

# MADE IN THE SHADE: PROMOTING SOLAR OVER WATER PROJECTS

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## ABSTRACT

*One rarely-mentioned impact of global climate change is that higher temperatures are causing water in reservoirs and canals to evaporate at faster rates. This increased evaporation is placing additional pressure on already-limited water supplies in some arid regions of the world. Finding ways to reduce evaporative water losses is thus becoming an increasingly important policy challenge in certain areas across the globe. Of course, generating more carbon-free energy also continues to be an important policy focus in the face of global warming and its threatening effects as well. One relatively new renewable energy strategy that can simultaneously help to address both challenges is to install solar panels over water. “Solar over water” projects are installations of photovoltaic solar panels on a water body’s surface or just above the surface of canals or other waterways. The panels generate carbon-free electricity, and the shade that they create also reduces evaporation rates so that more of a region’s precious water reaches end-users. Unfortunately, existing policies in many jurisdictions create unjustifiable obstacles to solar over water development. This Article uses the ongoing effort to install solar panels above portions of the Central Arizona Project’s canal system as a case study to highlight the significant potential benefits of solar over water development. The Article then identifies specific policy changes capable of better facilitating and promoting these innovative and uniquely valuable renewable energy projects.*

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## I. INTRODUCTION

Imagine having to take short showers, turn off lawn sprinkler systems, or even avoid doing the laundry on certain days because of state-imposed water rationing policies. Although such constraints on water use may seem unlikely to occur in much of the country, some arid regions—both around the world and in the United States—have already experienced this harsh reality.<sup>1</sup> As with other regions sharing

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1. See Steff Gault, *Water Rationing Introduced as Bolivia Drought Worsens*, ALJAZEERA (Nov. 20, 2016), <http://www.aljazeera.com/news/2016/11/water-rationing-introduced-bolivia-drought-worsens-161120093020654.html> (describing Bolivia’s ongoing water crisis including one event where water authorities were held hostage); See, Deborah Sullivan Brennan, *SD Adopts Mandatory Water Limits*, SAN DIEGO UNION TRIB. (Oct. 20, 2014), <http://www.sandiegouniontribune.com/news/environment/sdut-environment->

a similarly dry climate, the Western United States has faced severe water scarcity challenges in recent years. Despite the region's ingenious and invaluable canal system, diminishing water supplies and increases in water demand continue to threaten economic growth and security in this precious part of the country.

Despite plentiful rainfall in the winter of 2017, climate change impacts are widely believed to be causing longer and more severe droughts in the American West.<sup>2</sup> As global temperatures continue to increase, water consumption will also rise—as both people and crops will require even more quantities of water to survive.<sup>3</sup> Even in this incredibly wet year, the increased water is not “enough to satisfy all the state's demands, recharge overdrafted groundwater basins in the San Joaquin valley, or overcome the massive deficits suffered by California's ecosystems and endangered fisheries.”<sup>4</sup>

To cope with these difficulties, some Western states have even had to impose temporary water rationing rules on residents and businesses. California has only recently relaxed some of its more severe water conservation measures.<sup>5</sup> While Californians no longer have to severely curtail their water use in the short-term, State officials caution that the drought is not over and that individuals will have to adapt to a drier climate caused by climate change.<sup>6</sup> Particularly hard-hit regions of California offer a glimpse as to how harsh water rationing policies can be. On Catalina Island, for instance, water rationing had grown so strict that hotel owners were often forced to send their laundry to the mainland for washing and restaurant owners used diners' leftover drinking water in order to mop their floors.<sup>7</sup> If water continues to become scarcer in the coming decades, such restrictions on water could become a reality for many more people in the Western United States. Indeed, the region faces significant obstacles in managing its scarce water resources in the face of

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san-diego-water-restrictions-drought-2014oct20-story.html (describing San Diego's mandatory water restriction policy); Andrew Edwards, *Edison Ends Water Rationing for Catalina Island Residents, Thanks to Rains*, PRESS-TELEGRAM, <http://www.presstelegram.com/general-news/20170310/edison-ends-water-rationing-for-catalina-island-residents-thanks-to-rains> (last updated Sept. 1, 2017).

2. Peter Gleick, *A Wet Year Won't Beat California's Never-Ending Drought*, WIRED (Jan. 22, 2017), <https://www.wired.com/2017/01/wet-year-wont-beat-californias-never-ending-drought/>.

3. *Id.*

4. *Id.* We should not allow one wet year to blind us to the need for more effective water management efforts, even in years of plenty, as John Steinbeck once prophetically wrote: “And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way.” JOHN STEINBECK, *EAST OF EDEN* 5-6 (1952).

5. Adam Nagourney & Ian Lovett, *In Sharp Reversal, California Suspends Water Restrictions*, N.Y. TIMES (May 18, 2016), [https://www.nytimes.com/2016/05/19/us/california-suspends-water-restrictions.html?\\_r=0](https://www.nytimes.com/2016/05/19/us/california-suspends-water-restrictions.html?_r=0). This rollback was, however, accompanied by more permanent restrictions like a ban on washing down sidewalks and driveways. *Id.*

6. *Id.* Meteorologists are also predicting that rainfalls next year will be below the normal average. *Id.*

7. Edwards, *supra* note 1.

global climate change.<sup>8</sup> Despite its impressive canal system, diminishing water supplies and increasing water demand continue to pose a danger to economic growth and security in several Western states.

The water resources that supply much of the water to cities in the West travel great distances in open-air canals before reaching their destination and this heavy reliance on open-air canals could become increasingly ineffective as global temperatures rise.<sup>9</sup> Tens of thousands of gallons of water are already lost to evaporation each year in canal systems as water travels across the arid desert to metropolitan areas hundreds of miles away.<sup>10</sup> Rising temperatures will only increase these evaporation losses over time.<sup>11</sup>

Facing shrinking water supplies and rising global temperatures, many nations across the world are searching for ways to conserve their precious water resources while increasing their production of carbon-free renewable power. Investments in renewable energy technologies are an important part of the global response to climate change because they reduce the greenhouse gas emissions widely believed to be the primary contributors to the problem. However, constructing large-scale renewable energy projects in the desert can disrupt vulnerable ecosystems and threaten rare plant and animal life. Such projects—as valuable as they often are—also do little to help address the water scarcity crises that plague much of the West. Accordingly, there remains a need for additional ways to increase carbon-free energy production while conserving both water and land resources in the world’s arid regions.

One strategy that can help to address these water scarcity issues and clean energy challenges is to install photovoltaic solar panels over water reservoirs and canals. “Solar over water” projects not only generate carbon-free electricity, they also provide shade that reduces water evaporation. A number of countries have already made major strides toward developing solar over water projects, including Japan’s “floatovoltaic” installations at Yamakura Dam,<sup>12</sup> and India’s solar arrays above the Gujarat Canal.<sup>13</sup> Solar over water projects carry with them unique benefits, such as conserving land resources, reducing evaporation, and even increased power generation when compared to land-based solar.

Although the Trump administration has expressed its skepticism about the validity of climate change,<sup>14</sup> incentivizing such projects would arguably comport with

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8. Matt Weiser, *Why the West May Be Headed Toward Megadrought*, WATER DEEPLY (May 12, 2016), <https://www.newsdeeply.com/water/community/2016/05/12/why-the-west-may-be-headed-toward-megadrought>.

9. Jeff Gibbs, *Arizona Water Solutions That Don’t Evaporate*, AZCENTRAL (June 17, 2016), <http://www.azcentral.com/story/news/local/glendale-contributor/2016/06/17/arizona-water-conservation-evaporation/85820344/>.

10. *See id.*

11. *How is Climate Change Impacting the Water Cycle?*, CLIMATE REALITY PROJECT (May 9, 2016, 9:13 AM), <https://www.climateRealityProject.org/blog/climate-change-impacting-water-cycle>.

12. Erica Goode, *New Solar Plants Generate Floating Green Power*, N.Y. TIMES (May 20, 2016), <https://www.nytimes.com/2016/05/24/science/solar-power-floating-on-water.html?mcubz=1>.

13. Ryan Austin, *India’s Solar Canals: Two Birds with One Stone*, UNDERSTAND SOLAR (Sept. 23, 2016), <https://understandsolar.com/solar-canals/>.

14. *See* Jennifer A. Dlouhy, *Trump to Drop Climate Change from Environmental Reviews*, SOURCE SAYS, BLOOMBERG (Mar. 14, 2017), <https://www.bloomberg.com/news/articles/2017-03-14/trump-said-to>

some of President Trump's greater policy goals.<sup>15</sup> Independent of their ability to conserve valuable water resources and decrease greenhouse gas emissions, solar over water projects represent a significant investment in improving American infrastructure—enhancing the utility of the West's canals and reservoirs. These projects would also help to create jobs wherever they are pursued, furthering another goal of the Trump administration.<sup>16</sup>

In the United States, one particularly appealing potential site for a solar over water project is Arizona's sprawling Central Arizona Project ("CAP") canal system. In a state where utilities are preparing to decommission a large coal-fired power plant that powers the CAP's canals,<sup>17</sup> a solar over water project could not only protect already-scarce water resources from the rays of the sun, it could also harness that same sunlight to generate carbon-free power and drive economic development. Unfortunately, developers interested in covering portions of the CAP with solar panels have faced significant political and legal obstacles that have thus far prevented such a project from succeeding. Among other things, potential project developers must engage federal, state, and local government officials in an expensive and time-consuming process to receive numerous approvals. Funding for such projects has likewise proven difficult to obtain, and the CAP's own governing board has largely been unmotivated to seriously consider solar over water development. One reason for these failures is that the aggregate benefits to society from solar over water development are often significantly greater than the benefits that inure to individual developers or other primary stakeholders. New government intervention is thus needed to overcome this externality problem and promote a more optimal quantity of solar over water development.

This Article uses the example of Arizona's CAP to increase awareness about the unique value of solar over water projects and the hurdles that are preventing these projects from taking shape in the United States. The Article ultimately advocates for policies that better encourage canal and reservoir operators, project developers, and water rights holders to facilitate solar over water projects in areas where they would create the most value.

A wide range of strategies at the state and federal level could better enable stakeholders to capture the full benefits of solar over water projects. Among other things, states in the arid West could modify existing renewable portfolio strategies ("RPS") to include specific target carve-outs for solar installations over canals and

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drop-climate-change-from-environmental-reviews; Clare Foran, *Donald Trump and the Triumph of Climate-Change Denial*, ATLANTIC (Dec. 25, 2016), <https://www.theatlantic.com/politics/archive/2016/12/donald-trump-climate-change-skeptic-denial/510359/>; Donald J. Trump (@realDonaldTrump), TWITTER (Nov. 6, 2012, 11:15 AM), [https://twitter.com/realDonaldTrump/status/265895292191248385?ref\\_src=twsrc%5Etfw](https://twitter.com/realDonaldTrump/status/265895292191248385?ref_src=twsrc%5Etfw) ("The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.").

15. President Donald Trump, Remarks During a Joint Address to Congress (Feb. 28, 2017), <https://www.whitehouse.gov/the-press-office/2017/02/28/remarks-president-trump-joint-address-congress> (stating that "[c]rumbling infrastructure will be replaced[,]” advocating for Congressional approval on a \$1 trillion investment in infrastructure and promising that “I am going to bring back millions of jobs.”).

16. *Id.*

17. Ryan Randazzo, *Utilities Vote to Close Navajo Coal Plant at End of 2019*, AZCENTRAL (Feb. 13, 2017), <http://www.azcentral.com/story/money/business/energy/2017/02/13/utilities-vote-close-navajo-generating-station-coal-plant-2019/97866668/> [hereinafter *Navajo Coal Plant*]

reservoirs. The federal government could likewise offer enhanced Incentive Tax Credits (“ITCs”) for solar over water projects in states with the most severe water scarcity problems. State and federal agencies could also collaborate to streamline the lengthy and expensive permitting processes associated with such projects. Collectively, these and other policy strategies have the potential to more optimally incentivize and facilitate solar over water projects in locations where they are beneficial. By better promoting solar over water development, policymakers can unleash a new and valuable means of conserving precious water while generating clean, carbon-free renewable energy.

## II. OLD PROBLEMS, NEW DANGERS, AND INNOVATIVE SOLUTIONS

Throughout history, arid regions of the world have had to develop numerous innovations to better conserve their scarce water resources. Such regions, like the American West, will have to continue to do so in the future. Section A of Part II discusses how climate change is threatening the American West’s water supplies and intensifying the demand for clean, carbon-free energy.<sup>18</sup> Section B briefly examines the history of the settlement of the West and the policy strategies that have enabled those first settlers to make efficient use of scarce water resources and that continue to encourage water resource conservation in the West today.<sup>19</sup> Section C describes an innovative approach to the policy challenges discussed in Sections A and B: placing solar panels over canals and reservoirs to both reduce water lost while simultaneously producing carbon-free electric power.<sup>20</sup> Section D then highlights some primary policy obstacles to developing these solar over water projects.<sup>21</sup>

### A. Climate Change’s Impacts on Energy and Water

Human-induced climate change has created two major imperatives in the Western United States and in other arid regions across the world. The first is the need to reduce energy-related carbon dioxide emissions in order to curb rising temperatures across the globe. The second is the need to combat worsening drought conditions by improving water resource conservation. The following subsections briefly describe each of these policy goals and some of the efforts that policymakers have already made to address them.

#### i. The Need for Clean Energy

Scientists across the globe widely agree that greenhouse gas emissions are transforming the Earth’s climate in ways that will cause significant damage to human communities and natural ecosystems.<sup>22</sup> Humankind must dramatically curtail its carbon emissions in order to slow the rising global temperatures these emissions

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18. See *infra* Section II.A.

19. See *infra* Section II.B.

20. See *infra* Section II.C.

21. See *infra* Section II.D.

22. JOEL B. EISEN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS 290 (Robert C. Clark et al. eds., 4th ed. 2015).

appear to be causing.<sup>23</sup> In December of 2015, leaders from 195 countries met in Paris to address this issue and agreed to a landmark climate agreement, each pledging to reduce their emissions.<sup>24</sup> Despite this historic step, and even if all these countries meet their commitments under the Paris Agreement, the problem of climate change will persist.<sup>25</sup> The Agreement, whose future remains uncertain without U.S. involvement, is only one of many steps required to forestall climate change's harmful impacts.<sup>26</sup> The effects of climate change are wide-ranging; some regions may see devastating droughts while tiny island nations may become uninhabitable due to rising ocean levels.<sup>27</sup>

In addition to changes in individual human behavior, policy changes facilitating the more rapid adoption of carbon-free energy technologies are necessary to effectively combat the threat of climate change.<sup>28</sup> No single technology is a panacea to managing climate change's harmful effects.<sup>29</sup> One often-cited perspective on climate change mitigation is Robert Socolow and Stephen Pacala's 2004 framework of stabilization wedges<sup>30</sup>—a diverse portfolio of strategies for reducing greenhouse gas emissions.<sup>31</sup> While Socolow and Pacala originally theorized that implementing only eight of their fifteen identified wedges was necessary to stabilize emissions, today many recognize a need to pursue all fifteen of them.<sup>32</sup> However, increased utilization of solar resources is a component of three of their proposed wedges, making solar a key element of any long-term plan to stabilize emissions.<sup>33</sup>

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23. David Biello, *How to Solve Global Warming: It's the Energy Supply*, Sci. AM. (Apr. 13, 2014), <https://www.scientificamerican.com/article/how-to-solve-global-warming-its-the-energy-supply/> (describing how holding temperatures to no more than a 2°C increase would require a seventy percent reduction from 2010 emission levels).

24. Coral Davenport, *Nations Approve Landmark Climate Accord in Paris*, N.Y. TIMES (Dec. 12, 2015), <https://www.nytimes.com/2015/12/13/world/europe/climate-change-accord-paris.html?mcubz=1>.

25. *Id.* (“At best . . . [the Agreement] will cut global greenhouse gas emissions by about half enough as is necessary to stave off an increase in atmospheric temperatures of 2 degrees Celsius . . . the point at which, scientific studies have concluded, the world will be locked into a future of devastating consequences . . .”).

26. *Id.*; see Valerie Volcovici, *U.S. Submits Formal Notice of Withdrawal from Paris Climate Pact*, REUTERS (Aug. 4, 2017), <https://www.reuters.com/article/us-un-climate-usa-paris-idUSKBN1AK2FM>.

27. See André Viollaz, *Island Nations Seek UN Help Combatting Climate Change*, BUS. INSIDER (July 30, 2015), <http://www.businessinsider.com/afp-island-nations-seek-un-help-combatting-climate-change-2015-7>; *Drought and Climate Change*, CTR. FOR CLIMATE & ENERGY SOLUTIONS, <https://www.c2es.org/science-impacts/extreme-weather/drought> (last visited Jan. 6, 2018).

28. Biello, *supra* note 23 (“At the same time, emissions from traditional energy supplies must be zeroed out, either through CCS [carbon capture and storage] or replacement with less polluting energy sources, whether emissions-free wind and sun or lower carbon nuclear energy.”).

29. See William Pentland, *Rethinking Our Response to Climate Change: Carbon Wedges 2.0*, FORBES (Feb. 22, 2013), <http://www.forbes.com/sites/williampentland/2013/02/22/rethinking-our-response-to-climate-change-carbon-wedges-2-0/#75f42b1768a8> (describing how the wedges paradigm is based on use of multiple technologies).

30. See generally Robert Socolow & Stephen Pacala, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 968 (2004).

31. See EISEN ET AL., *supra* note 22, at 24–26 (discussing 15 wedges that would each reduce emissions by 1 billion tons of carbon); Pentland, *supra* note 29.

32. See EISEN ET AL., *supra* note 22, at 27.

33. *Id.* at 26.

In some settings, solar energy technologies remain underutilized because of their comparatively high costs or other constraints.<sup>34</sup> However, solar technologies have become increasingly cost competitive in recent years.<sup>35</sup> In fact, costs of installation have fallen to the point that in some areas with strong sunshine, solar panels can provide cheaper electricity than fossil-fuel plants.<sup>36</sup> Some analysts even predict that solar power could become the cheapest power on earth within the next twenty-five years, edging out coal.<sup>37</sup> As solar energy's costs continue to decrease and solar technology proliferates, it will become an increasingly important component of any strategy to combat the negative effects caused by man-made greenhouse gas emissions.<sup>38</sup>

## ii. Climate Change and Water Management

Even if the nations of the world are somehow able to come together to forestall human-induced climate change, there is little doubt that humanity will still suffer from many of its consequences.<sup>39</sup> Strains on water supplies are one of the most harmful impacts of the world's rising global temperatures, which are increasing the severity and length of droughts in some corners of the globe.<sup>40</sup> In many regions, climate change is expected to cause reductions in water supplies from a loss of snow pack.<sup>41</sup> As the sea level rises, saltwater could also begin to comingle with freshwater resources in coastal areas and further decrease the water supply.<sup>42</sup> Moreover, although some arid regions may see more intense precipitation events, overall precipitation levels are likely to shrink and could thus make droughts more unpredictable.<sup>43</sup> Compounding these and other problems is the growing demand for water resources because of increased heat.<sup>44</sup>

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34. Biello, *supra* note 23 ("The problem is that none of this technology exists or, where it does . . . has not been deployed at a large enough scale, because it costs much more than the alternative: freely polluting the atmosphere.").

35. Noah Long & Kevin Steinberger, *Renewable Energy is Key to Fighting Climate Change*, NRDC (July 26, 2016), <https://www.nrdc.org/experts/noah-long/renewable-energy-key-fighting-climate-change> (describing both environmental and economic benefits of renewables).

36. Rod Janssen, *Renewables Increasingly Cost Competitive*, ENERGY DEMAND (Sept. 26, 2014), <https://energyindemand.com/2014/09/26/renewables-increasingly-cost-competitive/>.

37. Jess Shankleman & Chris Martin, *Solar Could Beat Coal to Become the Cheapest Power on Earth*, BLOOMBERG (Jan. 3, 2017), <https://www.bloomberg.com/news/articles/2017-01-03/for-cheapest-power-on-earth-look-skyward-as-coal-falls-to-solar> (projecting that an average one megawatt solar system will cost seventy-three cents a watt by 2025).

38. See, e.g., Channing Arndt, *Will China Lead on Climate Change as Green Technology Booms?*, CONVERSATION (Nov. 21, 2016), <http://theconversation.com/will-china-lead-on-climate-change-as-green-technology-booms-68795> (discussing how China is attempting to solve their smog epidemic via a massive investment in renewables).

39. See Rob Renner, *Climate Change, Extreme Weather, and Water Utilities: Preparing for the New Normal*, 105 J. AM. WATER WORKS ASS'N 44, 44 (2013).

40. See Noah D. Hall et al., *Climate Change and Freshwater Resources*, 22 NAT. RESOURCES & ENV'T 30, 32 (2008).

41. *Id.* at 30.

42. *Id.* at 30, 32.

43. See *id.* at 30.

44. *Id.* This will exacerbate pressures already put on the water supply by forces like population growth and the desire to put the water to use for economic development. *Id.* at 32.

Climate change will likely also exacerbate existing political tensions surrounding water supplies, potentially causing outright conflict and contributing to destabilization in some of the more arid regions of the world.<sup>45</sup> In the Middle East, for example, disagreement over an Israeli diversion of the Jordan River was a major factor in the outbreak of the 1967 Six Day War.<sup>46</sup> Water continues to be a source of conflict for that region today. Domination of the region's water resources is a key component of the Islamic State's campaign, seizing the Tabqa dam in Syria and repeatedly launching offensives to capture the Mosul and Haditha dams in Iraq.<sup>47</sup> Not even the United States is totally immune from water-related political violence.<sup>48</sup> At one point in history, for example, the state of Arizona sent its national guard forces to prevent California from constructing a dam on the Colorado River.<sup>49</sup> Policies that address both the growing need for carbon-free energy, and the need to conserve scarce water supplies, could help to limit such tensions and conflicts as global warming continues in the decades to come.

#### B. Water and the West: Then and Now

Policies promoting the efficient use of water resources have long been a priority in the American West, and are more important than ever today. The following Subsection B.1 discusses the history of water challenges in the Southwest.<sup>50</sup> Section B.2 then describes some of the water scarcity problems facing the West today.<sup>51</sup>

##### i. The Settlement of the West and Management of Scarce Water Resources.

The pioneers of the American West believed they were entering a land of plenty, a belief enforced by the unusually plentiful amount of rain during the

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45. Lisdey Espinoza Pedraza & Markus Heinrich, *Water Scarcity: Cooperation or Conflict in the Middle East and North Africa?*, FOREIGN POL'Y J. (Sept. 2, 2016), <http://www.foreignpolicyjournal.com/2016/09/02/water-scarcity-cooperation-or-conflict-in-the-middle-east-and-north-africa/> (“Already an unstable region, access to shared water resources [in the Middle East and North Africa] will increasingly become an additional source of tension.”).

46. *Id.*

47. *Id.*

48. A. DAN TARLOCK ET AL., WATER RESOURCE MANAGEMENT: A CASEBOOK IN LAW AND PUBLIC POLICY 3 (Robert C. Clark et al., eds., 7th ed. 2014); Scott Harrison, *California Retrospective: How a 1930s Water War between California and Arizona Delayed Parker Dam*, L.A. TIMES (Aug. 30, 2015), <http://www.latimes.com/local/california/la-me-parker-dam-20150831-story.html> (describing the buildup and resolution to this conflict).

49. Harrison, *supra* note 48. These historic tensions will be elaborated on in Part II.B.2. Allusions to conflict between the states over water rights are frequent in the Supreme Court's jurisprudence on the subject. *E.g.*, *New Jersey v. New York*, 283 U.S. 336, 342 (1931) (“Different considerations come in when we are dealing with independent sovereigns having regard to the whole population and when the alternative to settlement is war.”); *Bean v. Morris*, 221 U.S. 485, 487 (1911) (noting the danger of allowing a state to settle its water rights disputes if it “invoked a trial of strength with its neighbors”).

50. *See infra* Section II.B.i.

51. *See infra* Section II.B.ii.

1870s.<sup>52</sup> However, tensions over water resources are not new in the American West, which has grappled with water shortages throughout the past two centuries.<sup>53</sup> The following paragraphs highlight some of those hardships and some ways that the West has addressed its water management problems in the past.

Although some of the pioneers that settled the West *en masse* in the nineteenth-century may have held the superstitious belief that “rain follows the plow;”<sup>54</sup> the original denizens of the region understood that in order to flourish they would need to make optimal use of its limited water supplies.<sup>55</sup> Recent archaeological findings near Tucson, Arizona, reveal an intricate web of canals dating back to as early as 1200 BC.<sup>56</sup> More famously, the Hohokam people constructed, in what is now modern Phoenix, Arizona, a canal system extending nearly five-hundred miles to serve as many as fifty-thousand people.<sup>57</sup> The American pioneers, at first, did not possess the wisdom of the Hohokam, and other ancient inhabitants of the West, and their repeated undervaluation of the water resources in the region detrimentally affected early attempts to settle the region.<sup>58</sup>

The Gold Rush of the early 1800s marked the beginning of the first substantial drive of pioneers from the eastern United States to the West.<sup>59</sup> In their rush to claim the riches of the earth, some of these miners first viewed water as their enemy and aggressively diverted water from rivers in order to extract gold from the dried river banks.<sup>60</sup> However, miners soon realized that water could, in fact, be a valuable ally and developed the method of hydraulic mining—blasting hillsides with highly pressurized water to release the gold contained underneath far more quickly than was possible with manual labor.<sup>61</sup> The demand for water to fuel this blasting sparked the beginning of widespread use of canals in the region. As one historian describes: “Thousands of miles of ditches brought water from the Sierra Nevada to bear on mines located in northern California watersheds. By 1857, some 700 miles of canals

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52. TED STEINBERG, *DOWN TO EARTH: NATURE’S ROLE IN AMERICAN HISTORY* 116 (3d ed. 2013); see Michael Toll, Comment, *Reimagining Western Water Law: Time-Limited Water Right Permits Based on a Comprehensive Beneficial Use Doctrine*, 82 U. COLO. L. REV. 595, 596 (2011). A rare voice advocating against this mindset was John Wesley Powell, who warned that “we shall have to expect a speedy return to extreme aridity, in which case of a large portion of the agricultural industries of these now growing up would be destroyed.” STEINBERG, *supra*.

53. See Robert Roy Britt, *Long History of Southwest Droughts Confirms Looming Water Shortage*, LIVE SCI. (May 26, 2006), <http://www.livescience.com/10480-long-history-southwest-droughts-confirms-looming-water-shortage.html> (noting the historic frequency of droughts in the region and the likelihood that they will occur again in the future).

<sup>54</sup> CHARLES DANA WILBER, *THE GREAT VALLEYS AND PRAIRIES OF NEBRASKA AND THE NORTHWEST* 68 (3d ed. 1881); see also Toll, *supra* note 52, at 596 n.1.

55. Thomas H. Maugh II, *Earliest Known Irrigation System Unearthed in Arizona*, L.A. TIMES (May 23, 2009), <http://articles.latimes.com/2009/may/23/science/sci-canals23>.

56. *Id.* (noting that these canals are likely not even the earliest in Arizona).

57. *Canal Origins*, SRP, <http://www.srpnet.com/water/canals/origins.aspx> (last visited Jan. 6, 2018). These same canals, once discovered by the pioneers, would form the basis for some of the first canals in Arizona. *Id.*

58. See generally STEINBERG, *supra* note 52, at 116–135.

59. *Id.* at 117–118.

60. *Id.* at 118. (“[mining] companies literally picked up rivers and moved them . . . [b]y 1853 nearly 25 miles of the Yuba River had been diverted.”).

61. *Id.* at 119.

crisscrossed the Yuba [River] alone.”<sup>62</sup> However, the settlers soon had to confront the harsh realities of water scarcity in the West, as the arid climate forced them to adapt their water-use strategies to combat droughts and accommodate the needs of growing populations.<sup>63</sup>

As population sizes increased and the Southwest’s economy turned away from mining and toward agriculture, the region increasingly relied upon large-scale and federally-funded infrastructure projects to facilitate better use of the water supply.<sup>64</sup> Created under the National Reclamation Act of 1902, the Bureau of Reclamation (“Reclamation”) was charged with the mission to “reclaim” patches of soil from the choking sands of the desert.<sup>65</sup> In only the first thirteen years of its existence, Reclamation constructed thirteen-hundred miles of canals in the West, bringing water to thousands of farmers.<sup>66</sup> Soon, dams and canals were scattered across the West, helping its inhabitants to wring as much agricultural production as possible from the naturally dry soil.<sup>67</sup> While these projects brought increased economic prosperity to the region, especially in places like California’s Central Valley, it also accelerated the depletion of scarce natural water resources.<sup>68</sup>

In order to further encourage economic development, Western states also sought to secure and protect their rights to use the region’s rivers—especially the Colorado River.<sup>69</sup> While a full exposition of the “Law of the River”—the collection of contracts, treaties, agreements, state and federal legislation, federal administrative actions, and United States Supreme Court decisions governing the Colorado River—is beyond the scope of this Article, a brief history of the interstate apportionment of the Colorado River provides a useful perspective on some of the water problems faced by the West today.<sup>70</sup>

From the very start of interstate water allocation negotiations among the Colorado River Basin states in 1921, cooperation proved difficult.<sup>71</sup> Arizonans, in particular, did not want to see Southern California flourish at the cost of Arizona’s economic prosperity.<sup>72</sup> Eventually, representatives from all of the basin states agreed to the Colorado River Compact (“The Compact”); but, alone among those states,

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62. *Id.* at 119.

63. *See generally id.* at 119–24.

64. *See* STEINBERG, *supra* note 52, at 182–84; *see also* Donald J. Pisani, *Federal Reclamation and the American West in the Twentieth Century*, 77 *AGRIC. HIST.* 391, 394 (2003).

65. STEINBERG, *supra* note 52, at 182–83; Pisani, *supra* note 64, at 393.

66. Pisani, *supra* note 64, at 394.

67. *See id.*

68. STEINBERG, *supra* note 52, at 183.

69. Robert Glennon & Jacob Kavkewitz, “A Smashing Victory”?: *Was Arizona v. California a Victory for the State of Arizona?*, 4 *ARIZ. J. ENVTL. L. & POL’Y* 1, 4–5 (2013) (describing the growing need for Basin-wide agreement on water allocation in response to economic development). The seven states sharing the basin are: Wyoming, Colorado, New Mexico, Utah, Nevada, California, and Arizona. *Id.* at 4.

70. *See* GARY PITZER ET AL., *LAYPERSON’S GUIDE TO ARIZONA WATER* 11 (Sue McClurg ed., 2007).

71. Glennon & Kavkewitz, *supra* note 69, at 5–7 (“[A]most as soon as the discussions . . . began, deep-seeded conflicts emerged.”).

72. *Id.* at 5.

Arizona's state legislature refused to endorse the agreement.<sup>73</sup> The inability of Arizona and California to reach an agreement on allocation of water led Congress to pass the Boulder Canyon Project Act ("BCPA"), which included a pre-approved apportionment among the lower basin states.<sup>74</sup> The passage of the BCPA prompted numerous legal challenges from Arizona over a span of more than twenty years.<sup>75</sup>

The primary reason for Arizona's struggle against California and the BCPA was Arizona's plan to build the Central Arizona Project ("CAP").<sup>76</sup> Although the original conception of CAP was relatively vague,<sup>77</sup> today the CAP is a 336-mile long system comprised of tunnels, canals, aqueducts, pumping plants, and pipelines,<sup>78</sup> extending throughout Arizona's Pinal, Pima, and Maricopa counties.<sup>79</sup> Other states had also built large canals with the help of the federal government, such as California's All-American Canal, to access Colorado River water.<sup>80</sup> However, for approval of the CAP to be feasible, Arizona needed to resolve its longstanding appropriation dispute with California, prompting Arizona state officials to sue California.<sup>81</sup> After Arizona had expended eleven years and \$5 million in litigation costs, the Supreme Court ultimately held that Arizona had the right to an allocation of 2.8 million acre-feet of Colorado River water and various related interests in tributaries of the Colorado within the State.<sup>82</sup> The Court further held that, in times of water surplus in the Lower Basin states, California and Arizona would split the surplus evenly.<sup>83</sup> This historic ruling in Arizona's favor paved the way for Arizona to eventually secure congressional approval for construction of the ambitious CAP.<sup>84</sup>

Arizona's efforts to gain approval for the CAP first started in 1947 when a group of citizens formed the Central Arizona Project Association.<sup>85</sup> The Association's primary purpose was to lobby Congress for the authorization to construct the CAP.<sup>86</sup>

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73. *Id.* at 6–7. The Supreme Court ruling in *Wyoming v. Colorado* spurred the other basin states into agreement. That case held that the doctrine of prior appropriation applied to conflicts over interstate rivers if both states subscribed to the doctrine, putting the other basin states on alert that California's increasing appropriations of Colorado River water would come at the exclusion of any water that other basin states desired for their own beneficial use; prior appropriation will be examined in greater detail *infra* Section D.1.

74. *Id.* at 13.

75. *See id.* at 15–18 (discussing the various "courtroom battles" fought by Arizona against the federal government and other Basin states).

76. *Id.* at 19.

77. Glennon & Kavkewitz, *supra* note 69, at 18.

78. *CAP About Us*, CENT. ARIZ. PROJECT, [www.cap-az.com/about-us](http://www.cap-az.com/about-us) (last visited Jan. 6, 2018).

79. *It Takes Power to Bring Water to Us!*, CENT. ARIZ. PROJECT, <http://www.cap-az.com/documents/education/It-Takes-Power-to-Bring-Water-to-Us.pdf> (last visited Jan. 6, 2018) (discussing the operation of the CAP system generally); *see also* U.S. DEP'T INTERIOR: BUREAU OF RECLAMATION, THE CENTRAL ARIZONA PROJECT 2 (2000), [docplayer.net/7557671-The-central-arizona-project.html](http://docplayer.net/7557671-The-central-arizona-project.html).

80. APRIL R. SUMMIT, *CONTESTED WATERS: AN ENVIRONMENTAL HISTORY OF THE COLORADO RIVER*, 114–115 (2013) (explaining the increased reliance of Southern California cities on water from the All-American Canal).

81. PITZER ET AL., *supra* note 70, at 12.

82. *Id.*

83. *Id.*

84. *Id.*

85. Michael Hanemann, *The Central Arizona Project* 3 (Dep't of Agric. & Res. Econ., UCB, Working Paper No. 937, 2002), <http://ageconsearch.umn.edu/bitstream/25124/1/wp020937.pdf>.

86. *Id.*

Founders of the Association believed that developing the CAP was crucial to Arizona, protecting its future economic growth and agricultural prosperity.<sup>87</sup> In a *quid pro quo* agreement with Congress, Arizona ultimately obtained the federal approval it needed to begin construction.<sup>88</sup> In exchange for federal funds, Arizona agreed to accept junior priority status for CAP Colorado River Water<sup>89</sup> and to pass a statewide Groundwater Management Act.<sup>90</sup> In response, the federal government granted a loan to Arizona for \$1.2 billion in 1972.<sup>91</sup> Reclamation built the project and served as its original manager before eventually turning management over to the Central Arizona Water Conservation District (“CAWCD”).<sup>92</sup>

Although the CAP and other canal systems have served Western states well and allowed for rapid economic expansion in the region, the West remains heavily dependent on its limited water resources. As the following subsection describes, climate change-induced drought conditions and population growth are now intensifying these challenges and causing policymakers to search for additional ways to address them.

#### ii. Modern Challenges in Managing the West’s Scarce Water Supplies

In recent years, long-term drought conditions in the West have greatly reduced the quantity of water flowing in the Colorado River and stored in its reservoirs.<sup>93</sup> This reduced flow affects not only the multiple states that depend upon the waters of the Colorado River but Mexico as well.<sup>94</sup> Pursuant to a 1944 treaty, the United States is obligated to annually deliver 1.5 million acre-feet of water from the Colorado River to Mexico.<sup>95</sup> In response to worsening drought conditions in the Southwest, Colorado River stakeholders agreed in 2007 to a shortage-sharing agreement because it was increasingly impossible to provide all stakeholders the

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87. *Id.*

88. *Id.*

89. PITZER et al., *supra* note 70. This means that “if a shortage is declared on the lower Colorado River water, Arizona theoretically could lose its entire 1.5 million acre-feet CAP allocation before California loses any of its allocation.” *Id.* at 12.

90. Hanemann, *supra* note 85, at 3.

91. *Understanding the CAP Repayment Obligation*, CENT. ARIZ. PROJECT, <http://www.cap-az.com/documents/departments/finance/Repayment-Obligation-102017.pdf> (last visited Jan. 6, 2018). That figure eventually ballooned to \$2.2 billion by 1993 at the conclusion of the project. *Id.*

92. Tom Kenworthy, *Arizona’s Federal Water Project a Bitter, Costly, Disappointment: The West: Cheap, Plentiful Supplies Were Supposed to Wean Farmers Off Underground Water, but with a Huge Price Tag, It Isn’t Working as Planned. California Could Benefit*, L.A. TIMES (Jan. 30, 1994), [http://articles.latimes.com/1994-01-30/local/me-16822\\_1\\_central-arizona-project](http://articles.latimes.com/1994-01-30/local/me-16822_1_central-arizona-project) (“[T]he project is being turned over in stages to the Central Arizona Water Conservation District, a state-created entity responsible for paying back the state’s share of the cost.”).

93. See Jonathan S. King et al., *Getting to the Right Side of the River: Lessons for Binational Cooperation on the Road to Minute 319*, 18 U. DENV. WATER L. REV. 36, 40 (2014) (explaining that drought conditions have reduced the once overflowing reservoirs of the river to slightly less than half full).

94. *Id.* at 41; see also *Lower Colorado River Water Delivery Contracts*, U.S. DEP’T INTERIOR: BUREAU OF RECLAMATION, <https://www.usbr.gov/lc/region/g4000/contracts/wateruse.html> (last updated June 4, 2015) [hereinafter *Lower Colorado Delivery Contracts*].

95. Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, U.S.-Mex., Feb. 3-Nov. 14, 1944, 59 Stat. 1219 (1944); *Lower Colorado Delivery Contracts*, *supra* note 94.

water in quantities promised to them under prior agreements.<sup>96</sup> Arriving at the shortage sharing agreement was no simple task, as one commenter describes:

In the negotiations, it was clear the concept of prior appropriation, codified in *Arizona v. California*, was an unmovable reality. California had been forced to drop its use to 4.4 million acre-feet, but for the foreseeable future, it would drop no more. It stood first in line for its remaining share. If there were any additional shortage, Arizona and Nevada would take the hit. But the details of how were the subject of intense argument among the state's representatives.<sup>97</sup>

The 2007 sharing arrangement establishes three tiers of water allocation reductions based on the reservoir level of Lake Mead, the first tier activating when the reservoir drops below 1,075 feet above sea level.<sup>98</sup> In the first tier of reductions, Arizona will be forced to reduce its take from the Colorado River by 320,000 acre-feet, Nevada by 13,000 acre-feet, and Mexico by 50,000 acre-feet.<sup>99</sup> CAP plans to absorb the entire cut for Arizona, which reaches 480,000 acre-feet at tier three.<sup>100</sup>

In the years following the signing of the 2007 shortage sharing agreement, multiple stakeholders have made efforts to forestall the arrival of shortage conditions. For example, Colorado River stakeholders negotiated the Minute 319 agreement, an appendage to the aforementioned 1944 treaty, which provides for the reduction of deliveries to Mexico during times of shortage as well as the storage of Mexico's allotment in Lake Mead.<sup>101</sup> Currently, discussions between water officials in the United States and Mexico are underway to extend and expand this agreement.<sup>102</sup> The CAP itself paid farmers roughly \$8 million over the last three years "to

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96. John Fleck, *What Seven States Can Agree to do: Deal-Making on the Colorado River*, STAN. RURAL W. INITIATIVE, <http://web.stanford.edu/group/ruralwest/cgi-bin/drupal/content/what-seven-states-can-agree-to-deal-making-colorado-river> (last updated Aug. 3, 2012).

97. *Id.*

98. COLORADO RIVER SHORTAGE, CENT. ARIZ. PROJECT 1 (Oct. 2014), <http://www.cap-az.com/documents/departments/planning/colorado-river-programs/Shortage-Issue-Brief.pdf> (explaining shortage conditions and their impact on Arizona); see also COLORADO RIVER SHORTAGE IMPACTS ON ARIZONA, CENT. ARIZ. PROJECT 2 (Apr. 2015), <http://www.cap-az.com/documents/shortage/Shortage-Fact-Sheet.pdf> (containing information for consumers on potential shortage conditions) [hereinafter SHORTAGE IMPACTS].

99. SHORTAGE IMPACTS, *supra* note 98, at 2.

100. See *id.*

101. King et. al, *supra* note 93, at 41–42 ("The Minute encompasses a series of agreements, operational measures, and cooperative projects that the United States and Mexico have agreed to undertake during a five-year period . . ."); Brandon Loomis, *Crisis Averted at Lake Mead: Colorado River Water Users Avoid Restrictions for Another Year*, AZCENTRAL (Aug. 16, 2016), <http://www.azcentral.com/story/news/local/arizona-water/2016/08/16/crisis-averted-lake-mead-colorado-river-water-users-avoid-restrictions-another-year-2017/88831940/> [hereinafter *Crisis Averted at Lake Mead*]; see also Brandon Loomis, *Sen. Jeff Flake Seals Deal: Arizona's Water to Stay in Lake Mead*, AZCENTRAL (July 20, 2016), <http://www.azcentral.com/story/news/local/arizona-water/2016/07/20/sen-jeff-flake-deal-arizona-water-stay-lake-mead/87340814/> (describing Arizona's plan to store 165,000 acre-feet of water in Lake Mead in order to stave off shortage conditions).

102. Henry Brean, *Early Snowpack Indicates 'Coin Flip' for Lake Mead Shortage Declaration in 2018*, L.V. REV. J. (Jan. 20, 2017), <http://www.reviewjournal.com/local/local-las-vegas/early-snowpack-indicates-coin-flip-for-lake-mead-shortage-declaration-2018/>. This agreement, known as Minute 32X "allows U.S. water agencies to invest in water-saving projects south of the border for a share of the water that is saved." *Id.*

cut back on their water use.”<sup>103</sup> These efforts, along with those of agencies in California and Nevada, caused the Lake Mead reservoir to rise by nine feet.<sup>104</sup> In spite of this achievement, the reservoir is projected to dip below the threshold elevation to bring shortage conditions into effect by either 2017 or 2018.<sup>105</sup> In Arizona and other states, the agricultural industry will be most impacted by cuts in CAP water.<sup>106</sup> With sharp cuts in the water supply hanging over these stakeholders, especially those in Arizona, the need to save water has perhaps never been greater.

Difficulties posed by the Colorado River’s looming water shortage conditions are compounded by the rising populations of many Western states.<sup>107</sup> “Eight of the ten fastest growing cities in the United States are located in” this arid region of the country.<sup>108</sup> Because of the location of these desert cities, distant from naturally abundant water supplies, they require even more water to be imported in order to sustain their growing populations.<sup>109</sup> Although many such cities have dealt with strained water supplies for some time,<sup>110</sup> most have been unsuccessful at reducing their total intake of water out of fear that loss of water would lead to economic decline.<sup>111</sup> Instead of reducing water consumption, cities and states have pursued creative strategies to make the most of their existing supply.<sup>112</sup> San Diego, for instance, has become a leader in recycling its water—reusing an estimated thirteen thousand acre-feet of water every year.<sup>113</sup> With populations continuing to rise and shortage conditions on the horizon, states and cities in the West will need to continue to pursue innovative strategies that facilitate the most effective use of water resources.

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103. *Crisis Averted at Lake Mead*, *supra* note 101.

104. *Id.*

105. *Id.*; see also SHORTAGE IMPACTS, *supra* note 98 (predicting a 2017 shortage declaration). *But see* Breaun, *supra* note 102 (describing optimism that a shortage may not be declared in 2018 because of the wet winter and increased snowpack).

106. See Tony Davis, *Possible CAP Water Cuts: No Crisis Now, Problems Later*, TUCSON.COM (June 4, 2016), [http://tucson.com/business/local/possible-cap-water-cuts-no-crisis-now-problems-later/article\\_656e2f0d-1968-5068-b1e4-80ea33191735.html](http://tucson.com/business/local/possible-cap-water-cuts-no-crisis-now-problems-later/article_656e2f0d-1968-5068-b1e4-80ea33191735.html) (stating that the proposed cuts would “crimp the use of CAP by farms—for whom the project was originally designed . . .”); see also SHORTAGE IMPACTS, *supra* note 98.

107. Denise D. Fort, *Water and Population in the American West*, 107 YALE FORESTRY & ENVTL. SCI. BULL. 17, 17; see generally SUMMIT, *supra* note 80, at 136–39 (tracing the growing water needs of Western cities as their populations increased).

108. Fort, *supra* note 107, at 19.

109. See *id.* at 19.

110. *E.g.*, SUMMIT, *supra* note 80, at 115 (discussing San Diego’s strained water supply caused by population increase as early as the 1940s).

111. *Id.* at 136 (“Throughout the stories of these cities that rely on the [Colorado R]iver, conservation is never a starting point but instead is always a last-resort response to a crisis.”). *But see* Nagourney & Lovett, *supra* note 5 (describing how Californian’s “reduced their use of potable urban water by twenty-four percent compared with 2013 levels.”). Efforts to reduce total consumption also implicate environmental justice concerns, because people of lower income levels are often not able to bear the difficulties of water conservation efforts. See SUMMIT, *supra* note 80, at 137–38.

112. See, *e.g.*, SUMMIT, *supra* note 80, at 116.

113. *Id.* San Diego’s water board hopes to increase that figure to upwards of 53,000 acre-feet by 2020. *Id.*

With Western water resources more precious than ever before, the evaporation of water in canal systems is also increasingly costly to the region.<sup>114</sup> For example, as water flows through the CAP's expansive canal system to end users, about 4.4 percent of that water is lost to evaporation.<sup>115</sup> Various factors contribute to this water loss including the CAP's design, the efficiency of the CAP's operation methods, and delivery system.<sup>116</sup> The CAP's evaporation rate is a particularly pressing issue because the CAP is considered a low priority body of water.<sup>117</sup> Its low priority status means that the CAP is especially vulnerable to water shortages.<sup>118</sup> Currently, the CAP is not taking great strides to prepare for climate change, which will increase evaporation rates and affect water availability.<sup>119</sup> At the least, the CAP is planning for potential shortages and their impacts by participating in modeling scenarios of river runoff, evaluating other options such as river augmentation, conservation, adaptive management, and storing excess water underground for use during shortages.<sup>120</sup> Recent research by the Water Resources Development Commission suggests that short-term planning may not be enough and that instead, Arizona, like other states, "must develop a broad portfolio of solutions to meet the myriad of challenges that are inherent in this diverse state" to deal with water shortages.<sup>121</sup>

Meanwhile, energy-related concerns are placing additional pressure on the CAP and some other Western canal systems. For instance, in order to pump massive amounts of water through its canal system each day, the CAP consumes 2.8 million megawatt hours of electricity—a fact that makes it the largest energy user in the state of Arizona.<sup>122</sup> Nearly all of the energy currently used to power the CAP is derived from the Navajo Generating Station ("NGS").<sup>123</sup> One major drawback of the NGS is that it generates nitrogen oxide emissions ("NOx").<sup>124</sup> To combat NOx emissions, the U.S. Environmental Protection Agency ("EPA") issued a proposed Best Available Retrofit Technology ("BART") rule that would lead to a reduction of NOx emissions from the power plant.<sup>125</sup> The technology to regulate emissions would cost \$544 million and may exceed \$1.1 billion if additional air filters are needed.<sup>126</sup> The

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114. See *FAQ*, CENT. ARIZ. PROJECT, <http://www.cap-az.com/about-us/faq> (last visited Jan. 6, 2018).

115. *Id.* ("Due to the design, constant delivery system and efficient operation methods, CAP's average annual evaporation loss is 4.4 percent, or 16,000 acre feet from the aqueduct and 50,000 acre feet from Lake Pleasant. Seepage losses are 0.6 percent, or 9,000 acre feet per year.")

116. *Id.*

117. Sharon B. Megdal, *The Central Arizona Project (CAP) and Planning for Times of Shortage*, U. ARIZ. 11 (2010), <http://udallcenter.arizona.edu/sarp/workshops/2010/pdfs/CAP%20and%20Planning%20for%20Times%20of%20Shortage.pdf>.

118. *Id.*

119. *Id.* at 11–16.

120. *Id.* at 15.

121. M. Byron Lewis, *New Era of Arizona Water Challenges*, ARIZ. ST. U. MORRISON INST. FOR PUB. POL'Y 2 (2014), <https://morrisoninstitute.asu.edu/sites/default/files/content/products/waterchallenge.pdf>.

122. *It Takes Power to Bring Water to Us!*, CENT. ARIZ. PROJECT, <http://www.cap-az.com/documents/education/It-Takes-Power-to-Bring-Water-to-Us.pdf> (last visited Jan. 6, 2018).

123. *Id.*

124. *Central Arizona Project TWG BART Proposal Fact Sheet*, CENT. ARIZ. PROJECT 1, <http://www.cap-az.com/documents/public-information/navajo-generating-station/CAP-Better-Than-BART-Fact-Sheet.pdf> (last visited Jan. 6, 2018).

125. *Id.*

126. *Id.*

CAP's portion of the cost for installing and operating the NOx emissions technology would be borne by not only CAP water customers, but also the people of Pinal, Maricopa, and Pima counties.<sup>127</sup>

Recent events have made these energy-related concerns all the more pressing in Arizona. In response to the rising costs of generating power, the ownership of NGS voted to shut it down when their lease expires in 2019.<sup>128</sup> While some stakeholders are still trying to find other groups, such as the Navajo Nation, to take over operation of the plant, if a deal cannot be struck the plant will have to be demolished by 2019.<sup>129</sup> Because CAWCD uses revenue garnered from selling surplus power generated at NGS to pay its debt to the federal government for the cost of construction, CAWCD will have to find some other revenue source to repay that debt—most likely by raising prices on CAP customers.<sup>130</sup> The closure of the plant has a human cost as well, affecting the 430 people who work there, as well as another 325 miners at the nearby Kayenta Mine that supplies the coal for NGS.<sup>131</sup>

With energy costs expected to increase and prices becoming more volatile, water agencies such as the CAP face the imposing challenge of trying to find ways to keep rates low for their customers.<sup>132</sup> Worse still, the increasing cost of the energy required to transport CAP water may impact settlements with some Native American tribes who surrendered their future water rights claims in return for low-cost access to CAP water.<sup>133</sup> All of these factors are placing unprecedented financial and other pressures on the CAP, and comparable pressures are impacting other Western canal systems.

### C. An Innovative Strategy: Solar Over Water

Solar over water projects are one strategy that, together with others, could help to address the two-fold policy challenge of conserving scarce water supplies and generating additional carbon-free energy. The following subsections describe the two main forms of solar over water—floatovoltaics and canal-top solar—and explains some of the unique advantages of this type of renewable energy development.

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127. *Id.*

128. *Navajo Coal Plant*, *supra* note 17.

129. *Id.*

130. Ryan Randazzo, *Navajo Generating Station threatened with closure*, AZCENTRAL, <http://www.azcentral.com/story/money/business/energy/2017/01/04/navajo-generating-station-threatened-closure/96164528/> (last updated Jan. 6, 2017) (“More than \$1 billion is owed, and if the water agency doesn’t have surplus power to sell, the only other option to raise revenue is to raise the price of water to cities like Phoenix that use the CAP canal.”).

131. *Navajo Coal Plant*, *supra* note 17.

132. *Floating Solar Systems Provide Power, Environmental Benefits*, WATERWORLD, <http://www.waterworld.com/articles/print/volume-27/issue-9/editorial-features/floating-solar-systems-provide-power-environmental-benefits.html> (last visited Jan. 6, 2018) [hereinafter WATERWORLD] (advocating for the use of floatovoltaics to keep water rates low).

133. David J. Hurlbut et al., *Navajo Generating Station and Air Visibility Regulations: Alternatives and Impacts, Energy Analysis*, NAT’L RENEWABLE ENERGY LABORATORY at v (Mar. 15, 2012), <http://www.nrel.gov/docs/fy12osti/53024.pdf>.

## i. What are Solar Over Water Projects?

Solar over water projects are projects that involve the installation of photovoltaic solar panels above open-air waterways and water bodies. These projects come in two main varieties: floatovoltaics and canal-top solar. Floatovoltaics are solar panels that float directly on the water's surface through the use of special racking systems.<sup>134</sup> Canal-top solar projects use supporting beams installed on the banks of canals to place solar panels directly above the canal.

Floatovoltaic installations are currently being installed on a large scale basis in countries across the world and are gaining increasing popularity in the United States.<sup>135</sup> For example, the Queen Elizabeth II reservoir, near London, will soon feature a floating array of twenty-three thousand solar panels that will generate 6.3 megawatts of power annually.<sup>136</sup> The power from this installation will power local water treatment plants, helping to provide clean drinking water to Southeast England's ten million residents.<sup>137</sup> A large floating solar array is also under construction on a reservoir in the Amazonia region of Brazil to make up for the declining electrical generation of a dam there.<sup>138</sup> In Asia, Japan is in the process of constructing a floating solar plant on the Yamakura Dam, near Tokyo, that will generate enough electricity to power five thousand homes and offset more than eight thousand tons of greenhouse gas emissions annually,<sup>139</sup> and China just recently activated a massive forty megawatt floating solar farm of its own.<sup>140</sup> In the United States, California's wine country has been the first major adopter of floatovoltaic technology, with some wineries installing them on ponds located on their grounds.<sup>141</sup> Sonoma County, California, is also installing a 12.5 megawatt floatovoltaic project on top of its wastewater treatment ponds that will be capable of powering three thousand homes.<sup>142</sup>

Floatovoltaics are an emerging renewable energy development strategy that carries with it several unique concerns. Developers must pay special attention to

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134. Kelly Pickerel, *Riding the New Wave of Floatovoltaic Installations*, SOLAR POWER WORLD (Aug. 31, 2015), <https://www.solarpowerworldonline.com/2015/08/riding-the-new-wave-of-floatovoltaic-installations/>.

135. Kate Zerrenner, *Floating Solar Panels are a Perfect Fit for Drought-Stricken States. Here's Why.*, ENVTL. DEF. FUND: VOICES (May 25, 2016), <https://www.edf.org/blog/2016/05/25/floating-solar-panels-are-perfect-fit-drought-stricken-states-heres-why>.

136. Lorraine Chow, *World's Largest Floating Solar Farm to Provide 10 Million People with Clean Drinking Water*, ECOWATCH (Mar. 1, 2016), <https://www.ecowatch.com/worlds-largest-floating-solar-farm-to-provide-10-million-people-with-c-1882182932.html>.

137. *Id.*

138. Marco Antonio Esteves Galdino & Marta Maria de Almeida Olivieri, *Some Remarks about the Deployment of Floating Solar Systems in Brazil*, 5 J. ELECTRICAL ENGINEERING 10, 16 (2017).

139. Adam Vaughan, *Japan Begins Work on "World's Largest" Floating Solar Farm*, GUARDIAN (Jan. 27, 2016), <https://www.theguardian.com/environment/2016/jan/27/japan-begins-work-on-worlds-largest-floating-solar-farm>.

140. Jason Daley, *China Turns on the World's Largest Floating Solar Farm*, SMITHSONIAN (June 7, 2017), <http://www.smithsonianmag.com/smart-news/china-launches-largest-floating-solar-farm-180963587/>.

141. Julia Pyper, *Sonoma County is Building the Largest Floating Solar Project in the US*, GREENTECH MEDIA (Mar. 11, 2015), <https://www.greentechmedia.com/articles/read/sonoma-county-to-build-the-largest-floating-solar-project-in-the-us>.

142. *Id.*

the type of water body involved when considering these projects.<sup>143</sup> For example, panels cannot be placed on bodies of water with salt content, because even a modest amount of salt can degrade the equipment.<sup>144</sup> Developers must also use solar panels that are practically waterproof to avoid water-related harms to the system.<sup>145</sup> One manufacturer recommends the use of panels designed to withstand submersion in several feet of water for up to thirty minutes.<sup>146</sup> Other impacts from nature, such as typhoons<sup>147</sup> or bird droppings, can further prevent floatovoltaic solar panels from operating at their peak capacity.<sup>148</sup>

The other major category of solar over water projects is canal-top solar—the placement of solar panels on supporting structures that span the width of a canal. The most significant canal-top solar plant in the world is located in Gujarat, India.<sup>149</sup> Construction of this plant began in 2012 with the installation of a one megawatt proof of concept project over a half-mile strip of the canal.<sup>150</sup> Seeing the benefits of this project, in terms of both electricity generation and water savings, Gujarat quickly moved forward with a ten megawatt addition that it completed in 2015.<sup>151</sup> Others are now showing an interest in following the success of the Gujarat plant, with the central Indian state of Maharashtra announcing a plan for an enormous 1.2 gigawatt canal-top solar installation.<sup>152</sup> Interest in canal-top solar exists in other countries as well, with discussions under way to begin a project that would install solar panels over the eleven miles-long Tijuana River Channel—a project capable of providing power to up to thirty thousand homes as well as treating the River’s wastewater.<sup>153</sup>

## ii. What are the Benefits?

Solar over water installations are beginning to appear throughout the world in part because these projects carry with them many desirable benefits. The potential advantages of solar over water installations, both in canal-top and floatovoltaic

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143. Pickerel, *supra* note 134.

144. *Id.*

145. *Id.*

146. *Id.* This may be a uniquely challenging part of the process for developers, because most panel manufacturers do not pay much attention to encapsulants because they are not planning on doing water-based installations. *Id.*

147. David Nield, *The World’s Largest Floating Solar Power Plant is Being Built in Japan*, SCIENCEALERT (Jan. 28, 2016), <http://www.sciencealert.com/the-world-s-largest-floating-solar-power-plant-is-being-built-in-japan>.

148. Pickerel, *supra* note 134.

149. See Austin, *supra* note 13; Manipadma Jena, *India Builds Solar Plants atop Canals to Save Land, Water*, REUTERS (Jan. 16, 2015), <http://in.reuters.com/article/india-solar-idINKBNOKPOZO20150116>.

150. Austin, *supra* note 13.

151. *Id.*

152. *Id.*

153. Sandra Dibble, *New Dream for Tijuana River: Producing Electricity*, SAN DIEGO UNION TRIB. (Nov. 14, 2015), <http://www.sandiegouniontribune.com/news/border-baja-california/sdut-tijuana-river-solar-energy-2015nov14-story.html>; Carolina A. Miranda, *Architect Rene Peralta Wants to Build a Solar Farm on the Tijuana River. Would it Work for L.A.?*, L.A. TIMES (Mar. 21, 2016), <http://www.latimes.com/entertainment/arts/miranda/la-et-cam-tijuana-architect-rene-peralta-solar-farm-tijuana-river-20160223-col-umn.html>.

form, are many-fold. These benefits include water savings, displacement of carbon-emitting fossil fuel power generation, economic development, and increases in renewable energy generating capacity with minimal use of land resources and relatively few habitat impacts.

One unique benefit of solar over water projects is that they can help communities conserve water resources. The Indian state of Gujarat began its ambitious canal project in large part because of a desire to avoid water losses due to evaporation in that dry and arid region.<sup>154</sup> Gujarat estimates that its canal-top installation, when completed, will save around two billion liters from evaporation losses each year.<sup>155</sup> Even its initial one-megawatt plant saves around nine million liters per year in evaporation savings.<sup>156</sup> That savings alone provides up to 2,500 households with ten liters of water every day.<sup>157</sup> Floatovoltaics similarly help to protect water supplies from losses due to evaporation.<sup>158</sup> By some reports, reductions in evaporation losses can be as great as 70%.<sup>159</sup> As climate change makes management of scarce water resources around the globe more uncertain, these evaporation savings can be a boon in fighting off water shortages.

Solar over water projects also generate clean and renewable electricity that displaces greenhouse gas-emitting fossil fuel generation.<sup>160</sup> As mentioned above, the Yamakura Dam in Japan will offset more than eight thousand tons of carbon emissions and provide power to nearly five thousand homes.<sup>161</sup> In India, where coal generates over 75% of the country's electricity, installing solar panels over only 30% of Gujarat's canals would generate enough energy to meet nearly a fifth of India's 2022 solar power goals.<sup>162</sup> Moreover, the solar energy generated from solar over water projects is actually often greater than that of land-based solar, because the water underneath the panels cools them and boosts their productivity.<sup>163</sup> Canal-top installations have even shown fewer signs of degradation over time when compared to land-based solar, meaning that the lifespan of the panels can be much longer.<sup>164</sup> Solar over water projects can likewise generate the power needed to serve nearby users, such as pumping stations for canals or wastewater treatment plants, meaning that less power is lost over long transmission lines.<sup>165</sup>

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154. Austin, *supra* note 13.

155. *Id.*

156. Mukta Patil, *Canal-top Solar Power Plants: One Example of Narendra Modi's Gujarat Model That's Working Well*, FIRSTPOST (Jan. 29, 2017), <http://www.firstpost.com/india/canal-top-solar-power-plants-one-example-of-narendra-modis-gujarat-model-thats-working-well-3225926.html>.

157. *Id.*; see also Zerrenner, *supra* note 135; Dibble, *supra* note 153.

158. Zerrenner, *supra* note 135.

159. *Id.*

160. Phillip Warburg, *Floating Solar is a Win-Win Energy Solution for Drought Stricken US Lakes*, GUARDIAN (June 30, 2016), <https://www.theguardian.com/environment/2016/jun/30/floating-solar-is-a-win-win-energy-solution-for-drought-stricken-us-lakes>; Zerrenner, *supra* note 135.

161. Zerrenner, *supra* note 135.

162. Patil, *supra* note 156; see also Warburg, *supra* note 160 ("If six percent of Lake Mead's surface were devoted to solar power, the yield would be at least 3,400 megawatts of electric-generating capacity—substantially more than Hoover Dam's generating capacity of 2,074 megawatts.").

163. Zerrenner, *supra* note 135.

164. Patil, *supra* note 156.

165. *Id.*

Solar over water projects also have the potential to help drive economic development.<sup>166</sup> A new report from the Department of Energy states that “solar energy accounts for the largest proportion of employers” in the electricity generation industry and that the gap between solar and fossil fuels is growing larger.<sup>167</sup> One Department of Energy official noted, “energy innovation is proving itself as the important driver of economic growth in America, producing 14 per cent of the new jobs in 2016.”<sup>168</sup> Solar over water projects are an additional type of solar energy development that could similarly contribute to economic growth and stability in regions where they are installed.

Solar over water projects are likewise uniquely beneficial in that they have the potential to avoid many of the land-use conflicts that can plague land-based solar energy projects.<sup>169</sup> Leasing or buying land for large land-based solar installation can be expensive, so it is potentially cheaper to develop on manmade water bodies.<sup>170</sup> Installing solar over water does not compete with existing or potential uses of valuable space, a factor that may make these projects especially desirable in crowded locations.<sup>171</sup> Some consider land-based solar an eyesore because the panels are not particularly attractive.<sup>172</sup> Solar over water projects can be more easily hidden from public view and may be installed over water bodies that are themselves not particularly eye-catching.<sup>173</sup> Some traditional land-based solar energy strategies also carry with them a greater potential for conflict with local wildlife.<sup>174</sup> For example, the Mojave Desert’s Ivanpah Solar Plant is criticized for having harmful impacts to wildlife, especially the desert tortoise and birds that fly near the plant.<sup>175</sup> Although more data is needed on the environmental impacts of solar over water projects, initial evidence suggests that they tend to be less harmful than solar installations on land within vulnerable desert ecosystems.<sup>176</sup> Greg Allen, a winemaker who installed floatovoltaics on his pond, reported, “[t]he fish are happy, the frogs are happy, the ducks came back. . . It’s a very healthy pond.”<sup>177</sup>

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166. See May Bulman, *US Solar Power Employs More People than Oil, Coal and Gas Combined, Report Shows*, INDEPENDENT (Jan. 23, 2017), <http://www.independent.co.uk/news/world/americas/us-solar-power-employs-more-people-more-oil-coal-gas-combined-donald-trump-green-energy-fossil-fuels-a7541971.html>.

167. *Id.*

168. *Id.*

169. See Goode, *supra* note 12.

170. *Id.*

171. Patil, *supra* note 156.

172. Tara Macisaac, *Are Solar Panels Ugly or Beautiful?*, EPOCH TIMES (Aug. 20, 2016), [https://www.theepochtimes.com/are-solar-panels-ugly-or-beautiful\\_2131189.html](https://www.theepochtimes.com/are-solar-panels-ugly-or-beautiful_2131189.html).

173. Goode, *supra* note 12.

174. See generally TROY A. RULE, SOLAR, WIND, AND LAND: CONFLICTS IN RENEWABLE ENERGY DEVELOPMENT (2014).

175. Peter Laufer, *The Tortoise is Collateral Damage in the Mojave Desert*, HIGH COUNTRY NEWS (Mar. 19, 2014), <http://www.hcn.org/wotr/the-tortoise-is-collateral-damage-in-the-mojave-desert> (noting that tortoises are still dying despite \$50 million spent on relocation efforts); Louis Sahagun, *This Mojave Desert Solar Plant Kills 6,000 Birds a Year. Here’s Why That Won’t Change Any Time Soon*, L.A. TIMES (Sept. 2, 2016), <http://www.latimes.com/local/california/la-me-solar-bird-deaths-20160831-snap-story.html>.

176. See Warburg, *supra* note 160.

177. Goode, *supra* note 12.

#### D. Obstacles to Implementation

Despite all of the potential benefits that solar over water projects have to offer, several obstacles continue to impede the development of these projects on a wider basis in the United States.<sup>178</sup> The following paragraphs focus on legal and policy hurdles impacting efforts to install solar arrays above Arizona's CAP as a way of highlighting challenges that are deterring solar over water development across much of the West. Among other things, the legal uncertainty surrounding these projects, the high administrative barriers affecting them, and the inability for developers to capture all of the benefits the projects create can get in the way of solar over water development. Fortunately, policy changes are possible that could effectively address these obstacles, and promote far more solar over water projects in the coming years.

##### i. Legal Uncertainty: Prior Appropriation and Developed Water vs. Salvaged Water Confusion

Originating from the Eastern United States, many of the nation's early pioneer settlers saw no need for a new legal regime to manage water resources.<sup>179</sup> However, as the reality of the West's arid climate grew more apparent, Westerners needed to adopt a new set of water allocation rules to incentivize the region's scarce water resources.<sup>180</sup> To address their concerns, they developed the prior appropriation doctrine, a "first in time, first in right" approach that grants rights to use water to those who first divert it to a beneficial use.<sup>181</sup> Within this priority system, senior users have priority over junior users—who may not necessarily receive all or any of the water.<sup>182</sup> For example, "[w]hen a downstream senior right holder is not satisfied with the quantity of water he is receiving, he can place a 'call' on the river. This means that upstream junior appropriators must cease diverting water."<sup>183</sup> In order to establish a right to use the water, a user must: (1) have intent to apply the water to a beneficial use, (2) actually divert the water from the source, and (3) apply the water to a beneficial use within a reasonable time.<sup>184</sup> This system of allocating rights in water was well suited to promoting productive use of scarce water resources during the drive to settle the sparsely populated American West in the nineteenth century.<sup>185</sup>

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178. Diane Cardwell, *Renewable Sources of Power Survive, but in a Patchwork*, N.Y. TIMES (Apr. 10, 2012), <http://www.nytimes.com/2012/04/11/business/energy-environment/renewable-energy-advances-in-the-us-despite-obstacles.html?mcubz=3>.

179. See generally STEINBERG, *supra* note 52, at 116–117; Toll, *supra* note 52, at 596.

180. Toll, *supra* note 52, at 600–01 (describing the origin of prior appropriation in the mining camps of California).

181. Rhett Larson, *Augmented Water Law*, 48 TEX. TECH L. REV. 757, 765–66 (2016); Lawrence J. MacDonnell, *Prior Appropriation: A Reassessment*, 18 U. DENV. WATER L. REV. 228, 242 (2015).

182. See Larson, *supra* note 181, at 766.

183. Eli Feldman, *Death Penalty for Water Thieves*, 8 U. DENV. WATER L. REV. 1, 3 (2004).

184. See DAVID H. GETCHES ET AL., WATER LAW IN A NUTSHELL 79 (5th ed. 2015) (failure to continue using the water beneficially may result in forfeiture of the right).

185. Toll, *supra* note 52, at 607–08.

The law of prior appropriation draws a critical distinction between two types of water: developed water and salvaged water.<sup>186</sup> Developed water is water that would not naturally be in a stream and is only there because of human effort.<sup>187</sup> The developer, the person responsible for putting the new water into the stream, has an absolute right to its use that is not subject to the priority system.<sup>188</sup> This means, for example, that a developer will not be subject to a call placed on the river by a senior right holder.<sup>189</sup> By granting this right to use the water outside of the normal priority system, developed water rights can incentivize efforts to increase the water available in the stream.<sup>190</sup>

Salvaged water, in contrast, is water recovered from existing uses or losses through human intervention.<sup>191</sup> Because the water is not new to the stream in the same sense as developed water, it “remains part of the priority system, and the party that salvaged the water has no special or superior claim to the water even though . . . the water would have been otherwise available.”<sup>192</sup>

Unfortunately, the law’s formalistic distinction between developed and salvaged water is ill-suited to account for modern methods of augmenting the water supply and fails to provide proper incentives for people to engage in such innovative strategies.<sup>193</sup> For example, upstream water users have relatively little incentive to invest resources in removal of invasive plant species that consume vast quantities of water because any water saved would be salvaged water.<sup>194</sup> If an upstream state did invest such time and money, the benefits would likely not accrue to them, but to states downstream.<sup>195</sup> The failure of the law to incentivize this particular strategy is problematic, especially given the added benefits of pursuing it: improving forest health by allowing other trees to reach maturity, mitigation of wildfire risk and insect infestation, and decreasing erosion and runoff that contribute to lowering water quality.<sup>196</sup> The same quandary holds true in the case of desalination. Prior appropriation law fails to incentivize desalination as a method to treat in-stream pollution because this would create only salvaged water that would still be subject to the priority system.<sup>197</sup>

Conversely, prior appropriation law provides incentives for some strategies that may not create materially more water supply or might be inefficient. Returning to the example of desalination, because desalinated seawater is developed water it

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186. Larson, *supra* note 181, at 766.

187. *Id.* (one common example is a bulk water import).

188. GETCHES ET AL., *supra* note 184, at 98–99; Feldman, *supra* note 183, at 3–4.

189. Feldman, *supra* note 183, at 3.

190. *See* Larson, *supra* note 181, at 767.

191. *See id.* at 766.

192. *Id.*

193. *Id.* at 767 (“[W]hat incentives exist for improved watershed management if those investing in it cannot secure the benefit of augmented water?”).

194. Feldman, *supra* note 183, at 25 (discussing how salvaged water poses barriers to solving problems on an interstate level).

195. *Id.*

196. *See* Larson, *supra* note 181, at 762. Watershed management strategies, however, must be pursued with caution in order to avoid adverse effects on aquatic and wildlife habitats. *Id.* at 762–63.

197. *Id.* at 767.

will invest the person who engaged in desalination with a superior right to use that water outside of the priority system.<sup>198</sup> Yet, such an activity is arguably no more deserving of a superior right than is the treatment of unusable brackish water within the stream—which would be considered salvaged water under traditional prior appropriation principles.<sup>199</sup> Also potentially problematic, are the existing paradigm incentivizes strategies—such as bulk water transports—that are highly energy intensive and themselves contribute to greenhouse gas emissions.<sup>200</sup>

As new and innovative water augmentation strategies arise through the use of technologies such as desalination or cloud seeding, the distinction between developed and salvaged water becomes increasingly blurred and problematic.<sup>201</sup> Using desalination to augment water supply could possibly create either a developed or salvaged right to water.<sup>202</sup> Cloud seeding, the dispersal of particles via airplane or cannon to induce rainfall, also raises questions under the traditional distinction.<sup>203</sup> Would the answer to whether cloud seeding grants a developed or salvaged right to water hinge on where the water in the cloud originally came from, the water body being augmented, or some other source?<sup>204</sup> The law is uncertain about the answer to these question, and water generated from new technologies—like floatovoltaics and canal-top solar—also reside in a zone of uncertainty.<sup>205</sup> This uncertainty alone can serve as a disincentive to investment in such expensive projects.

Although the law of prior appropriation was effective at promoting optimal use of scarce water resources during the settlement of the American West, the law seems increasingly simplistic given the needs of the present day. Among these are rapidly decreasing supplies due to greenhouse gas-induced climate change, the dramatic increase in population growth in the West, and fulfilling promises made long ago (but never fulfilled) to Native American tribes to ensure their water rights.<sup>206</sup> A somewhat more sophisticated and flexible governance structure is arguably needed to better address these growing water policy challenges. Such a structure might well include better means of incentivizing and rewarding parties for conserving thousands of gallons of water from evaporation through solar over water projects.

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198. Rhett B. Larson, *Innovation and International Commons: The Case of Desalination under International Law*, 2012 UTAH L. REV. 759, 789 (2012).

199. See Larson, *supra* note 181, at 767.

200. *Id.* at 761.

201. See Larson, *supra* note 198, at 789 (discussing differing outcomes of desalination).

202. *Id.*

203. Larson, *supra* note 181, at 767 (noting legal uncertainty hindering further utilization of this technology).

204. *Id.*

205. See *id.*

206. See Janet C. Neuman, *Beneficial Use, Waste, and Forfeiture: The Inefficient Search for Efficiency in Western Water Use*, 28 ENVTL L. 919, 975 (1998); Toll, *supra* note 52, at 607–08.

## ii. Transaction Costs

There are also significant administrative hurdles that can slow the development of solar over water installations.<sup>207</sup> For example, efforts in Arizona to develop an ambitious canal-top solar project over the CAP are not new, but prior efforts have fizzled out, in part, due to administrative red tape and bureaucratic inertia.<sup>208</sup> Developers have to deal with numerous state and federal agencies: the CAP Board, the Department of the Interior, and the EPA to name a few.<sup>209</sup> The CAP Board specifically appears to have little incentive to engage in such projects: the Board faces uncertainty and risk and is unsure of what exactly its reward for taking that risk might be.<sup>210</sup>

One of the main challenges in persuading water agencies and canal system operators of the benefits of solar over water projects is that, without a proof of concept, there are differing opinions about how much water such projects can save or how much electricity they will generate.<sup>211</sup> Even arriving at this first step is difficult, costing large amounts of money and time to get administrative approval.<sup>212</sup> In fact, other developers have tried and failed to install solar panels over the CAP, their projects fizzling out in the initial stages.<sup>213</sup> Because few have ever tackled this kind of project before, both developers and administrative bodies may be overly skeptical about the prospects for success.

Even after gaining approval from the CAP Board, the project would still have to be approved by the Department of the Interior, and any environmental impacts would need to be assessed by the EPA.<sup>214</sup> The project may also need to gain approval for development on any sections that abut Bureau of Land Management (“BLM”) or tribal lands. This administrative headache can serve to frustrate local

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207. Interview with David Tietgen, Managing Partner, Am. Clean Air Network, LLC, in Phx., Ariz. (Jan. 4, 2017) (“Development of canal top installations is complicated because numerous regulatory agencies have a stake in the approval process including the CAP Board, the Department of the Interior, and even the EPA.”) [hereinafter Interview with David Tietgen] (on file with authors).

208. *Id.* (“Several other groups have tried and failed to get these projects off the ground in the past.”).

209. See, e.g., Tom Fitzgerald, *Central Arizona Project Canal Trail: A Pathway for Water and People*, AM. TRAILS, <http://www.americantrails.org/resources/land/Central-Arizona-Project-Canal-Trail.html> (last visited Jan. 7, 2018) (discussing the need for trails abutting the canal to gain permitting from Bureau of Reclamation as well as complying with EPA regulations).

210. See generally U.S. DEP’T INTERIOR: BUREAU OF RECLAMATION, FUNDAMENTAL CONSIDERATIONS ASSOCIATED WITH PLACING SOLAR GENERATION STRUCTURES AT CENTRAL ARIZONA PROJECT CANAL (2016), <https://www.usbr.gov/main/qoi/docs/09.27.2016%20Placing%20Solar%20Generation%20Structures%20Over%20the%20CAP%20Canal%20final%20.pdf> [hereinafter U.S. DEP’T INTERIOR: BUREAU OF RECLAMATION]. *But see infra* Part III for a discussion on some possible benefits to CAP of engaging in such a project.

211. Interview with David Tietgen, *supra* note 207 (predicting a relatively high amount of water savings and further noting that: “Without a proof of concept, it is difficult to demonstrate precisely how much water is saved or electricity generated.”). *But see* U.S. DEP’T INTERIOR: BUREAU OF RECLAMATION, *supra* note 210, at 13 (estimating that evaporation rate could be cut by only 50%).

212. Interview with David Tietgen, *supra* note 207 (“Even getting to the point where building a proof of concept is feasible is an incredibly difficult process.”).

213. *Id.*

214. *Id.*

agencies or private developers who want to build canal-top solar, either in Arizona or elsewhere.

### iii. Project Construction Costs

One other obstacle is the high upfront costs of solar over water installations and the lack of policies that reflect the full societal benefits of these project. At the time of CAP's construction, Reclamation estimated that covering the CAP, even without solar panels, "would have quadrupled the \$4 billion the project originally cost."<sup>215</sup> However, there is some evidence that these costs are not as high as they once were.<sup>216</sup> The canal-top solar plant in Gujarat added a ten megawatt addition that cost only \$18.3 million.<sup>217</sup> Solar projects spanning canals and covering reservoirs can also save costs in some ways that traditional land-based solar cannot—there may be no need to purchase undeveloped land for the installation, for example.<sup>218</sup> However, in terms of installation and maintenance, costs are still higher on average than a comparable land-based solar plant.<sup>219</sup> This is all the more true for floatovoltaic projects because of the need to purchase special panels and conduct maintenance should deleterious effects (like rust) begin to impact their operation.<sup>220</sup>

Moreover, although solar over water projects are generally less likely to conflict with wildlife or competing land uses than land-based solar installations, such conflicts are still possible in some cases.<sup>221</sup> Small-scale solar over water projects are unlikely to have any material wildlife impact.<sup>222</sup> However, the potential impacts for large-scale solar over water projects are less clear.<sup>223</sup> Studies are currently underway to determine the environmental impact of floatovoltaics in reservoirs around the globe.<sup>224</sup> Solar over water projects have the potential to not only conflict with local wildlife but with views of canals or reservoirs in locations where those views are valued.<sup>225</sup> Recreational uses of reservoirs, such as waterskiing, might also see impacts from solar over water projects in some settings. Canal system operators might also have concerns about canal-top solar's impacts on canal access for oper-

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215. *FAQ*, *supra* note 114.

216. *See Austin*, *supra* note 13 (noting a cheaper figure for the Gujarat canal system).

217. *Id.*

218. *Id.*

219. *See Manipadma*, *supra* note 149 ("The 1 MW canal-top plant cost \$2.8 million, according to SSNNL, whereas a 1 MW land-based solar plant costs \$2.3 million.").

220. *See Pickerel*, *supra* note 134.

221. *See, e.g., Holly Matthews*, *PUB Studies Environmental Impact of Floating Solar Panels*, TODAY (July 3, 2015), <http://www.todayonline.com/singapore/solar-energy-powering-chua-chua-kang-waterworks>.

222. *Goode*, *supra* note 12 ("The fish are happy, the frogs are happy, the ducks came back . . . It's a very healthy pond.").

223. *Morgan Lee*, *Solar Energy Blotting out Nature, Farms in California*, SAN DIEGO UNION TRIB. (Oct. 19, 2015), <http://www.sandiegouniontribune.com/sdut-big-solar-big-impacts-2015oct19-story.html> (noting that while floating solar is an innovative solution, it may displace water fowl).

224. *See, e.g., Matthews*, *supra* note 221.

225. U.S. DEP'T INTERIOR: BUREAU OF RECLAMATION, *supra* note 210, at 11–12.

ation and maintenance or about impacts on the structural integrity of the canal itself.<sup>226</sup> Any of these concerns can engender opposition to an otherwise promising solar over water project.

Despite their unique challenges, solar over water projects generate many positive societal benefits that are available in few other ways. These benefits include conserving water through evaporation savings, displacing greenhouse gas emitting fossil fuels, the ability to install on land already in use, the potential to drive economic development, and more. However, obstacles like administrative burdens and high upfront costs do not allow developers to internalize these valuable social benefits. Because these social benefits are not reflected in the current cost of completing one of these projects, they are currently underutilized. This article now turns to a discussion of policy proposals that can help developers capture more of the important societal benefits these projects create.

### III. OVERCOMING OBSTACLES AND PROMOTING SOLAR OVER WATER

Current state and federal policies do relatively little to promote solar over water projects. Fortunately, there are numerous ways that governments could revise laws to better incentivize this uniquely valuable type of development. Streamlined leasing and permitting procedures, an enhanced federal investment tax credit, and modifications to state Renewable Portfolio Standard (RPS) policies to include specific targets for solar over water could all do a lot to facilitate wider implementation of solar over water technologies.

Part III describes these and other potential policy approaches to increasing solar over water development in the United States. Section A of this Part examines the permitting challenges faced by stakeholders and suggests a streamlined process.<sup>227</sup> Section B analyzes the current federal tax incentive landscape for solar projects and suggests expanding the existing investment tax credit (“ITC”) over developing a new production tax credit (“PTC”).<sup>228</sup> Section C then describes the role of state RPS standards in driving renewable energy development structure and advocates for special carve-out provisions in some Western states to increase market demand for projects that place solar arrays on or over water.<sup>229</sup>

#### A. Streamlining the Approval Process

Project developers interested in installing solar arrays over canals and reservoirs face a number of challenges, many of which are typical of the renewable energy project approval process.<sup>230</sup> For example, agencies may not be convinced that floating solar serves their interests,<sup>231</sup> many projects tend to be situated at remote

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226. *Id.* at 12.

227. *See infra* Section III.A.

228. *See infra* Section III.B.

229. *See infra* Section III.C.

230. Goode, *supra* note 12.

231. *Id.*

locations, regulatory roadblocks delay the process, and dealing with numerous federal, state, and local authorities can forestall approval.<sup>232</sup> A streamlined approval process for solar over water is necessary to overcome these challenges and create an environment for vital water-saving solar over water projects to flourish. The myriad of regulatory agencies cause uncertainty that ultimately leads to inaction because developers face ambiguity regarding who to get approval from for their projects.<sup>233</sup> Further, even when developers know who they need to go to, the sheer number of agencies they have to deal with also discourages development.

Although the numerous regulatory hurdles impacting renewable energy development are usually motivated by good intentions such as environmental protection, the potential benefits of a more streamlined approval process for these valuable projects are often ignored. Streamlining the approval process could make it easier for developers to obtain financing. Streamlining itself also promotes project development, helping utilities and governments to meet their renewable energy policy goals.<sup>234</sup> Streamlining solar over water projects would likewise promote job creation and drive economic development by reducing overall development costs.<sup>235</sup> Streamlined approval programs for solar over water, in particular, would even promote land conservation by enabling solar development to take place atop canals that are often less environmentally sensitive than areas used for traditional land-based solar.<sup>236</sup> Given these benefits and the distinct water scarcity issues facing the West, states in the region should consider developing a more streamlined permitting process for utility-scale solar over water projects similar to those permitting processes already in place for wind power in some jurisdictions.

This section identifies the challenges of streamlined permitting at the federal and state level. It then describes the ability of streamlined permitting to reduce uncertainty and to promote meeting renewable energy goals at the federal and state levels. Next, it highlights successful streamlined permitting projects both in the United States and abroad. Finally, it makes the case for streamlined permits for utility-scale solar over canals and reservoirs.

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232. *Renewable Energy Projects: Siting and Permitting Legal Challenges*, STRAFFORD (Jan. 18, 2012), <https://www.straffordpub.com/products/renewable-energy-projects-siting-and-permitting-legal-challenges-2017-04-04> (recording available for purchase, program materials available online); “Facility developers, property owners and their counsel must also navigate a battleground between federal, state and some local authorities to obtain siting and permitting approval.” *Id.*; see Neal McAilley, *Federal Environmental Permitting of Renewable Energy Projects*, ENVTL. LEADER (Aug. 2, 2011), <https://www.environmental-leader.com/2011/08/federal-environmental-permitting-of-renewable-energy-projects/> (“[T]here rarely is ‘one-stop shopping’ for environmental approvals, because permits and approvals almost invariably are required from multiple [federal] government agencies.”).

233. McAilley, *supra* note 232.

234. Nathaniel Logar, *When the Fast Track Hits the Off Ramp: Renewable Energy Permitting and Legal Resistance on Western Public Lands*, 27 COLO. NAT. RESOURCES, ENERGY & ENVTL. L. REV. 361, 367 (2016); Elizabeth Shogren, *Making Sense of President Trump’s Energy Plan*, HIGH COUNTRY NEWS (Jan. 23, 2017), <http://www.hcn.org/articles/making-sense-of-president-trumps-energy-plan> (“It appears [President Trump’s] administration’s energy policies are as contradictory as ever.”).

235. See Logar, *supra* note 234, at 386.

236. Jena, *supra* note 149 (“efficient and cheap land use”).

## i. Challenges of Streamlining at the Federal and State Level

Acquiring the proper state and federal permits, the first step in developing any renewable energy project, can be a lengthy and expensive process for developers.<sup>237</sup> In addition to the length of the process, the patchwork of distinct regulatory landscapes that vary from jurisdiction to jurisdiction can create uncertainty and confusion for potential solar over water developers.<sup>238</sup> These delays and complexities can quickly become burdensome and costly.<sup>239</sup>

Project developers seeking to use federal public lands—including canals and reservoirs—must first obtain approval from federal regulatory agencies.<sup>240</sup> Solar energy project developers looking to place their project on federal public lands would need to obtain approval from the BLM.<sup>241</sup> Recognizing some of the burdens of the federal approval process, the BLM launched a “fast track initiative.”<sup>242</sup> Although they are moving in the right direction, the BLM and agencies like it should expand efforts like the fast track initiative to include solar over water projects.<sup>243</sup>

Federal law also imposes unique requirements for development on tribal lands, often ideal locations for solar over water, that can be even more cumbersome. For example, developers are required to adequately “consult” with tribes about proposed projects that might adversely affect tribal interests on ancestral lands.<sup>244</sup> Unfortunately, while courts have offered some guidance, the standard for adequate consultation is still unclear—and future court battles over this requirement are likely.<sup>245</sup> In addition to this obligation to consult, developers looking to build solar over water on tribal lands require the approval of the federal government itself.<sup>246</sup> To bypass this federal approval process, Congress implemented

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237. Al Maiorino, *The Primary Source for Renewable Project Delays and the Strategies to Prevent Them*, RENEWABLE ENERGY MAG. (Sept. 12, 2016), <http://www.renewableenergymagazine.com/al-maiorino/the-primary-source-for-renewable-project-delays-20160912>.

238. See Uma Outka, *The Renewable Energy Footprint*, 30 STAN. ENVTL. L. J. 241, 309 (2011).

239. See Jeffrey Thaler, *Fiddling as the World Floods and Burns: How Climate Change Urgently Requires a Paradigm Shift in the Permitting of Renewable Energy Projects*, 42 ENVTL. L. 1101, 1156 (2012).

240. McAilley, *supra* note 232.

241. *Id.* (“From offshore wind farms, to solar and wind projects on federal land . . . large-scale renewable energy projects usually need the approval of at least one federal agency, such as the new Bureau of Ocean Energy Management Regulation and Enforcement (“BOEMRE”) and Federal Energy Regulatory Commission (“FERC”) for offshore projects, to the Bureau of Land Management (“BLM”) and U.S. Forest Service for projects on federal lands in the West.”).

242. Outka, *supra* note 238, at 271.

243. See *id.*

244. RULE, *supra* note 174, at 125–26 (stating that, at the very least, to comply with NHPA’s consultation requirements, federal officials would be well advised to “begin early” and insure that tribes have “adequate information and time” to investigate the potential impact on cultural resources).

245. *Id.* at 128.

246. Donald M. Clary, *Commercial-Scale Renewable Energy Projects on Tribal Lands*, 25 NAT. RESOURCES & ENV’T 19, 23 (2011); Joshua Zaffos, *Renewable Energy on Tribal Lands Stalls Out*, HIGH COUNTRY NEWS (July 3, 2015), <http://www.hcn.org/articles/federal-agency-shortcomings-stalling-solar-wind-tribal-winds>; see also 25 U.S.C. § 81 (2012) (requiring federal approval for renewable energy projects encumbering tribal land for more than seven years).

“Tribal Energy Resource Agreements” (“TERAs”).<sup>247</sup> TERAs grant tribes the authority to approve leases for development without requiring additional approval from the Secretary of Interior.<sup>248</sup> Although TERAs would provide project developers with more efficiency and assurances about project development, leading to improved investor confidence for such projects, they remain regrettably underutilized.<sup>249</sup> Just like in the state context, streamlined permitting on tribal lands has the potential to promote job growth and a greener economy.<sup>250</sup>

In addition to dealing with federal agencies, developers must satisfy a long list of state requirements and regulations to obtain the relevant permits for large-scale renewable energy projects.<sup>251</sup> State requirements add on to the cost, length, and unpredictability of the approval process.<sup>252</sup> Furthermore, given the smaller size and budgets of state agencies, the agency may find itself overwhelmed and unable to provide timely review of all applications.<sup>253</sup>

ii. The Advantages of a Streamlined Approval Process: Mitigating Uncertainty to Promote Renewable Energy

Financing uncertainty is a powerful disincentive to renewable project development that can also be partially mitigated through streamlined approval processes.<sup>254</sup> Renewable energy projects have received much less financing than have other energy sources like oil or nuclear.<sup>255</sup> The federal government’s unpredictable commitment to renewable energy growth negatively impacts the development of renewable energy projects.<sup>256</sup> For example, uncertainty surrounding the renewal of the Production Tax Credit (“PTC”) caused the United States’ capacity for new wind projects to decrease by over seventy-five percent from each prior year between 1999 and 2003.<sup>257</sup> Again in 2013, uncertainty over PTC renewal led wind development to hit its lowest level since 2004.<sup>258</sup> When faced with similar uncertainty over

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247. See generally Renewal of Agency Information Collection for Tribal Energy Resource Agreements, 81 Fed. Reg. 49255 (2016).

248. Clary, *supra* note 246, at 23.

249. *Id.*

250. RULE, *supra* note 174, at 132.

251. Francesco Belfiore et al., *Risks and Opportunities in the Operation of Large Solar Plants*, GOLDER ASSOC. 3–7 (May 23, 2013), [https://www.golderassociates.dk/en/modules.php?name=Publication&sp\\_id=300&page\\_id=&sector\\_id=12](https://www.golderassociates.dk/en/modules.php?name=Publication&sp_id=300&page_id=&sector_id=12).

252. Outka, *supra* note 238, at 267. (“[I]n states that rely on local governance for some or all energy siting, the local approval process can be lengthy, costly, and unpredictable.”).

253. See David R. Baker, *Bureaucracy Trips Up Renewable Energy Projects*, WINDACTION (Nov. 27, 2009), [http://www.windaction.org/posts/23319-bureaucracy-trips-up-renewable-energy-projects#.WLd3bH\\_\\_mM8](http://www.windaction.org/posts/23319-bureaucracy-trips-up-renewable-energy-projects#.WLd3bH__mM8) (“The local, state and federal agencies involved [in the process for winning government permits for renewable energy projects] have been buried in applications, more than they can easily handle.”).

254. Logar, *supra* note 234, at 372.

255. Andrew C. Fink, *Securitize Me: Stimulating Renewable Energy Financing by Embracing the Capital Markets*, 12 U. N.H. L. REV. 109, 114 (2014).

256. *Id.* at 116.

257. *Id.*

258. See Silvio Marcacci, *2013 Wind Energy Installations Stall in US, Surge in China*, CLEAN TECHNICA (Feb. 6, 2014), <https://cleantechnica.com/2014/02/06/2013-wind-energy-installations-stall-u-s-surge-china/>.

tax credit renewal, the solar market fared just as poorly.<sup>259</sup> Today, some are concerned that sustainable energy companies may scale back plans to build more solar projects because of renewed uncertainty surrounding tax credits.<sup>260</sup> In the face of this uncertainty over tax credits, project developers often seek out alternative financing options such as federal grants and loans.<sup>261</sup> These alternative forms of funding often depend on the developer's ability to meet specific deadlines, meaning that streamlining the approval process will ease developers' pursuit of alternative financing options.<sup>262</sup> This will be especially helpful to developers should policymakers fail to improve the tax credit environment, because developers will have greater assurance of their ability to garner funds from alternative sources.<sup>263</sup>

### iii. The Success of Streamlined Permitting for Wind Power

Although streamlined permitting for solar is currently available only for residential projects and small-scale commercial projects,<sup>264</sup> large-scale commercial wind farms have benefitted greatly from streamlined permitting processes.<sup>265</sup> The increasing demand for wind energy prompted the federal government to establish a streamlined permitting process managed by Fish and Wildlife Services.<sup>266</sup> This program, the "Programmatic Regional Wind Energy Development Evaluation Process," provides project developers with a more structured, consistent, and efficient review process.<sup>267</sup> The process relies upon the "Upper Great Plains Wind Energy Final Programmatic Environmental Impact Statement" ("PEIS").<sup>268</sup> This regional PEIS streamlines environmental review for wind projects.<sup>269</sup> The streamline approach identifies

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259. Fink, *supra* note 255, at 115.

260. *Will Solar Energy Plummet if the Investment Tax Credit Fades Away?*, WALL ST. J., (Nov. 15, 2015), <https://www.wsj.com/articles/will-solar-energy-plummet-if-the-investment-tax-credit-fades-away-1447643512>.

261. Press Release, U.S. Dep't Agric., USDA Provides Funding for More Than 1,100 Renewable Energy and Energy Efficiency Projects Nationwide (Oct. 26, 2015), <https://www.usda.gov/wps/portal/usda/usdahome?contentid=2015/10/0296.xml>.

262. *Id.*

263. Richard W. Caperton, *Good Government Investments in Renewable Energy*, CTR. FOR AM. PROGRESS (Jan. 10, 2012), <https://www.americanprogress.org/issues/green/reports/2012/01/10/10956/good-government-investments-in-renewable-energy/>.

264. See Eric Wesoff, *New California Law Cuts Solar-Permitting Red Tape*, GREENTECH MEDIA (Sept. 23, 2014), <https://www.greentechmedia.com/articles/read/New-California-Law-Cuts-the-Red-Tape-and-Costs-of-Solar-Permitting> (describing California's efforts to streamline permitting for residential and commercial solar).

265. Sara Orr & Bobbi-Jo Dobush, *US FSW Announces Record of Decision Streamlining Wind Energy Permitting for the Upper Great Plains*, LATHAM & WATKINS LLP: CLEAN ENERGY L. REP. (July 21, 2016), <http://www.cleanenergylawreport.com/finance-and-project-development/us-fws-announces-record-of-decision-streamlining-wind-energy-permitting-for-the-upper-great-plains/>.

266. *Id.*

267. *Id.*

268. David C. Levy, *U.S. Fish and Wildlife Service and the Western Area Power Administration Streamline the Environmental Review Process for Wind Energy Projects*, BAIRDHOLM LLP (July 27, 2016), <http://www.bairdholm.com/publications-feed/entry/u-s-fish-and-wildlife-service-and-the-western-area-power-administration-streamline-the-environmental-review-process-for-wind-energy-projects.html>.

269. *Id.*

the environmental impact of wind projects in the Great Plains, as well as, the mitigation measures project developers need to take.<sup>270</sup> Identifying regional environmental impacts using a PEIS eases the approval process by eliminating the need for individualized reviews of environmental impacts for each project. Although the federal government has made strides to streamline the permitting process, other countries—like Denmark—have implemented highly successful “one-stop shop” approval programs.<sup>271</sup> Thanks in large part to the success of this program, Denmark is on track to meet its goal of using wind to power fifty percent of its energy needs by 2020.<sup>272</sup>

Some states are implementing their own streamlined permitting procedures for renewable energy. Maine, for example, encouraged grid-scale development of wind energy by designating large portions of the state for expedited review.<sup>273</sup> Today, Maine leads the way in wind power among the New England states, with a wind energy industry that has generated over \$1 billion in value during the past few years.<sup>274</sup>

Some individual counties have also adopted their own streamlined approval strategies to promote wind development. Counties have utilized tools like “energy overlay zones” (“EOZs”) to encourage the growth of wind.<sup>275</sup> EOZs identify data on wind resources, wildlife habitat areas, and transmission availability to determine ideal areas for wind farms.<sup>276</sup> In one county, EOZs enabled proposals for wind energy development to be approved in as little as 45 days.<sup>277</sup> Establishing such favorable conditions for project development, attracted many project developers and proved to be an important economic boon for the area.<sup>278</sup>

#### iv. The Case for Streamlined Permits for Utility-Scale Solar over Canals and Reservoirs

Streamlined permitting processes for solar over water projects could potentially bring economic benefits comparable to those it has generated in the context

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270. Lisa Meiman, *Streamlined Environmental Process to Help Accelerate Wind Project Development in Midwest*, W. AREA POWER ADMIN. (Aug. 25, 2015), <https://www.wapa.gov/newsroom/News-Releases/2015/Pages/wind-decision.aspx>.

271. *Denmark’s Offshore Wind Power Among Best in World, with More Growth by 2020*, EV WIND (Oct. 31, 2014), <https://www.evwind.es/2014/10/31/denmarks-offshore-wind-power-among-best-in-world-with-more-growth-by-2020/48438>.

272. *Id.* (describing how Denmark’s streamlined permitting process requires project developers to visit only one agency).

273. *Commercial Wind Farm Opponents Seek to Opt Out of Speedy Reviews*, MAINEBIZ. (Jan. 4, 2016), <http://www.mainebiz.biz/article/20160104/NEWS0101/160109994/commercial-wind-farm-opponents-seek-to-opt-out-of-speedy-reviews>; see ALSO FRI A-5: VISUAL IMPACT ASSESSMENT: WIND ENERGY AND THE MAIN WIND ENERGY ACT, AM. SOC’Y LANDSCAPE ARCHITECTS 1 (2012), [https://www.asla.org/uploaded-Files/CMS/Meetings\\_and\\_Events/2012\\_Annual\\_Meeting\\_Handouts/FRI-A5%20Visual%20Impact%20Assessment%20Wind%20Energy%20and%20the%20Maine%20Wind%20Energy%20Act.pdf](https://www.asla.org/uploaded-Files/CMS/Meetings_and_Events/2012_Annual_Meeting_Handouts/FRI-A5%20Visual%20Impact%20Assessment%20Wind%20Energy%20and%20the%20Maine%20Wind%20Energy%20Act.pdf).

274. *Commercial Wind Farm Opponents Seek to Opt Out of Speedy Reviews*, *supra* note 273.

275. RULE, *supra* note 174, at 174–76 (discussing the example of Klickitat County).

276. *Id.*

277. *Id.*

278. *Id.*

of wind energy. This streamlining will be most effective if all levels of government take action: federal, state, and local.

Federal regulatory agencies should take action to streamline their cumbersome approval process. Agencies such as the BLM, which manages and operates canals and reservoirs ideal for solar over water development, could expand fast-track approval to include solar arrays installed over reservoirs and canals on federal land.<sup>279</sup> Currently, the BLM's approval rate for renewable energy projects is slow, with few projects receiving approval.<sup>280</sup> Expanding fast-track approval could lessen these delays and help to attract business from both project developers and utility companies. Such an approach should be similar to Denmark's successful "one-stop shop" approach that has proved beneficial for both project developers and the country's renewable energy economy.<sup>281</sup> By reducing the transaction costs faced by developers in gaining approval, the federal government could potentially replicate some of the desirable outcomes generated by Denmark's innovative program.

Perhaps the most critical element of a streamlined approval process at the federal level is a PEIS. Solar installations spanning the canals and reservoirs of drought-stricken Western states are deserving of a PEIS because they present little, if any, harm to the environment. Solar over water projects have already demonstrated their ability to coexist peacefully with animal life—even on natural ponds.<sup>282</sup> When installed on biodiverse waters, the panels are not placed on the areas most vulnerable to harmful intrusions—the shores.<sup>283</sup> Installations sited atop large canals and reservoirs intrude even less upon fragile ecosystems.<sup>284</sup> Canals and reservoirs are not biodiverse waters and, generally, contain little animal life.<sup>285</sup> A PEIS for solar over water is also appropriate because these projects are built on already developed land. Traditional utility-scale solar, on the other hand, requires development of large tracts of desert land—disrupting vulnerable plant and animal life.<sup>286</sup> These problems compound one another, as changes in the size and cover of plants lead to shifts in animal populations as well.<sup>287</sup> Given the existence of few, if any, cognizable environmental impacts of solar over water projects and their efficient use of land, a streamlined approval process using a PEIS also makes sense because the agency

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279. Sharon Rice, *City Proactive in Protecting BLM Lands, Waterway*, FRIDAY FLYER (July 27, 2012), <http://fridayflyer.com/2012/07/27/city-proactive-in-protecting-blm-lands-waterway>. For example, the BLM manages land in Canyon Lake Park, portions of the CAP, and parts of Lake Havasu. Rice, *supra*.

280. See Logar, *supra* note 234, at 385 (noting that, despite efforts to fast-track, the BLM approval process is relatively slow moving).

281. See generally STATE OF GREEN, WIND ENERGY MOVING AHEAD: HOW DENMARK UTILISES WIND IN THE ENERGY SECTOR (State of Green ed., 2015), <https://stateofgreen.com/files/download/6955>.

282. Goode, *supra* note 12.

283. Michael Lerner, *Feature: The Global Growth of "Floatovoltaics,"* BLOUIN NEWS: BLOUIN BEAT: BUS. (July 10, 2015), <http://blogs.blouinnews.com/blouinbeatbusiness/2015/07/10/feature-the-global-growth-of-floatovoltaics/>.

284. *Id.*

285. See, e.g., Dibble, *supra* note 153 (discussing the dire state of pollution on the Tijuana Canal).

286. Pat Brennan, *Desert Damage: The Dark Side of Solar Power*, PHYS ORG. (Mar. 30, 2009), <https://phys.org/news/2009-03-dark-side-solar-power.html>; see also Warburg, *supra* note 160.

287. Brennan, *supra* note 286.

will not need to exert a great deal of time, energy, and resources to assess the environmental impact.

Western states could also follow Maine's lead and introduce legislation to streamline approval of solar over water projects. Just like at the federal level, streamlined state-level approval processes for solar over water could promote job growth, as well as helping certain states achieve their RPS, and combat energy costs. Renewable energy projects in Arizona, California, Colorado, New Mexico, and Utah have the potential to generate 209,000 direct jobs and \$137 billion in investment over the next two decades.<sup>288</sup> States that recognize the potential of solar over water projects by implementing a streamlined approval process such as the one described above may be able to reap a large return on new jobs and increased investment. Additionally, state water agencies could benefit from streamlining because it encourages development of projects that conserve existing water resources—a critical goal for thirsty Western cities and states.<sup>289</sup> Ultimately, streamlined permitting could even help states come closer to achieving the goal of energy independence.<sup>290</sup>

Alternatively, counties within those states can adopt a similar approach to others that have realized the value of streamlined permitting for project development. County-level action enables smaller populations to reap the benefits of solar over water projects; it gives the county power to determine the boundaries of the projects in its own areas and it promotes careful environmental assessment.

Ultimately, an approach involving all levels of government to streamline approval for solar arrays covering reservoirs and canals throughout the Southwest is an ideal solution because it reduces uncertainties faced by project developers and investors. This approach precludes the need for various agency approvals and individualized environmental impact statements. By implementing this approach, the federal government is better able to meet its renewable energy goals, states and counties satisfy their citizens, and all parties would be incentivized to work together to achieve a greener, healthier, and more sustainable Southwest.

#### B. Renewable Portfolio Standard Carve-outs for Solar Over Water

In the parched West, states should also consider modifying existing RPS to include carve-outs for solar over water technologies. This Section begins by describing the basics of RPS policies, focusing mostly on California's RPS program; and, ultimately, provides justifications for these special carve-out provisions that will greater incentivize the development of solar over water projects.

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288. Jessica Goad et al., *The Vast Potential for Renewable Energy in the American West*, CTR. FOR AM. PROGRESS (Aug. 6, 2012), <https://www.americanprogress.org/issues/green/reports/2012/08/06/12002/the-vast-potential-for-renewable-energy-in-the-american-west/>.

289. WATERWORLD, *supra* note 132 ("water facilities in several states are taking control of their energy costs by turning to solar photovoltaic (PV) power.").

290. *See id.*

## i. An Overview of the Current RPS Framework

Unlike the PTC and ITC, which are administered at the federal level, an RPS is a state level program implemented to promote renewable energy technologies.<sup>291</sup> Many states have mandatory RPS in place, while some, like Utah, have voluntary Renewable Portfolio Goals.<sup>292</sup> RPS programs have proven quite effective at promoting renewable energy.<sup>293</sup> These programs require a percentage of the electricity generated and sold by electric utility companies to be sourced from renewable energy resources.<sup>294</sup> An RPS creates economic and environmental benefits resulting from reduced emissions of greenhouse gases, sulfur dioxide, and other harmful air pollutants.<sup>295</sup> Because it is a state level initiative, RPS programs allow each state to craft a policy specifically tailored to their own unique resources, goals, and markets.<sup>296</sup>

California's RPS program is just one example of how successful such initiatives can be. With one of the most aggressive RPS in the country, California requires that fifty percent of regulated utilities' electricity come from renewable energy by 2030.<sup>297</sup> California's RPS program has benefited its citizens in numerous ways.<sup>298</sup> California can currently power more than five million homes through renewable energy, a number expected to double by 2030.<sup>299</sup> Further, RPS stimulates investment in technology and especially sparks innovation in solar—leading to economic growth in that field.<sup>300</sup> Finally, and most notably, those who comply with RPS receive tradable renewable energy credits (“TRECS”).<sup>301</sup> The TREC market incentivizes development for RPS-eligible projects, such as solar, because it allows developers to recoup some of the costs of developing and maintaining the renewable energy

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291. See Benjamin K. Sovacool & Christopher Cooper, *The Hidden Costs of State Renewable Portfolio Standards (RPS)*, 15 BUFF. ENVTL. L. J. 1, 2–3 (2007).

292. *Most States Have Renewable Portfolio Standards*, U.S. ENERGY INFO. ADMIN. (Feb. 3, 2012), <https://www.eia.gov/todayinenergy/detail.php?id=4850>.

293. Sovacool & Cooper, *supra* note 291, at 2.

294. Lincoln L. Davies, *Power Forward: The Argument for a National RPS*, 42 CONN. L. REV. 1339, 1342 (2010).

295. Jeff St. John, *Report: Benefits from State Renewable Portfolio Standards Far Outweigh Costs*, GREENTECH MEDIA (Jan. 6, 2016), <https://www.greentechmedia.com/articles/read/report-benefits-from-state-renewable-portfolio-standards-outweigh-costs>.

296. *Renewable Portfolio Standards*, NAT'L RENEWABLE ENERGY LABORATORY, <https://www.nrel.gov/technical-assistance/basics-portfolio-standards.html> (last visited Jan. 8, 2018) (stating that RPS can be flexibly implemented because it can be tailored to include all utilities or only investor owned utilities).

297. *California's Renewables Portfolio Standard (RPS) Program: Fact Sheet*, UNION CONCERNED SCIENTISTS 1 (July 2016), <https://www.ucsusa.org/sites/default/files/attach/2016/07/california-renewables-portfolio-standard-program.pdf>.

298. *California's Renewables Portfolio Standard (RPS) Program (2016)*, UNION CONCERNED SCIENTISTS, <https://www.ucsusa.org/clean-energy/ca-and-western-states/renewables-portfolio-standard#.Wk0ekVQ-fPB> (last visited Jan. 7, 2018).

299. *Id.*

300. *See id.*

301. *Renewables Portfolio Standard*, N.C. CLEAN ENERGY TECH. CTR., <http://programs.dsireusa.org/system/program/detail/840> (last updated Apr. 19, 2017).

project.<sup>302</sup> California's experience demonstrates just how effective an RPS can be in achieving desirable policy outcomes.

## ii. Existing RPS Carve-Out Provisions

To drive growth of certain renewable energy technologies, states sometimes incorporate "carve-out" provisions into their RPS.<sup>303</sup> Carve-out provisions require that a certain percentage of the electricity generation needed to achieve an RPS standard comes from a particular type of renewable energy, like solar or biomass.<sup>304</sup> Carve-outs for a particular technology are helpful policy tools because they create demand for a technology previously underutilized by utilities.<sup>305</sup>

Several states already implement RPS carve-outs for solar technology. Arizona, for example, requires its utilities to obtain fifteen percent of their power from renewable energy resources, thirty percent of which must come from distributed energy technologies.<sup>306</sup> Although Arizona's RPS does not use market forces to manage renewables, it has proved effective at changing utility behavior and encouraging them to purchase power from solar energy providers. For example, in 2011 Tucson Electric Power contracted with solar projects to purchase 107 megawatts of electricity.<sup>307</sup>

While many states have set similar renewable energy carve-outs, New Jersey's is one of the most successful because of its ability to specifically incentivize the development of solar technology.<sup>308</sup> New Jersey allows utilities to use Solar Renewable Energy Certificates ("SREC") to meet their solar carve-out requirements and demonstrate compliance with RPS.<sup>309</sup> A solar power system owner earns a SREC each time that system generates 1,000 kilowatts of electricity.<sup>310</sup> SRECs are sold in a competitive marketplace with frequently fluctuating prices.<sup>311</sup> New Jersey's solar carve-out system incentivizes efficient solar development because those who are able to cheaply transition to solar power will do so, while those who cannot cheaply transition will purchase SREC credits to comply with the carve-out. According to state law, selling SRECs enables project owners to generate income for the first fifteen years of the solar project's operation.<sup>312</sup> This means that utilities themselves will

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302. *Id.*

303. See Albert H. Acken & Matthew G. Bingham, *Sustainable Energy in Arizona*, 43 ARIZ. ST. L.J. 669, 691–92 (2011).

304. See *id.* at 679–80.

305. Melanie Grant, *Where are They Now? A Look at the Effectiveness of RPS Policies*, 2011 BYU L. REV. 849, 858 (2011).

306. *Renewable Energy Standard*, DEP'T ENERGY, <https://energy.gov/savings/renewable-energy-standard-0> (last visited Jan. 7, 2018).

307. Acken & Bingham, *supra* note 303, at 680.

308. Joshua S. Wirtshafter, *The Solar Resurrection: Keeping New Jersey's Solar Industry Alive at the Expense of Ratepayers*, 38 SETON HALL LEGIS. J. 189, 196–97 (2013); see also Herman K. Trabish, *Which State Has the Best Solar REC Market? It Depends on What the Meaning of "Best" Is*, GREENTECH MEDIA (Sept. 26, 2012), <https://www.greentechmedia.com/articles/read/Which-State-Has-the-Best-Solar-REC-Market>.

309. Wirtshafter, *supra* note 308, at 196–97.

310. Leon Kaye, *The State of Solar in New Jersey is Shining Brighter*, CLEAN TECHNICA (Mar. 26, 2015), <https://cleantechnica.com/2015/03/26/state-solar-new-jersey-shining-brighter/>.

311. Wirtshafter, *supra* note 308, at 197–98.

312. *Id.* at 202–03.

ultimately have to achieve the goal set by the carve-out once the credit program expires.<sup>313</sup> Finally, unlike RPS carve-out programs by California and Arizona, New Jersey's RPS carve-out approach is unique because it encourages solar development on under-utilized land such as brownfields and landfills.<sup>314</sup>

### iii. An RPS Carve Out for Solar Over Water Projects?

Developing carve-outs for solar over water in Western states such as California, Arizona, Utah, and New Mexico would greatly encourage development of these innovative projects. By requiring utilities to sell a percentage of their energy from solar over water projects, states could almost instantly create demand for solar over water development. Such a carve-out would also help project developers capture more of the social benefits of their work—evaporation savings and fossil fuel displacement. This is especially true if the developer can sell credits to utilities in a SREC marketplace similar to New Jersey's.

Western states should follow the market approach pioneered by New Jersey when crafting an RPS carve-out for solar over water projects. If states were to create carve-outs specific to solar over water, utilities would be forced to either invest in building their own renewable energy solar over water plants or purchasing a SREC to comply with RPS.<sup>315</sup> This encourages demand for solar over water project development because it creates a marketplace for the SREC credits the project generates.<sup>316</sup> As highlighted by New Jersey's approach, an RPS carve-out with a corresponding SREC marketplace can generate income for project developers and thereby help offset the costs of expanding, maintaining, and repairing the projects.<sup>317</sup> Offsetting these costs through the use of an SREC would provide a critical boon to solar over water projects because of their relative novelty. When wind farms and traditional ground-based solar were new innovations they, like solar over water projects now, appeared too expensive to be feasible.<sup>318</sup> However, as more

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313. *Incentives: Net-Meeting*, AMPED ON SOLAR, LLC, <http://www.ampedonsolar.com/incentives-amped-on-solar> (last visited Jan. 7, 2018); see also *Solar Market FAQ*, N.J. CLEAN ENERGY, <http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs> (last visited Jan. 7, 2018).

314. Richard Bookbinder, *An Array of Policies Makes New Jersey an Unlikely Leader in Solar Energy*, SOLAR INDUSTRY (Mar. 27, 2014), <http://solarindustrymag.com/an-array-of-policies-makes-new-jersey-an-unlikely-leader-in-solar-energy>.

315. *What is an SREC?*, SOLECT ENERGY, <https://solect.com/what-is-an-srec/> (last visited Jan. 7, 2018).

316. *Id.*

317. Bookbinder, *supra* note 314.

318. *E.g.*, Diane Cardwell, *Solar and Wind Energy Start to Win on Price vs. Conventional Fuels*, N.Y. TIMES (Nov. 23, 2014), [https://www.nytimes.com/2014/11/24/business/energy-environment/solar-and-wind-energy-start-to-win-on-price-vs-conventional-fuels.html?\\_r=0](https://www.nytimes.com/2014/11/24/business/energy-environment/solar-and-wind-energy-start-to-win-on-price-vs-conventional-fuels.html?_r=0) ("The cost of providing electricity from wind and solar power plants has plummeted over the last five years, so much so that in some markets renewable generation is now cheaper than coal or natural gas.").

developers took the plunge, sometimes pushed along by helpful subsidies and improvements in technologies, the costs of installation rapidly declined.<sup>319</sup> By encouraging developers to construct their projects now, SREC credits could result in a similar future cost reduction for solar over water projects.

An RPS carve-out for solar over water technology would likewise generate other public policy benefits, including greater conservation of existing water resources.<sup>320</sup> Tensions over water resources are not new to the West, which has grappled with this issue throughout the past two centuries.<sup>321</sup> Generally, states in the West have not been successful at reducing their overall water consumption out of fear of economic decline.<sup>322</sup> The inability to reduce water consumption means that cities and states have had to conserve existing water resources.<sup>323</sup> Solar over water projects can do much to improve the West's water conservation efforts. Solar panels installed on canals and reservoirs protect the water from evaporation, thereby preserving it for use within the state.<sup>324</sup> In addition to shielding the water from evaporation, electricity from these installations can also be used for wastewater treatment, as demonstrated by the experience of Sonoma County and Tijuana, further maximizing the use of existing water resources.<sup>325</sup> Solar over water projects could even slightly reduce the cost of water for end-users by increasing the amount of water available, and these lower water costs might "trickle down" and lower the costs of food production, manufacturing, and even electricity generation.

A special RPS carve-out at a certain percentage for solar over water projects could even promote job growth and economic development. RPS standards are highly influential in promoting renewable energy development.<sup>326</sup> RPS carve-outs, such as those suggested for solar over water projects, can promote job growth and investment in that field, just as they have done more generally for solar power.<sup>327</sup> For example, Maryland's SREC program led to the addition of more than one thousand solar jobs in 2015 alone and the job growth in the industry is expected to increase by 8.5% by the end of 2016.<sup>328</sup> Renewable energy projects require labor not only for installation but also for continued maintenance. This is likely to be especially true for massive solar over water projects that cover lengthy canals and vast reservoirs. These economic benefits are yet another reason why states should consider ways to better incentivize solar over water development through RPS carve-outs.

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319. *Id.*

320. Zerrenner, *supra* note 135.

321. *See generally* SUMMIT, *supra* note 80, at 113–48.

322. *See generally id.*

323. *See generally id.*

324. WATERWORLD, *supra* note 132.

325. Miranda, *supra* note 153; *see* Pyper, *supra* note 141.

326. *State RPSs Central to Renewable Energy Growth*, SPARKLIBRARY, <https://www.sparklibrary.com/state-rpss-central-to-renewable-energy-growth/> (last visited Jan. 7, 2018).

327. *Id.*

328. Sara Rafalson, *Will the Clean Energy Jobs Bill Stabilize the Maryland Solar Market?*, SOLSYSTEMS (Mar. 8, 2016), <http://www.solssystem.com/blog/2016/03/08/will-the-clean-energy-jobs-bill-stabilize-the-maryland-solar-market/>.

## C. Incentivizing Solar over Water through Special Tax Credits

The federal government could likewise better promote solar over water projects by offering enhanced tax credits for project developers operating in drought-stricken states. This section compares production tax credits to investment tax credits, describes why federal tax credits for solar over water projects are preferable to state credits, and ultimately argues for enhanced investment tax credits for solar over water development.

## i. Production Tax Credits versus Investment Tax Credits

In recent years, the federal government has offered an array of tax credits and policy initiatives to encourage the development of renewable energy technologies.<sup>329</sup> Tax credits are an especially powerful policy incentive because they reduce the taxpayer's liability dollar for dollar, unlike a standard deduction that only removes a percentage of the tax owed.<sup>330</sup> This fact makes them especially desirable for project developers. These tax credits help developers internalize the social benefits of their projects, promoting development of larger-scale projects and driving the growth of the nation's renewable energy industry.<sup>331</sup> The two most significant federal tax credit programs for renewable energy projects are the PTC and ITC.<sup>332</sup> The PTC and ITC differ in important ways and in their comparative advantages and disadvantages.

A PTC reduces the federal income tax owed by qualified taxpaying owners in proportion to the kilowatt hours of power generated by their project.<sup>333</sup> The PTC currently only applies to wind power projects.<sup>334</sup> The PTC is efficient because, over time, the value of the credit increases as the capacity of the renewable energy facility improves.<sup>335</sup> Further, the productivity of the PTC is credited with being a driving force behind the \$128 billion in private investment to the United States economy over the last ten years.<sup>336</sup> Since its enactment in 2005, wind production has more than quadrupled in the United States—an increase driven in large part by the PTC.<sup>337</sup>

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329. Jonathan B. Wilson, *Renewable Energy*, 2010 A.B.A. RECENT DEV. PUB. UTIL. COMM. & TRANSP. INDUSTRIES 317, 318 (2010).

330. *Tax Credits vs. Tax Deductions*, IRS, <https://www.irs.com/articles/tax-credits-vs-tax-deductions> (last visited Jan. 7, 2018).

331. *See id.*

332. *Renewable Energy Tax Credits*, NIXONPEABODY, [https://www.nixonpeabody.com/-/media/Files/Brochures/180940\\_NP\\_RenewEnergyTaxCredit\\_Dec2015.ashx](https://www.nixonpeabody.com/-/media/Files/Brochures/180940_NP_RenewEnergyTaxCredit_Dec2015.ashx) (last visited Jan. 7, 2018).

333. *Id.*

334. David Cusick, *Renewables Boom Expected Thanks to Tax Credit*, SCI. AM. (Dec. 21, 2015), <https://www.scientificamerican.com/article/renewables-boom-expected-thanks-to-tax-credit/>.

335. Trieu Mai et al., *Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions*, NAT'L RENEWABLE ENERGY LABORATORY, 9–10 (2016) <https://www.nrel.gov/docs/fy16osti/65571.pdf>.

336. *U.S. Number One in the World in Wind Energy Production*, AM. WIND ENERGY ASS'N (Feb. 29, 2016), <http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=8463>.

337. Mitchell Ward, *The PTC and Wind Energy: Restructuring the Production Tax Credit as a More Effective Incentive*, 11 HOUS. BUS. & TAX L.J. 455, 462 (2011).

In contrast, an ITC reduces the federal income tax for qualifying taxpaying project owners based on their capital investment in the project.<sup>338</sup> Unlike the PTC, the ITC currently applies to solar projects.<sup>339</sup> The ITC allows developers to deduct thirty percent of the cost of installing a solar system and applies to both residential and commercial systems.<sup>340</sup> Use of the ITC has promoted the development of solar projects nationwide.<sup>341</sup> In both the residential and commercial sectors, the ITC prompted annual solar installations to increase by 1,600 percent since 2006.<sup>342</sup>

#### ii. Adjusting Federal Tax Credit Programs to Promote Solar Over Water

For a few reasons, federal-level tax credit incentives for solar over water projects are preferable to comparable credits through state income taxation. Most existing state-level solar tax credits apply primarily to residential projects, not to utility-scale solar development.<sup>343</sup> Also, state tax incentives are smaller in scale and are therefore less able to subsidize massive infrastructure projects like solar panels spanning canals and reservoirs.<sup>344</sup>

The federal government is also more financially able than drought-affected states to provide special tax benefits for solar over water projects. The federal government has the financial ability to make the investment in renewable energy using a variety of cash grants, tax expenditures, and regulatory incentives.<sup>345</sup> Also, the federal government is in a better position than states to provide tax credits for solar over water development because most large Western canals and reservoirs are located on federal land.<sup>346</sup>

#### iii. Solar Over Water Projects Should Use ITC Instead of PTC

Expanding the existing ITC is a better option than creating a new PTC to incentivize the development of solar over water projects. In addition to the fact that it presently applies only to wind energy,<sup>347</sup> the federal PTC is currently scheduled to

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338. Jenna Goodward & Mariana Gonzalez, *The Bottom Line on Renewable Energy Tax Credits*, WORLD RESOURCES INST. (Oct. 2010), <http://www.wri.org/publication/bottom-line-renewable-energy-tax-credits>.

339. Cusick, *supra* note 334.

340. Sara Matasci, *Congress Extends Solar Tax Credit – Everything You Need to Know About the Federal ITC*, ENERGY SAGE (Mar. 12, 2017), <http://news.energysage.com/congress-extends-the-solar-tax-credit/>.

341. Katie Fehrenbacher, *How a Single Tax Credit Dominates U.S. Solar*, FORTUNE (Feb. 24, 2016), <http://fortune.com/2016/02/24/solar-tax-credit-influence/>.

342. *Solar Investment Tax Credit (ITC)*, SOLAR ENERGY INDUSTRIES ASS'N., <https://www.seia.org/initiatives/solar-investment-tax-credit-itc> (last visited Jan. 21, 2018).

343. *Solar Panel Incentives, Rebates, and Tax Breaks*, ENERGY SAGE, <https://www.energysage.com/solar/cost-benefit/solar-incentives-and-rebates/> (last visited Jan. 8, 2018).

344. *Id.*

345. Richard W. Caperton, *Good Government Investments in Renewable Energy*, CTR. FOR AM. PROGRESS (Jan. 10, 2012), <https://www.americanprogress.org/issues/green/reports/2012/01/10/10956/good-government-investments-in-renewable-energy/>.

346. See Trevor Salter, *NEPA and Renewable Energy: Realizing the Most Environmental Benefit in the Quickest Time*, 34 ENVIRONS ENVTL. L. & POL'Y J. 173, 174 (2011).

347. Cusick, *supra* note 334.

phase out in 2020.<sup>348</sup> The expiration of the PTC deters parties from investing in power purchase agreements with renewable energy companies.<sup>349</sup> If the PTC were to apply to solar over water projects, and utilities were deterred from entering into power purchase agreements with the project, developers may not be profitable enough to maintain the facility. More importantly, expiration also eliminates one of the primary incentive structures for renewable energy development.<sup>350</sup> Finally, even if the PTC applied to solar over water projects and were even expanded to include the evaporated water savings, such a solution might prove unworkable. Measuring evaporated water savings is a fact-intensive inquiry that may lead to litigation and conflict, undermining the goals of the PTC.

The ITC does not suffer from these potential drawbacks and would thus be more beneficial for both project developers and parties who lease land to developers. The ITC allows investors, lessees, and project developers to deduct thirty percent of their costs of installing solar.<sup>351</sup> An ITC promotes greater investment in solar over water projects than the PTC because parties are able to receive the tax deductions necessary to finance high upfront development costs.<sup>352</sup> To promote more investment in solar over water projects, the federal government should increase the value of the tax credit to an amount more than thirty percent, and it has good reasons to do so.

#### iv. A Restructured ITC for Solar Over Water Projects

To promote solar over water projects, the federal government should amend the ITC to provide enhanced subsidies for solar over water projects so that developers of these projects can better capture the unique social benefits these projects create. For example, Congress could authorize an additional ten percent ITC for such projects that is in addition to the thirty percent credit already available for traditional solar energy development. This additional ITC would ideally only be au-

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348. Diane Cardwell, *Proposed Extension of Tax Credits for Renewable Energy Would Have Uneven Effect*, N.Y. TIMES (Dec. 17, 2015), <https://www.nytimes.com/2015/12/18/business/energy-environment/proposed-extension-of-tax-credits-for-renewable-energy-would-have-uneven-effect.html>.

349. John Powers, *What the PTC's Expiration Means for Leading Companies*, RENEWABLE CHOICE ENERGY (last visited Jan. 8, 2018), <http://www.renewablechoice.com/blog-ptc-expiration-14-01-15/> ("It can take months to convince the CFO of a Fortune 100 company to invest in a 20-year PPA, and the PTC expiration is likely to derail the conversation completely.").

350. Mike Garland & Susan Reilly, *Setting the Record Straight on the Wind Energy Tax Credit*, HILL (June 11, 2015), <http://thehill.com/blogs/congress-blog/energy-environment/244569-setting-the-record-straight-on-the-wind-energy-tax> ("[PTC] is the primary federal incentive for wind energy, and provides initial tax relief that has allowed wind industry to scale up against mature industries that continue to get a wide variety of permanent subsidies after up to 100 years.").

351. Matasci, *supra* note 340.

352. Greg Pfahl, *ITC or PTC for Your Renewable Energy Project?* RENEWABLE ENERGY WORLD (July 19, 2010), <http://www.renewableenergyworld.com/articles/2010/07/itc-or-ptc-for-your-renewable-energy-project.html>.

thorized for solar over water development states like California, Nevada, Utah, Arizona, Idaho, and Washington that face substantial water scarcity challenges.<sup>353</sup> Limiting the enhanced ITC for solar over water projects to project developers in arid states would reflect the unique value of such projects in that region of the country, incentivizing project developers to build in states that need it most. With this structure, states like California, Nevada, Utah, and Arizona will be priority spots for project developers.

One reason that solar over water projects are deserving of an expanded ITC is that these projects are generally likely to have less of an adverse environmental impact than ordinary land-based solar development.<sup>354</sup> Environmental activists have sometimes criticized traditional solar projects for their harmful impacts on wildlife.<sup>355</sup> As discussed previously, the Mojave Desert's Ivanpah Solar Plan has had a negative impact upon the desert tortoise and birds flying near the plant.<sup>356</sup> Additionally, the tab for removing and transplanting the tortoises to new burrows has cost project developers \$56 million.<sup>357</sup> Despite this expense, the removal process was far from perfect. During removal, some desert tortoises were crushed by vehicle tires, while others were attacked by ants in their makeshift nurseries.<sup>358</sup>

Another reason that solar over water projects are deserving of an expanded ITC is that it promotes efficient use of land. Unlike traditional solar, panels placed atop canals and reservoirs are a more efficient use of the land,<sup>359</sup> because they utilize existing man-made canals and reservoirs.<sup>360</sup> Additionally, installing solar over water does not compete with existing or potential uses of valuable space, and so it may be an attractive option for crowded areas.<sup>361</sup> Furthermore, by maximizing existing land uses to increase solar development, land that could have been occupied by traditional solar development would be free to devote to some other beneficial use. Offering project developers an ITC higher than the one offered for traditional solar can incentivize development on bodies of water as opposed to on land because it can ameliorate the higher upfront costs, which can potentially prohibit development associated with such projects. This approach comports with the purpose

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353. Sean Breslin, *9 States that Are Still in Severe Drought*, WEATHER CHANNEL (May 28, 2015), <https://weather.com/climate-weather/drought/news/severe-drought-states>.

354. See Suman Chakrabortil, *Floating Solar Panel More 'Powerful' than Land Avatar*, TIMES INDIA (May 3, 2015), <http://timesofindia.indiatimes.com/home/environment/developmental-issues/Floating-solar-panel-more-powerful-than-land-avatar/articleshow/47135981.cms>.

355. Kiera Butler, *Big Solar' Death Panels*, MOTHER JONES (Mar.-Apr. 2011), <http://www.motherjones.com/environment/2011/03/solar-panels-desert-tortoise-mojave>.

356. See Laufer, *supra* note 175.

357. Ken Wells, *Where Tortoises and Solar Power Don't Mix*, BLOOMBERG BUSINESSWEEK (Oct. 10, 2012), <https://www.bloomberg.com/news/articles/2012-10-10/where-tortoises-and-solar-power-dont-mix>.

358. Julie Cart, *Saving Desert Tortoises Is a Costly Hurdle for Solar Projects*, L.A. TIMES (Mar. 4, 2012), <http://articles.latimes.com/2012/mar/04/local/la-me-solar-tortoise-20120304>.

359. See Laufer, *supra* note 175.

360. See Goode, *supra* note 12.

361. Mark Leybourne, *Floatovoltaics – Thinking beyond the Cost of Floating Solar PV*, LINKEDIN (July 4, 2017), <https://www.linkedin.com/pulse/floatovoltaics-thinking-beyond-cost-floating-solar-pv-mark-leybourne/>.

of the ITC—to promote development of renewable energy projects in an environmentally-friendly manner.<sup>362</sup>

An ITC is also economically beneficial for canal and reservoir management agencies that might have outstanding debts to the federal government. For example, project developers in Arizona would need to lease land from the CAP to build solar arrays on the canal.<sup>363</sup> The CAP currently owes \$1.65 billion in debt to the federal government for the original cost of construction.<sup>364</sup> Because an expanded ITC incentivizes project development on such structures, more project developers will seek out lease agreements with the CAP Board. In turn, demand for lease agreements would enable the Board to assign the project to the highest bidder. This steady stream of revenue could provide a useful alternative source of income for the CAP to repay its debt to the federal government. In summary, the ITC for existing solar projects should be increased for solar over water projects because it provides financial benefits to all parties involved and it encourages environmentally-friendly project development.

A federal ITC for solar over water projects obviously would not prevent states from acting on their own to incentivize this uniquely valuable form of development. Although potentially staved off by the wet winter of 2017, Western states still face the possibility that harsh shortage conditions might be declared should the Lake Mead reservoir dip further.<sup>365</sup> In order to lessen this prospective hardship on their citizens, Western states could add their own incentives on top of any federal ITC. By promoting project development in their states, policymakers could do much to spare their citizens the burdens of having to ration water supplies. When combined with new RPS carve-outs for solar over water in arid Western states and streamlined permitting process, such enhanced credits could do much to promote the development of these distinct projects that conserve water while simultaneously generating clean, carbon-free electric power.

#### IV. CONCLUSION

Solar over water projects create several unique benefits that are not available through ordinary land-based utility-scale solar energy plants. These projects generate clean, carbon-free electricity, reduce the evaporation of precious water supplies in arid areas, and have much smaller land footprints than equivalent solar energy projects sited elsewhere. Unfortunately, as developers seeking to put solar panels over canals within Arizona's CAP have discovered, there are also many regulatory obstacles to siting and building this type of project. Developers must engage both

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362. See John Houghton, *ICT and the Environment in Developing Countries: Opportunities and Developments*, VICTORIA U. CTR. FOR STRATEGIC ECON. STUD. 3–11 (Oct. 8, 2009), <http://www.oecd.org/ict/4d/44005687.pdf>.

363. See U.S. DEP'T INTERIOR: BUREAU OF RECLAMATION, *supra* note 210, at 18–20.

364. *FAQ*, *supra* note 114.

365. See Tony Davis, *Lake Mead Forecast Drops Sharply, May Trigger CAP Water Shortage*, ARIZ. DAILY STAR (June 16, 2017), [http://tucson.com/news/local/lake-mead-forecast-drops-sharply-may-trigger-cap-water-shortage/article\\_9ca6d46a-7847-5a8c-9575-5aee6a8cabe3.html](http://tucson.com/news/local/lake-mead-forecast-drops-sharply-may-trigger-cap-water-shortage/article_9ca6d46a-7847-5a8c-9575-5aee6a8cabe3.html).

federal and state government agencies to obtain required approvals for these projects, funding is difficult to obtain, and entities that control Western canals and reservoirs have few incentives to approve such projects.

Numerous potential policy changes at the federal and state level could reduce the obstacles to solar over water development and even promote these unique and valuable projects. For example, the federal government could offer an enhanced ITC for solar over water project in arid states to account for the distinct water-saving benefits that such projects provide in that region. State governments in the West could also add carve-out provisions to their RPS policies mandating that a specified percentage of utilities' renewable energy generation come from solar over water projects. And at both the state and local level, streamlined permitting procedures for solar over water installations within federally-controlled areas could encourage more developers to consider building these distinctive projects. Although global warming is intensifying struggles over water and for carbon-free electricity in the West, responding through innovative new strategies such as solar over water development can help to ensure that the region's future remains as bright as the sun.