamas, *supra* note 38.

157. Article 2 of the 1985 Water Act defines the "dominio público hidráulico" or the hydraulic public domain of Spain's water systems. Texto Refundido Ley de Aguas, R.D.L. 1/2001, *available at* http://www.boe.es/buscar/pdf/2001/BOE-A-2001-14276-consolidado.pdf.

158. *Id.*

159. Article 2(e) read, "[l]as aguas procedentes de la desalación de agua de mar" as an additional amendment to the 1985 Water Act. Texto Refundido Ley de Aguas, R.D.L. 1/2001, *available at* http://www.boe.es/buscar/pdf/2001/BOE-A-2001-14276-consolidado.pdf (noting updated legislation including desalination provision).

160. Texto Refundido Ley de Aguas art. 13, R.D.L. 1/2001, *available at* http://www.boe.es/buscar/pdf/2001/BOE-A-2001-14276-consolidado.pdf (noting amendments to legislation including Article 13 on desalination under Chapter 5) [hereinafter Article 13].

161. *See* Ley 46/1999, B.O.E. 1999, 298, 13, *available at* http://www.boe.es/boe/dias/1999/12/14/pdfs/A43100-43113.pdf.

162. Article 13, *supra* note 160, at art. 13(5).

national and local agencies can manage the plant directly.[163] Finally, if the developer with the permit to desalinate seawater is not the ultimate and exclusive consumer of the water, then the State can set minimum and maximum prices at which to sell the final product.[164]

In sum, Spanish legislation is much clearer than federal or California state law on how desalination fits into the country's water regime, who owns the water, and how rights are distributed. The water rights the Spanish government allocates create an approach similar to the appropriation regime available in some U.S. states, where the state owns the water and gives permits to users to consume a certain quantity.[165] Desalination plant developers in Spain can then expect both national and local oversight of their projects, with even more government participation in projects the government labels as in the State's general interest.

Apart from understanding how desalinated water fits into the country's water law regime, desalination plant developers in Spain must understand how supranational regulations affect the industry's development. For example, in 2000 the European Union enacted the Water Framework Directive (WFD).[166] The WFD outlines EU-wide standards for water pricing, environmental goals, and new requirements for public participation in water management.[167] As an EU Directive State, Spain must superimpose the WFD's requirements onto existing legislation and harmonize the two.[168]

Prior to enactment of the WFD, Spain's approach to water policy focused on the Spanish National Hydrological Plan, which emphasized water distribution across regions of the country.[169] As Professors Garrido and Llamas explain, "[f]or Spain, as well as most other EU countries, the WFD implies a rebalancing of priorities from ensuring water supplies to all economic users to improving the ecological status of all water bodies."[170] In other words, Spain's water management not only involves allocating a resource, but the WFD now requires a greater emphasis on preserving water sources. Naturally, desalination plants' impact on available water sources would be a part of this analysis. Furthermore, the WFD's implications for Spain's overall water management suggest that there are different legal sources that could influence how a desalination plant can operate in Spain.

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163. Examples of agencies that can manage desalination plant operations are the Ministry for the Environment or the more local hydrographic confederations. *See id.* at art. 13(2).

164. *Id.* at art. 13(5).

165. *See generally* ADLER, *supra* note 116, at 87–171.

166. Garrido & Llamas, *supra* note 38, at 126.

167. *Id.*

168. *See id.*

169. *See* Lucia De Stefano & Nuria Hernández-Mora, *Water Planning and Management After the EU Water Framework Directive*, *in* WATER, AGRICULTURE, AND THE ENVIRONMENT IN SPAIN: CAN WE SQUARE THE CIRCLE? 35, 36 (Lucia De Stefano & M. Ramón Llamas eds., 2013).

170. Garrido & Llamas, *supra* note 38, at 126.

IV. Case Studies: United States and Spain

The following case studies highlight the practical implications of United States and Spanish law and policies regulating desalination plants. This section describes the Carlsbad Desalination Project and the Llobregat Desalination Plant as examples of how governments can read national and local law to allow desalination plants to provide new water resources, while at the same time promoting stricter environmental standards over time.

A. The Carlsbad Desalination Project: California, United States

In 2016, Poseidon Water will launch the Carlsbad Plant in California. A public-private partnership with the San Diego County Water Authority,[171] the desalination plant will be the largest in the Western Hemisphere.[172] With approximately $1 billion in investment, the Carlsbad Plant aims to deliver fifty million gallons of fresh water per day[173]—enough to satisfy almost ten percent of San Diego's residents[174]—by using the reverse osmosis process discussed in Part II.[175]

Due to the project's magnitude and the state's current water shortage, many view the Carlsbad project as a test case for future desalination projects in California.[176] Currently, there are fifteen project proposals for desalination plants along the California coast.[177] The state's oversight of the project through the permit process may set a precedent for desalination's future in California.

1. A Long Permit Process for the Carlsbad Plant

Looking to the permit process timeline, Poseidon Resources first proposed the Carlsbad Desalination Project in 1998.[178] By 2006, the City of Carlsbad certified the project's EIR after consulting with several agencies.[179] In 2009, the City of Carlsbad also approved an addendum to the

171. *Carlsbad Project News*, *supra* note 56.

172. Greg Lee, *Carlsbad Desalination Plant Helps Curb Water Demands*, ABC NEWS, Oct. 28, 2014, http://abc7.com/science/carlsbad-desalination-plant-helps-curb-water-demands/369579/.

173. *Id.*

174. *Id.*

175. *See, e.g.*, *Carlsbad Project News*, *supra* note 56.

176. Paul Rogers, *Nation's largest ocean desalination plant goes up near Sand Diego; Future of the California coast?*, SAN JOSE MERCURY NEWS, May 29, 2014, http://www.mercurynews.com/science/ci_25859513/nations-largest-ocean-desalination-plant-goes-up-near.

177. *See* Scott Bridges, *Carlsbad $1 billion desalination plant is "Test Case"*, LA BIZ (June 16, 2014), http://www.bizjournals.com/losangeles/news/2014/06/16/carlsbad-1-billion-desalination-plant-is-a-test.html?page=all.

178. Carlsbad Desalination Project, *Surfrider Foundation Abandons Lawsuit Challenging Carlsbad Desalination Project*, CARLSBADDESAL.COM (Jan. 8, 2010), http://carlsbad-desal.com/surfrider-foundation-abandons-lawsuit

179. *See* Dudek, *Second Addendum, Precise Development Plan and Desalination Plant Project, Final Environmental Impact Report (EIR 03-05) City of Carlsbad, California*, SAN DIEGO COUNTY WATER AUTHORITY, 3 (November 2012), *available at* http://www.sdcwa.org/sites/default/files/files/environmental-docs/Desal/CEQA%20Addendum_SDCWA%20Improvements_11_16_12.pdf.

project's EIR, as well as six local land use permits focusing on project development, habitat management, and coastal development plans.[180] To issue these permits, the City consulted the California Coastal Commission, the California State Lands Commission, and San Diego's Regional Water Quality Control Board.[181] After the City of Carlsbad approved the permits, community groups began lawsuits targeting whether it was proper for California and the City of Carlsbad to approve these permits at all.[182]

Apart from receiving NPDES approval in 2010,[183] the project secured approval for twenty permits and plans from the San Diego Water Authority.[184] It also acquired additional permits that addressed public health and environmental issues.[185] These involved drinking water quality, leases, coastal development, energy minimization, greenhouse gases concerns, erosion projections, and water pollution standards.[186] For example, California's Department of Health Services approved the plant's water treatment process for eliminating certain contaminants and parasites to produce safe drinking water.[187] The Carlsbad Plant petitioned the State Lands Commission to receive a lease for ocean water intake and discharge piping,[188] and also sought approval from the CCC for its project development plans.[189]

The Carlsbad Plant confirmed that it has completed all of the required permits to supply water by 2016.[190] One may wonder if the permit process will be as extensive for future projects. Perhaps the Carlsbad Plant established the regulatory groundwork for future large-scale desalination projects. Yet state agencies' case-by-case evaluations will possibly cause future projects to undergo a similarly complicated and uncertain process.

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180. *See* Poseidon Water, Six Years of Permitting, (2013) (on file with author).

181. *Carlsbad Project News*, *supra* note 56.

182. *See* Garrett, *supra* note 134, at 4.

183. Cal. Regional Water Quality Control Board, *Order No. R9-2010-0073*, 1, 1-2 (May 12 2010), http://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2010/R9-2010-0073.pdf.

184. *See* San Diego County Water Authority, *Carlsbad Desalination Project Approved Permits and Plans*, SDCWA.ORG (2014), http://www.sdcwa.org/carlsbad-desalination-project-approved-permits-and-plans.

185. *Id.*

186. *Id.*

187. *See* Letter from Brian Bernados, San Diego District Engineer, to Peter MacLaggan, Senior Vice President Poseidon Resources, 1 (Oct. 19, 2006), http://www.sdcwa.org/sites/default/files/files/environmental-docs/city-of-carlsbad/9-drinking-water-permit-conceptual-approval-letter-Oct19_2006.pdf [hereinafter Bernados Letter].

188. Bradley J. Fikes, *Water: Carlsbad Desal Plant Gets Final Approval*, CACOASTKEEPER.ORG (Aug. 22, 2008), http://www.cacoastkeeper.org/news/water-carlsbad-desal-plant-gets-final-approval.

189. Water Education Foundation, *Coastal Commission Issues Construction Permit to Carlsbad Desalination Project; Pre-Construction of California's First Large-Scale Seawater Desalination Plant Starts Next Week*, WATEREDUCATION.ORG (Nov. 3, 2009), http://www.watereducation.org/aquafornia-news/coastal-commission-issues-construction-permit-carlsbad-desalination-project-pre.

190. *Carlsbad Project News*, *supra* note 56.

2. Litigation Against the Carlsbad Plant

Evaluating court opinions for cases challenging the Carlsbad Plant's permits reflects how the state balances environmental conservation and increasing water demands. The state judicial system serves as an additional level of review for the permits that state agencies approve. Thus, state court decisions provide insight into how the state balances environmental standards and requests to approve new water resources like desalination.

Because several agencies and the courts have the authority to approve different aspects of a desalination proposal, it is unclear who has the final say on whether the project can move forward.[191] For example, many of the Carlsbad Plant's permits have the condition of securing other permits.[192] If a court found invalid one of the permits that the project secured, the project may not meet the requirements for the other permits it already secured. Fourteen cases[193] were lodged against the Carlsbad Plant, which delayed construction until December 2012.[194] Understanding the key cases among these is vital to understanding whether desalination as an industry can comply with law and navigate the chicken and egg problem.

Apart from the court system, some administrative agencies also review permits. For example, in 2006 the Southern California Watershed Alliance and the Desal Response Group challenged the Carlsbad Plant's EIR certification.[195] After the court dismissed the case due to a statute of limitations violation,[196] the two groups filed a challenge with California's State Water Resources Control Board.[197] The Board found that the San Diego Water Quality Board acted appropriately when it issued a salt brine discharge permit to the project.[198] So, permit review may involve a combination of administrative and judicial actors, complicating the chicken and egg permit problem even further.

San Diego Coastkeeper v. California State Lands Commission in 2010 also involved a challenge to the Carlsbad Plant's EIR certification process.[199] In the California Court of Appeals, Coastkeeper argued that

191. ADLER, *supra* note 116, at 515.

192. *See, e.g.*, Bernados Letter, *supra* note 187.

193. From 2006 to 2011, there were fourteen legal challenges to the Carlsbad Desalination Project's permits. These included nine cases in California state courts, three permit challenges before the California State Water Resources Control Board, and two challenges before the California Coastal Commission. *See* Poseidon Resources, Chronology of Legal Challenges to Poseidon's Carlsbad Seawater Desalination Project, (2014) (on file with author).

194. Rogers, *supra* note 176.

195. Terry Rodgers, *Group sues Carlsbad for desalination plant report*, U-T SAN DIEGO (July 20, 2006), http://www.utsandiego.com/uniontrib/20060720/news_1mi20suit.html.

196. *See Chronology of Carlsbad's Legal Challenges*, Sept. 2011 (on file with Poseidon Water).

197. Poseidon Resources, *News Release*, COMPLETECAMAPAIGNS.COM (June 5, 2007), https://www.completecampaigns.com/Sitebuilder/CarlsbadDeSal/news.aspx?id=135.

198. *Id.*

199. 2010 Cal. App. LEXIS 9797 (Cal. App. 4th Dist. Dec. 10, 2010).

CEQA required the State Lands Commission to prepare a supplemental EIR.[200] Coastkeeper argued that Carlsbad's final EIR did not sufficiently analyze the plant's environmental impact should the Encina Power Station stop providing seawater to the desalination plant.[201] In theory, using the Encina Power Station's seawater intake to cool the plant would minimize the desalination plant's own seawater intake.[202] Despite Coastkeeper's concerns, the court found that the State Lands Commission complied with CEQA.[203] The court noted the desalination plant's final EIR did consider the marine life impact of the plant if it were a standalone facility.[204] Taken together, the cases brought by the Southern California Watershed Alliance, the Desal Response Group, and Coastkeeper suggest that once a desalination plant receives a permit from an agency, courts will show deference to the agency that issued the permit, decreasing the probability that the developer will lose the permit in the future.

Surfrider Foundation v. California Regional Water Quality Control Board is a final example of how courts analyze whether a desalination plant complies with state law.[205] This case is especially important because it focused on the Carlsbad Plant's compliance with California's Porter-Cologne Act.[206] The Surfrider Foundation argued that the Board erred in applying the Porter-Cologne Act, which requires new projects to use the best technology, site, design, and mitigation measures to minimize the impact to marine life from seawater intake.[207] The Surfrider Foundation argued that the project did not meet the best available site-specific standard.[208] The Surfrider Foundation's argument before the California Court of Appeals focused on Carlsbad Plant's NPDES permit,[209] which regulates how the desalination plant discharges salt brine.[210] The Foundation stressed that the only substantive measure the project implemented to minimize impact on marine life was wetlands restoration.[211] Therefore, Surfrider Foundation argued that the Carlsbad plant proposal only included

200. *Id.* at 2.

201. *Id.*

202. *See id.* at 5.

203. *Id.* at 3.

204. *Id.* at 28. *See also* Carlsbad Desalination Project, *Executive Summary*, CARLSBADDESAL.COM (Dec. 2005), http://carlsbaddesal.com/Websites/carlsbaddesal/images/eir/EIR_1.pdf.

205. 211 Cal. App. 4th 557 (2012).

206. *Id.*

207. CAL. WATER CODE § 13142.5(b) (West 1995).

208. 211 Cal. App. 4th 557, 576 (2012). *See also* CAL. WATER CODE § 13142.5(b) ("[F]or each new or expanded coastal powerplant or other industrial installation using seawater . . . the *best available* site, design, technology, and mitigation measures feasible shall be used to minimize the intake and mortality of all forms of marine life.") (emphasis added).

209. Surfrider Found. v. Cal. Reg'l Water Quality Control Bd., 211 Cal. App. 4th 557, 561 (2012).

210. *See* U.S. Environmental Protection Agency, *NPDES Permit Program Basics*, WATER.EPA.GOV (last updated Apr. 7, 2015), http://water.epa.gov/polwaste/npdes/basics/index.cfm.

211. *Surfrider Found.*, 211 Cal. App. at 570.

after-the-fact restoration, rather than delivering the best available design to minimize harm to marine life.[212]

Nevertheless, the court affirmed the issuance of the NPDES permit,[213] again demonstrating judicial deference to state agencies in approving permits as occurred in the *Southern California Watershed Alliance*, the *Desal Response Group*, and *Coastkeeper* cases. The court reasoned that the Carlsbad proposal included other substantial mitigating measures to offset potential harm to marine life, including enough measures related to the site's design, technology, and location to complement the wetland restoration efforts.[214]

In affirming the Board's decision, the court also emphasized the temporal component of the Porter-Cologne analysis. For example, when the Board issued the NPDES permit, it did not decide whether the desalination plant would still meet the best available standard for salt brine discharge if it stopped seawater intake from the Encina Power Station (referred to as Scenario 3).[215] The court noted the following:

> It was reasonable for the Regional Board to defer the decision about what measures to require as a condition of operating the desalination facility in the future under Scenario 3 [the Carlsbad Plant as a standalone facility], as that analysis will take place *years in the future when new technology or designs may be available or environmental conditions may have changed.* Requiring the Minimization Plan to address Scenario 3 at this point, prior to the development of new technology and without an understanding of future environmental conditions, would not further the goal of minimizing the intake and mortality of marine life.[216]

In other words, the court recognized that the environmental standard used to evaluate whether a desalination plant complies with the Porter-Cologne Act's best available standard will change over time.

The court also acknowledged that state agencies approving permits for desalination plants should make decisions considering the best available conditions *at that moment*. Though state agencies can outline future scenarios that would trigger reevaluating a permit, the Porter-Cologne Act authorizes comparing desalination proposals with conditions as they stand at the time of application. This reduces the number of evolving factors federal and state agencies need to consider. Unless the permit specifies a future scenario that will trigger reevaluation, it is unlikely that an agency will declare a permit invalid after it was approved.

In sum, the Porter-Cologne Act provides California state agencies with the flexibility to evaluate future desalination plant proposals along different environmental standards as technology improves and environmental conditions shift. For developers, currently held desalination permits

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212. *Id.* at 569.
213. *Id.* at 584–85.
214. *Id.* at 571–74. ("[S]ubstantial evidence supports a finding that the site, design and technology measures in the Minimization Plan are substantive, not illusory.").
215. *Id.* at 584.
216. *Id.* (emphasis added).

inform, to some extent, what designs and operating conditions may comply with the Act. When the state, however, evaluates a new proposal later on, the approval standard may be more demanding if the state later identifies desalination methods that further minimize harm to marine life.

B. Technical Innovations at the Llobregat Plant, Spain

The Llobregat Desalination Plant is currently the largest functioning desalination plant in Europe that supplies water to urban residents.[217] It provides water to Barcelona and seven neighboring regions.[218] The plant can produce 200 million liters of potable water per day by treating water from the Mediterranean Ocean.[219] This is equivalent to 52 million gallons of fresh water per day—enough for twenty-four percent of Barcelona's residents.[220]

A €230 million investment ($265 million), the Llobregat Plant created a new water source to make the region less dependent on the Ter River, which in turn helps the Ter River recover its water level.[221] One of the Llobregat Plant's main innovations is that it incorporates new energy recovery systems. For example, the plant has 15,000 photovoltaic panels that allow solar energy to offset the plant's energy costs, reducing the plant's carbon footprint.[222]

Acciona, a Spanish renewable energy and water management company, now administers the Llobregat Plant (along with the neighboring La Tordera desalination plant).[223] With a fifty-year concessionary contract from the Catalonia regional government to operate the Llobregat Plant,[224] Acciona will likely continue to integrate energy efficiency and alternative energy resources into the Llobregat Plant's operations. Giving the contract to Acciona suggests the Catalonia government can use the concessionary or tender process to integrate higher environmental standards into desalination operations.

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217. Generalitat de Catalunya, *Llobregat Desalination Plant*, GENCAT.CAT, http://gencat.cat/especial/prat/eng/que.htm.

218. *See id.*

219. Ayesa, *Desalination Plant in El Prat de Llobregat*, AYESA.COM (July 20, 2009), http://www.ayesa.com/es/node/1407.

220. Generalitat de Catalunya, *supra* note 217.

221. *See id.*

222. Abantia, *Aigües Ter Llobregat Solar Plant*, ABANTIA.COM, http://www.abantia.com/proyectos/en_proyectos_destacados/cat/50/88/aigues-ter-llobregat-solar-plant.

223. Acciona, *ACCIONA awarded the management contract for Aigües Ter Llobregat*, ACCIONA.COM (Nov. 6, 2012), http://www.acciona.com/news/acciona-awarded-the-management-contract-for-aigues-ter-llobregat/. *See also* Acciona, *The Concessionary Company Lead* [sic] *by Acciona Signs the Aigues Ter Llobregat Management Contract*, ACCIONA.COM (Dec. 27, 2012), http://www.acciona.com/news/the-concessionary-company-lead-by-acciona-signs-the-aigues-ter-llobregat-management-contract.

224. Randall Hackley, *Acciona to Manage Two Barcelona Desalination Plants with BTG*, BLOOMBERG BUSINESSWEEK (Nov. 9, 2012), http://www.bloomberg.com/news/articles/2012-11-09/acciona-to-manage-two-barcelona-desalination-plants-with-btg.

V. Recommendations: Best Practices from the United States and Spain

Though other solutions to droughts may surface, agencies should consider desalination if new proposals meet standards similar to the Porter-Cologne best available standard. In California, the California Court of Appeals' decision in *Surfrider* suggests a desalination plant could meet this standard, but also that this standard is evolving.[225] Therefore, California agencies can read the Porter-Cologne Act to require a higher environmental standard for desalination plants as technology improves. Other state and local governments looking to balance environmental and commercial interests, as well as reduce water shortages, could enact regulations similar to the Porter-Cologne Act. On the other hand, countries like the United States could benefit from clarifying how desalinated water fits into their traditional water law regimes, as Spain did with its amendments to the 1985 Water Act.

Different desalination technologies have different impacts on energy resources and marine life.[226] For example, researchers at Stanford University are focusing on lowering energy consumption by treating "brackish" or wastewater rather than seawater.[227] More specifically, flow-through electrode capacitive desalination (FTE-CD) uses an electric current to separate water from salt.[228] Other technologies focus on making membrane filtration systems more energy efficient.[229] Though many projects struggle to scale these new technologies, the state may consider them in its permit approval process.[230]

After evaluating a desalination plant proposal, a state agency may deny the permit and choose to promote different water supplies altogether, if they find that other water resources are more cost-effective and sustainable. However, an agency can also use the permit process to support desalination proposals that in fact provide the best available site, technology, and design. This section will focus on how agencies in both the United States and Spain can distinguish between some of today's desalination methods and designs based on environmental impact and energy costs.

A. Reducing Desalination's Impact on Marine Life

Though certain elements of a plant's design have no substitutes, there are design options for water intake systems in terms of where they are installed, and some suggest that the state should support plants that bury

225. Surfrider Found. v. Cal. Reg'l Water Quality Control Bd., 211 Cal. App. 4th 557 (2012).

226. Katz, *supra* note 103.

227. *Id.*

228. *Id.*

229. *See e.g.* Lockheed Martin, *Wanted: Clean Drinking Water*, LOCKHEEDMARTIN.COM (March 22, 2013), http://lockheedmartin.com/us/mst/features/2013/130322-wanted-clean-drinking-water.html.

230. Katz, *supra* note 103.

their water intake systems at a deeper level.[231] Burying the intake system reduces the amount of marine life that gets caught in filtration screens, which is an improvement over open systems.[232] Furthermore, buried intake systems might better diffuse the residual salt brine left after the plant completes the desalination process.[233] Considering this and other environmentally-oriented design decisions, governments can use the permit process to insist on certain design choices that will minimize desalination plants' marine life impact before construction begins.

Critics of desalination also stress that the way desalination plants release the remaining salt brine into the ocean is harmful to the environment. Specifically, the concentrated salt brine can affect the salinity level of coastal ecosystems and, in turn, harm marine life.[234] Rather than simply regulating how the plant disposes of salt brine, a state may also use the permit and concessionary process to support proposals that repurpose the brine.

For example, Water FX is an independent water producer that builds solar desalination systems.[235] With parabolic mirrors, Water FX concentrates solar energy to produce 14,000 gallons of potable water per day.[236] Apart from operating the desalination process with solar energy, Water FX uses the remaining salt brine to produce marketable chemicals.[237] Water FX mainly focuses on processing wastewater, drainage water, runoff, and saline groundwater.[238] Yet the way Water FX considers environmental impact throughout the desalination process is something governments may want to promote for seawater desalination plants as well. The Llobregat Plant uses a similar approach by operating solar panels to reduce the plant's energy costs.[239] A next step for regional governments in Spain and the United States would be to insist that desalination plants repurpose salt brine rather than discard it. In other words, the government can allow innovation to inform its definition of best practices.

B. Reducing Desalination's Energy Costs

Regardless of whether a plant is in the United States or Spain,

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231. *Id. See also* Kelley, *supra* note 7, at 278.

232. Kelley, *supra* note 7, at 278.

233. *Id.* at 296.

234. State Water Resources Control Board, *Ocean Standards: Desalination Facilities and Brine Disposal*, SWRCB.CA.GOV (last updated Aug. 26, 2014), http://www.swrcb.ca.gov/water_issues/programs/ocean/desalination/.

235. *See* Water FX, *About*, WATERFX.CO (2014) http://waterfx.co/about-waterfx/. *See also* Katz, *supra* note 103.

236. Oliver Balch, *Is solar-powered desalination answer to water independence for California?*, THEGUARDIAN.COM (Jan. 28, 2014), http://www.theguardian.com/sustainable-business/solar-power-california-water.

237. *Id.*

238. Water FX, *About Aqua4 Technology*, Waterfx.co (2014), http://waterfx.co/aqua4/.

239. Abantia, *Aigües Ter Llobregat Solar Plant*, ABANTIA.COM, http://www.abantia.com/proyectos/en_proyectos_destacados/cat/50/88/aigues-ter-llobregat-solar-plant.

desalination is an energy-intensive process.[240] Therefore, governments may have concerns about the impact of desalination plants on greenhouse gas emissions and their use of energy resources generally. As with the Llobregat Plant and the Water FX examples, there are desalination projects around the world that aim to offset energy consumption by implementing alternative energy sources. For example, the Emu Downs Wind Farm outside Perth provides energy to desalinate water in Western Australia.[241] Spain is also investing in an offshore facility that desalinates water using only solar energy.[242] Thus, the United States may look to desalination projects in countries like Australia and Spain when it considers alternative energy in its best available technology balancing equation.

Another energy question agencies may ask in the permit process is whether the plant is choosing the right type of water to treat. The United Nations World Water Development report observes:

> An interesting and notable flip side of the water-energy nexus is that wastewater is becoming recognized as a potential source of energy . . . rather than a mere waste stream. In several countries, water supply companies are working towards becoming energy neutral; they intend to generate an amount of energy from wastewater that equals the amount of energy consumed in their other operations.[243]

Though California's Porter-Cologne Act Section 13142.5(b) focuses on processing seawater, the state agency issuing permits to a desalination plant may analyze the energy costs of a seawater desalination plant versus, for example, a desalination plant treating brackish wastewater. If the seawater desalination plant proposal still provides benefits that outweigh those of other alternative water sources, then that would be another indicator that the proposal meets the best available standard of the Act.

With desalination and energy concerns in the United States and Spain, there is still the question of water treatment capacity. Even large-scale projects like the Carlsbad Plant will only meet ten percent of water demand in San Diego, despite its billion-dollar price tag.[244] In short, governments should read legislation like the Porter-Cologne best available standard as requiring more capacity from future desalination plants compared to the plant's energy use, further benefiting desalination proposals if technology improves. At times, these analyses may lead agencies to question the efficiency of desalination and approve other water management projects instead. However, the permit process is a practical tool agencies have to encourage investment in more efficient and cost-effective technologies, including improvements in the desalination industry.

Innovation in the coming years will have a significant impact on whether large-scale desalination projects are feasible. Governments can

240. Herndon, *supra* note 12.
241. ADLER, *supra* note 116, at 531.
242. *Id.*
243. UN Water, *UN World Water Development Report: Water and Energy*, UNESCO 26 (2014), http://unesdoc.unesco.org/images/0022/002257/225741E.pdf.
244. *See* Lee, *supra* note 172.

tackle water shortages around the globe with various strategies. But encouraging water treatment methods with potential for innovation, like desalination, is a way of increasing governments' options when faced with droughts.

Conclusion

How the United States and Spain apply environmental laws to desalination proposals today will impact how the regulatory standard for the desalination industry evolves. Experience from projects like the Carlsbad Plant and the Llobregat Plant help frame how state agencies may include desalination in a country's long-term water plans. From marine life conservation to production capacity and energy costs, the permit process requires agencies to examine multiple factors as they change over a long period of time.

The United States and Spain's water regulations show two overall trends in regulating desalination plants. First, both sets of regulations promote significant government intervention in the plant's design and construction. Second, both regimes suggest supporting desalination projects that are less energy intensive and cause less harm to the environment. Governments can favor these types of projects through the permit process required to build and operate the plant. They can also support future operations by granting concessionary management contracts to supply residents with water.

As is seen in California with the Porter-Cologne Act, the standard for whether a government should approve a desalination plant project is not necessarily wooden. Instead, lawmakers can craft laws that require a different environmental protection standard for desalination plants as technology improves. Both the United States and Spain have water law regimes capable of supporting desalination, as long as the desalination plants provide high-quality water through increasingly sustainable practices. If a country chooses to support desalination, its agencies should analyze how the new desalination plants impact sustainability at each step of the water treatment process. This sustainability can occur both at the economic (energy savings) and environmental (marine life protection) level.

Desalination plants are not a stand-alone solution to global drought problems, but may help mitigate shortages. As Thomas Fuller observed, "[w]e never know the worth of water until the well is dry."[245] As United States and Spanish lawmakers continue to develop their countries' water laws, each would do well to remember why securing new water sources is so crucial in the first place.

245. Goodreads, *Thomas Fuller Quote*, GOODREADS.COM, http://www.goodreads.com/quotes/43481-we-never-know-the-worth-of-water-till-the-well.