Water and Renewable Energy Generation in the Western United States: An Overview of Current Challenges and Opportunities

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I. INTRODUCTION

Development and generation of energy throughout the West presents many challenges. Endangered species protection, climate change, navigating and harmonizing local, state and federal regulation are just a few. Assessing, identifying, acquiring and maintaining the water supply necessary to support energy development and generation is one of the challenges that can readily determine success or failure. With limited exception, as with traditional fossil fuels, securing and maintaining the water necessary to support the development and generation of renewable energy poses numerous challenges as well as opportunities. These are rendered more complex given that most renewable resources (solar, wind, geothermal) are abundant in the western United States where water is as scarce as wind, solar and geothermal are plentiful.

This paper will explore emerging challenges and opportunities with regard to water supply and renewable energy generation in the western United States. The paper will discuss relative water consumption related to renewable energy generation and provide examples of existing and developing state and federal policies and regulations affecting the acquisition of water supplies necessary to support such projects. Additionally, the paper will discuss considerations for siting projects in light of water demands and relevant state and federal policies and regulations.

II. WATER USE RELATED TO GENERATION OF RENEWABLE ENERGY

Virtually every western state has a renewable portfolio standard that it imposes on the utilities it regulates.[1] These standards require a utility to provide between 15%[2] and 33%[3] of the

[1] To date 28 states and the District of Columbia have Renewable Portfolio Standards. Some of the standards for western states include the following: Arizona requires 15% by 2025. ARIZ. ADMIN. CODE R14-4-1801–1816 (2007); ARIZONA CORP. COMM'N. RENEWABLE ENERGY STANDARD AND TARRIFF, *available at* http://www.azcc.gov/divisions/utilities/electric/environmental.asp (last visited Aug. 7, 2012). California requires 20% by December 31, 2013, 25% by December 31, 2016, and 33% by 2020. CA PUB. UTIL. CODE §399.11–399.31; CA PUB. RES. CODE §25740–25751(2003); CA PUB. UTILITIES COMM'N, CALIFORNIA RENEWABLES PORTFOLIO STANDARD (RPS), *available at* http://www.cpuc.ca.gov/renewables (last visited Aug. 7, 2012). Colorado requires 30% by 2020 for investor-owned utilities, 10% by 2020 for electric cooperatives, and 10% by 2020 for municipal utilities serving more than 40,000 customers. COLO. REV. STAT. §40-2-124 (2004); 4 COLO. CODE REG. §723-3-3650–3699 (2006); COLORADO PUB. UTILITIES COMM'N, IMPLEMENTING THE RENEWABLE ENERGY STANDARD, *available at* http://www.dora.state.co.us/PUC/rulemaking/RenewableEnergyStandard.htm (last visited Aug. 7, 2012). Nevada requires 25% by 2025. NEV. REV. STAT. §§ 704.7801–.7828 (2001); NEV. ADMIN. CODE 704.8831–.8899 (2006); LCB File R167-05 (Revised Regulations), Assemb. Bill 150 2001 Leg. (Nev. 2011);PUB. UTILITIES COMM'N OF NEVADA, RENEWABLE ENERGY, *available at* http://pucweb1.state.nv.us/PUCN/RenewableEnergy.aspx (last visited Aug. 7, 2012). New Mexico requires 20% by 2020 for investor-owned utilities and 10% by 2020 for rural electric cooperatives, N.M. STAT. ANN. §§ 62-15-34–37 (1978) and §§ 62-16-1–10 (2012); N.M. ADMIN. CODE 17.9.572; NEW MEXICO PUB. REG. COMM'N, UTILITIES—RENEWABLE ENERGY, *available at*

power it supplies from renewable energy sources, depending on the state in which it is located. Although these renewable energy standards are aimed at "greening" the western United States' energy supply on a state-by-state basis, generally, at least at inception, the standards were devoid of consideration of water demand related to renewable energy generation. The water demands of renewable energy generation can rival or exceed those of traditional fossil-fuel based generation. Water demand is dependent upon the renewable resource at issue and the type of technology employed. Table 1 presents the relative water demands of renewable energy versus fossil fuels on a MW basis.

Table 1. Water Intensity of Electricity by Fuel Source and Generation Technology[4]

Generation Technology	Wet Cooling Water Consumption[a] (gal/MWh)	Other Water Consumption[b] (gal/MWh)
Solar Trough	760-920	8
Solar Tower	750	8
Photovoltaic Solar	0	5[c]
Wind	0	0
Fossil	300-480	35-104
Biomass[5]	300-480	Highly variable depending on whether biomass is irrigated
Nuclear	400-720[d]	75-180
Natural Gas Combined Cycle	180	18-21
Geothermal	1,400	Not available
Coal Integrated Gasification Combined-Cycle (IGCC)[e]	200	140
Hydroelectric		Highly variable, avg. 4,500 due to evaporation

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http://www.nmprc.state.nm.us/renewable.htm (last visited Aug. 7, 2012). Utah has a renewables portfolio goal of 20% of adjusted retails sales by 2025. UTAH CODE ANN. §§ 54-17-101–103 and §§ 10-19-101–102 (1953). For a complete list of all states' renewable portfolio standards and rules, regulations and policies for renewable energy please see the Unites States Department of Energy's Database of State Incentives for Renewables & Efficiency, *available at* http://www.dsireusa.org/summarytables/rrpre.cfm (last visited Aug. 7, 2012).

[2] Arizona has a 15% by 2015 renewable portfolio goal. *See* ARIZ. ADMIN. CODE R14-4-1801–1816 (2007); ARIZONA CORP. COMM'N, *supra* note 1.

[3] California has a 33% by 2020 renewable portfolio goal; *see* CA PUB. UTIL. CODE §§ 399.11–399.31 (2011); CA PUB. RES. CODE §§ 25740–25751(2003); CA PUB. UTILITIES COMM'N, *supra* note 1.

[4] OFFICE OF SENATOR JON KYL, WATER POLICY CONSIDERATIONS: DEPLOYING SOLAR POWER IN THE STATE OF ARIZONA: A BRIEF OVERVIEW OF THE SOLAR-WATER NEXUS-MAY 2010, *available at* http://www.circleofblue.org/waternews/wp-content/uploads/2010/08/solar-water1.pdf. Data for this table was calculated from U.S. DEP'T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER (Dec. 2006), *available at* http://www.sandia.gov/energy-water/congress_report.htm (last visited Aug. 7, 2012).

a. Data is for cooling tower technology.
b. Includes water consumed in producing or enhancing the fuel source and in generation; excluding cooling water consumption.
c. National Renewable Energy Laboratory (NREL), Fuel from the Sky; Solar Power's Potential for Western Energy Supply, NREL/SR-550-321+0 (July 2002), at 99.
d. Cooling ponds which are commonly used at nuclear facilities consume roughly 720 gal/MWh.
e. IGCC is Integrated Gasification Combined-Cycle.

[5] The biomass referenced in Table 1 does not include woody biomass.

The West, the most water-scarce region of the United States, also has the most available sources of renewable energy generation – sun, wind and geothermal. With regard to solar energy in particular, the U.S. Department of Energy's National Renewable Lab (NREL) projects concentrated solar development to occur predominately in California and Arizona.[6] However, those same locations identified by NREL also have been identified as the most water constrained.[7] Compounding this fact is that many of the choice locations for renewable projects from an energy generation perspective will require use of non-renewable groundwater as opposed to renewable surface supplies.

In response to some of the unique issues associated with renewable energy vis-à-vis water supply, some states are considering standards or regulations relating specifically to water use in connection with renewable development. Some regulations and standards are aimed to lift obstacles where water use is in fact small,[8] others to impose restrictions to encourage or discourage certain kinds of projects.[9] The federal government has not been silent on the issue, and is actively addressing renewable energy development while considering water use and alternative technologies.[10] A combination of political, economic and technological choices will influence the mandates at both the state and federal level for renewable energy development and the need for water to support such generation projects.

III. STATE REGULATION AND POLICIES RELATING TO WATER USE FOR RENEWABLE ENERGY PROJECTS

States struggling with the allocation of scarce water resources for energy development, including renewable projects, are addressing water issues and considering the siting of renewable energy projects both generally and specifically, primarily with regard to geothermal and solar resources. The developing policies and regulations across the West demonstrate efforts to harmonize competing demands for increasingly scarce water supplies with increasing demands for more renewable energy generation.

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[6] *See* Nate Blair, *Concentrating Solar Deployment Systems (CSDS) – A New Model for Estimating U.S. Concentrating Solar Power Market Potential*, 1, NAT'L RENEWABLE LAB. (undated) *available at* http://www1.eere.energy.gov/solar/review_meeting/pdfs/p_55_blair_nrel.pdf. (last visited Aug. 8, 2012) The model used by NREL to project CST deployment looked at siting issues and load location and load growth to select the purported best sites for CST.

[7] *See* Electric Power Research Institute, *A Survey of Water Use and Sustainability in the United States with a Focus on PowerGeneration: Topical Report* 5 (Palo Alto, CA 2003).

[8] *See*, *e.g*., Cal. SB 267, (as signed into law October 11, 2011) (providing an exemption from requirement to prepare water supply assessments for solar photovoltaic and wind projects)**.**

[9] For example, the Arizona Corporation Commission ("ACC") prohibited the use of groundwater for a thermal power plant when it denied Hualapai Valley Solar a certificate of environmental compatibility; as a result Hualapai Valley Solar proposed the use of a combination of effluent and dry cooling in order to receive a certificate of environmental compatibility from the ACC. *See* Arizona Corp. Comm'n. Decision 71957, November 1, 2010.

[10] *See, e.g.,* U.S. DEP'T OF ENERGY, *supra* note 4.

A. Overview of State Water Resource Regulation

State law generally governs the allocation and use of water in the West.[11] Accordingly, the specific laws and regulations relating to acquisition of water supply and use of water for a renewable energy project will vary from state to state depending on the particular law of a state. However, there are significant similarities and overlap in how western states approach the regulation of water.

Generally, water in the West is governed by the law of prior appropriation.[12] Three states, Oklahoma, Nebraska and California retain various vestiges of riparianism and are considered dual doctrine states.[13] The law of prior appropriation is generally driven by two concepts that arose as a result of scarcity: beneficial use and "first in time, first in right." In most states "beneficial use" is not specifically defined and is generally recognized as any consumptive use of water which is not wasteful. The first in time, first in right principle determines the assignment of a priority date to the use of water in times of scarcity based on the date of the initiation of the right. Under the prior appropriation doctrine, water can be developed through an appropriation and application to beneficial use. Once established, the developed water right can be moved or transferred from the land to which it is appurtenant to another place, purpose of use or point of diversion subject to considerations of effects on other users.[14] In both the initial appropriation of water and the movement of water to another place or purpose of use after establishment of a water right, most states consider whether the proposed change is in the "public interest" or in the public welfare of the state.[15] Because beneficial use is the basis and the measure of the right to water under the prior appropriation doctrine a water right, even once established can be lost for non-use.[16]

Some western states govern surface water and groundwater conjunctively, and apply similar rules of appropriation and use to both resources.[17] Other states have a bifurcated approach to the regulation of surface and groundwater and regulate surface water according to strict prior appropriation but regulate groundwater under a variety of different paradigms depending on the state. For example, in California, there is no comprehensive state groundwater

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[11] *See generally* WATERS AND WATER RIGHTS §30.01(b)(2) (Robert E. Beck et al., eds., 1991).

[12] ENVTL. LAW PRACTICE GUIDE: STATE AND FEDERAL LAW §16.05[2] (Michael B. Gerrard, Esq. et al., eds. 2012).

[13] ENVTL. LAW PRACTICE GUIDE, *supra* note 12; Joseph W. Dellapenna, *Riparian Rights in the West*, 43 Okla. L. Rev. 51, (1990); CAL.WATER.CODE § 101 (1971); *Lux v. Haggin*, 69 Cal. 255, 10 P. 674 (1886); *Pleasant Valley Canal Co. v. Borror*, 61 Cal. App. 4th 742, 72 Cal. Rptr. 2d 1, 22-23 (5th Dist. 1998); *San Joaquin & Kings River Canal & Irrigation Co. v. Worswick*, 187 Cal. 674, 203 P. 999 (1922); *Wasserburger v. Coffee,* 180 Neb. 149, 141 N.W.2d 738, *modified*, 180 Neb. 569, 144 N.W.2d 209 (1966); OKLA. STAT. § 60 (1970); 82 OKLA. STAT. §§ 105.1-105.6 (. 1989). *Oklahoma Water Resource Bd. v. Central Okla. Master Conservancy Dist*., 464 P.2d 748 (Okla. 1968); *Smith v. Stanolind Oil & Gas Co.*, 197 Okla. 499, 172 P.2d 1002 (1946); *Chicago, R.I. & P. Ry. v. Groves*, 20 Okla. 101, 93 P. 755 (1908).

[14] *See, e.g.,* N.M. STAT. ANN., § 72-5-23–24 (1978); UTAH CODE ANN. § 73-3-3 (1953).

[15] *See, e.g.,* N.M. STAT. ANN. § 72-5-23 (1978); IDAHO CODE ANN. § 42-222(1) (1919); KAN. STAT. ANN. § 82A-1502(c)(3) (1983).

[16] Rights may be lost by either abandonment or forfeiture or both, depending on the law of a particular state. In all states except Colorado, a permit may be cancelled for non-use. L. OF WATER RIGHTS AND RESOURCES § 5:89 (West).

[17] *See, e.g.,* N.M. STAT. ANN., § 72-12B-2 (1978); UTAH CODE ANN. § 73-1-1– § 73-30-202 (1953); NEV. REV. STAT. §§ 532.010–544.240 (1949).

code and groundwater regulation is primarily governed by local water districts.[18] Regulation of groundwater in Arizona is based on a complex set of considerations including whether the proposed withdrawal is from an Active Management Area ("AMA")[19] or an irrigation non-expansion area ("INA")[20] and whether the well proposed for withdrawal has a pumping capacity of not more than 35 gallons per minute.[21] In Oklahoma groundwater is owned by the overlying landowner but a permit is required from the Oklahoma Water Resources Board to develop the groundwater.[22] Texas generally follows the rule of capture but local groundwater districts can limit withdrawal.[23]

The riparian doctrine is governed by its relation to ownership of riparian lands and is generally governed by a reasonable use requirement.[24] Riparian rights are not subject to forfeiture for non-use, and in times of shortages rights to water are shared and not allocated based on priority of use. To the extent riparian rights remain recognized in Nebraska, Oklahoma and California, they are considered superior to rights secured under the prior appropriation doctrine in times of shortage. In Nebraska, the legislature amended the water code in 1889 to mandate that prior appropriation would fully apply going forward but recognized all riparian rights developed prior to that time.[25] In Oklahoma, the legislature similarly tried to firmly ground the State's water law in prior appropriation by recognizing all prior riparian rights but adopting prior appropriation as the sole basis going forward. The Oklahoma Supreme Court rejected that approach, finding that it would take away vested rights.[26] In California, rights of riparian use are still alive and well and the state seems content to live within its dual doctrine system.

Some States maintain preferences for certain kinds of water uses, including water use for power generation.[27] Some states explicitly recognize water use for power generation or energy development as a beneficial use,[28] while others do not specifically reference power generation,

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[18] *See* L. OF WATER RIGHTS AND RESOURCES, § 4:16; BUREAU OF LAND MGMT, CALIFORNIA WATER RIGHTS FACT SHEET, *available at* http://www.klamathbasincrisis.org/waterrights/blmwaterrightsfactsheet101609ca.htm (last visited Aug. 7 2012).
[19] ARIZ. REV. STAT. ANN. §§ 45-599 and 45-469– 471 (1980).
[20] ARIZ. REV. STAT. ANN. § 45-596 (1980).
[21] ARIZ. REV. STAT. ANN. §§ 45-402 and 45-454 (1980).
[22] OKLA STAT ANN. tit. 82, § 1020.7 (1972).
[23] TEX. WATER CODE ANN. § 11.021 (1977).
[24] *See* L. OF WATER RIGHTS AND RESOURCES §3:55-3:56; ENVTL. LAW PRACTICE GUIDE: STATE AND FEDERAL LAW § 16.05[1][a] (Michael B. Gerrard, Esq. et al., eds. 2012). *U.S. v. Willow River Power Co.*, 324 U.S. 499 (1945).
[25] Act of March 27, 1889 § 7, currently codified at NEB. REV. STAT. §46-203 (1889).
[26] *Franco American Charolaise, Ltd. V. Oklahoma Water Res. Bd.*, 855 P.2d 568 (Okla. 1990).
[27] ARIZ. REV. STAT. ANN. §§ 45-157(A),(B)(1) (1980); CAL. WATER CODE ANN. §§ 1460, 1253, 1254, and 1463 (1943); Colo. Const, art. XVI § 6; Idaho Const. art. XV § 3; KANSAS STAT. ANN § 82a-707(b) (2009); Ne. Rev. St. CONST. art. XV § 6; NEV. REV. STAT. ANN. § 534.120(3) (2008); N.M. STAT. ANN. § 73-14-47(I) (1978); OR. REV. STAT. § 536.310(12) (1955); UTAH CODE ANN. § 73-3-21 (1953); *see also* Memorandum from John Clyde to Steve Clyde onUse Preferences in the 17 Prior Appropriation States, (June 11, 2008), *available at* www.waterrights.utah.gov/miscinfo/WaterTaskForce/Pref-st.pdf.
[28] ARIZ. REV. STAT. ANN. § 45-156 (1980) (legislative authorization for appropriation of water to generate power through change of use); ARIZ. REV. STAT. ANN. § 45-166 (1980) (approval for appropriation of water for electricity generation).

including such uses under generalized industrial uses.[29] Arizona statutes specifically limit the amount of water permitted for thermal electric power generation.[30] California legislation reflects a state policy regarding the important nexus between energy generation and water, providing that it is the goal of the state to "promote all feasible means of energy and water conservation and all feasible use of alternative energy and water supply sources."[31] California also has a statute prohibiting potable water use for energy production.[32] In the 2009 legislative session, California Assembly Bill 40 sought to exempt renewable energy projects from this requirement. The Bill was introduced and was referred to, and remains pending before, the California Senate Energy, Utilities and Communications Committee.[33] In an effort to conserve water resources and encourage energy development states are exploring the use of non-potable water for use in energy projects.

Effluent and water re-use may be a potential important source of water supply for renewable energy generation. Some states explicitly recognize the use of effluent for purposes of power generation.[34] Under most state laws, effluent is generally considered to be the property of the entity generating the effluent until it is discharged and control over the stream lost.[35] Accordingly, effluent can be used relatively free of state regulation and dedicated to beneficial use for power generation.[36] Some states exert some regulatory authority over the use of effluent. The regulatory concerns appear to be regarding public health and the effect cessation of the effluent stream would have on downstream users or compact obligations. In Nevada the use of effluent for beneficial use may be approved if it is not contrary to the public health, safety or welfare and it does not interfere with federal obligations to deliver water to the Colorado River.[37] In 1975, the California State Water Resources Control Board adopted a policy that freshwater should be considered as a last resort for power generation and directed utilities to study the feasibility of the use of effluent for power generation.[38] As noted, California law generally precludes the use of additional freshwater supplies for thermoelectric generation.[39]

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[29] California and New Mexico are examples of states which do not specifically call out power generation or energy development as beneficial uses.
[30] *See* ARIZ. REV. STAT. ANN.§ 45-165 (1980).
[31] CAL. PUB. RES. CODE § 25008 (1991).
[32] CAL. PUB. RES. CODE §§ 13550 and 25008 (1991).
[33] For the latest draft of the Bill please see http://legiscan.com/gaits/text/7154 (last visited Aug. 7, 2012).
[34] CAL. WATER CODE § 462 (1974).
[35] N.M. STAT. ANN. § 72-5-27 (1978); ARIZ. REV. STAT. ANN. § 45-2201 (1980); CO. REV. STAT. §37-82-106 (1979); *see also* L. WATER RIGHTS AND RESOURCES §5:94.
[36] *Reynolds v. Roswell,* 99 N.M. 84 (1982); N.M. STAT. ANN. 1972 § 72-5-27; ARIZ. REV. STAT. ANN. § 45-2201(1980).
[37] NEV. REV. STAT. §§ 533.440 and 533.024 (1971).
[38] Resolution No. 75-58, "Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Power Plant Cooling." (June 19, 1975) *available at* http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1975/rs75_058.pdf. The California Energy Commission, California's principal energy policy and planning organization, reiterated the 1975 policy in its 2003 Integrated Energy Policy Report that the Commission would only approve power plants using freshwater for cooling in limited circumstances. *See* U.S. GOV'T. ACCOUNTABILITY OFFICE, REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE AND TECHNOLOGY, HOUSE OF REPRESENTATIVES, ENERGY-WATER NEXUS IMPROVEMENTS TO FEDERAL WATER USE DATA WOULD INCREASE TRENDS IN POWER PLANT WATER USE, (,(October 2009), 37, *available at* http://www.gao.gov/products/GAO-10-23(last visited Aug. 7, 2012).
[39] *See* latest bill draft, *supra* note 33.

Outright prohibition on the out of state export of water was firmly rejected by the United States Supreme Court several decades ago.[40] However, the use of large amounts of scarce water resources within a state for the generation of power to be used solely out of state, is raising the export issue in a new way. Nevada's water code explicitly authorizes the Nevada State Engineer to approve applications to use water to generate energy for export if it is in the public interest and the economic welfare of the State of Nevada, and if the water use is beneficial.[41] Wyoming has a statute that precludes use of water outside the state except with explicit legislative approval.[42] Originally designed to prevent the use of water to export coal slurry out of state, it is unclear whether the statute would or could be used to block the generation of exported power supported by Wyoming water. The 2010 decision by the Arizona Corporation Commission denying a groundwater permit and therefore siting approval for the Hualapai Valley Solar, LLC solar plant appears to be based, at least in part, on a determination that the use of state groundwater resources should not be permitted for generation of power that will be exported out of state.[43] As noted, many states have a public interest or public welfare requirement when determining whether to approve an appropriation or transfer of water rights for any kind of use. States could rely on this criterion as a way to consider the use of water for exported power in the permitting process. Whether doing so will be prohibited by Commerce Clause restrictions or will be preempted by national energy policies remains to be seen. The strong and well-established deference to state water law and policy will certainly be an influential, if not determinative, factor.

Most states require a renewable energy project to go through several levels of review and permitting. It is usual for water use issues to be evaluated by both the state agency authorizing the project and siting, and the agency charged specifically with regulating the use and allocation of water resources.[44] Obtaining site location approval from a state's utility commission invariably requires an examination of environmental factors including impacts on water resources. Accordingly, while the acquisition and use of the specific water supply will generally be subject to application to and approval by the state water resource agency, the state utility commission also will examine whether the specific use of water should be approved in the context of approving site location,[45] or certificate of environmental compatibility.[46] The Nevada Public Utilities Commission must approve all renewable projects greater than 70 MW.[47] In California, the California Energy Commission oversees permitting of all power plants with a generating capacity of 50MW or more.[48] In Arizona, an application for a renewable energy project must apply to the Arizona Corporation Commission for a certificate of environmental

[40] *Sporhase v. Nebraska*, 458 U.S. 941 (1982).
[41] NEV. REV. STAT. § 533.372 (1971).
[42] WYO. STAT. ANN. § 41-3-115 (1974).
[43] *See* Arizona Corp. Comm'n. Decision 71957, November 1, 2010.
[44] Arizona: Arizona Corporation Commission, ARIZ. REV. STAT. ANN. § 40-360.06 (1980); ARIZONA DEP'T OF WATER RESOURCES, www.azwater.gov (last visited Aug. 7, 2012); New Mexico, N.M, STAT. ANN. § 72-1-1–12 and § 62-9-3 (1978); STATE OF NEVADA DIVISION OF WATER RESOURCES, water.nv.gov (last visited Aug. 7 2012); PUB. UTILITIES COMM'N. OF NEVADA, http://pucweb1.state.nv.us/pucn/PUCHome.aspx (last visited Aug. 7, 2012).
[45] N.M. STAT. ANN. § 62-9-3 (1978).
[46] ARIZ. REV. STAT. ANN. § 40-360.06 (1980).
[47] NEV. ADMIN. CODE §§ 704.8901–704.8937 (2006).
[48] CAL. PUB. RES. CODE § 25520 (1974) (providing that an application for a power facility must include available site information, including water supply).

compatibility.[49] Similarly, in New Mexico, site location approvals, (while limited to projects greater than 300 MW) require a review of all environmental impacts including water supply.[50] Colorado also requires all electric utilities subject to the Colorado Utility Commission's jurisdiction, including renewable energy projects, to submit a resource plan to the Commission for approval, which includes the annual water consumption of the facility and the water intensity of the existing generation system as a whole.[51] Wyoming imposes permit requirements for renewable projects in the state, including wind projects larger than 5MW[52, 53]

1. Geothermal Energy Generation and Water Use

In its first comprehensive assessment of geothermal sources on private and accessible public lands across 13 western states, the United States Geological Survey (USGS) estimated a potential capacity to produce between 8,000 and 73,000 MW, with a mean estimate of 33,000 MW.[54] Generation of geothermal energy generally involves extraction of geothermal heat by pumping water or air into deep wells causing heated water or steam to rise to the surface for conversion to electricity. As liquid or gases are removed from underground, replacement fluid or water must be re-injected to replenish the removed reservoir. Water is necessary for reinjection as well as blow down. There are three general designs for geothermal power plants which differentially impact the amount of water consumed. The three different approaches are depicted in the diagrams below.[55] In the simplest design, steam goes through a turbine and into a condenser where it is condensed into water. In a second system, hot water is depressurized or "flashed" into steam, which is then used to drive the turbine. In the third system, generally referred to as a "binary system", hot water passes through a heat exchanger where it heats a second liquid, such as isobutene, in a closed loop. The second liquid boils at a lower temperature than water, so it is converted into steam more easily than water to run the turbine. Thus, generation of geothermal energy can either use a water cooled steam process or a binary or closed loop system. The choice of the design for extracting geothermal energy is determined by the resource; if the water comes out of the well as steam it can be used directly (the dry steam design), otherwise the water must go through a heat exchanger (the flash steam or binary design).

[49] ARIZ. REV. STAT. ANN. § 40-360.06 (1980) (outlining the factors to consider in determine whether to grant a certificate of environmental compatibility. The statute includes broad factors for consideration including the "total environment of the area" § 40-360.06 (B)(7). Water is one of the factors which may be considered and in the case of Arizona has been determinative in some cases.)

[50] N.M. STAT. ANN. § 62-9-3 (1978).

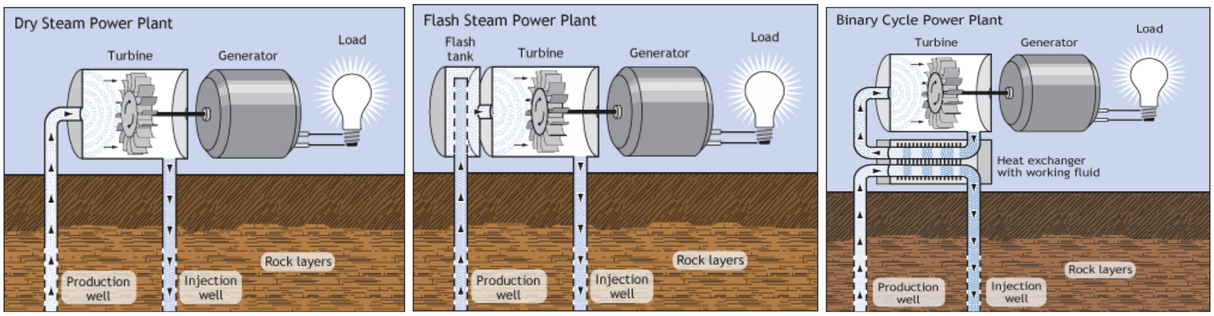
[51] 4- CCR-723-3-3500 *et seq.*

[52] WYO. STAT. ANN. §§ 18-5-500 *et seq*.

[53] Permitting of water supplies for power generation, including renewable generation, will often also require approvals from the relevant state agency which regulates water quality.

[54] Williams, C.F., *et al*., *Assessment of moderate-and high-temperature geothermal resources of the United States. U.S. Geological Survey fact sheet 2008-3082*, 4 (Washington, DC: U.S. Department of the Interior, 2008).

[55] U.S. Dep't. of Energy diagram, *available at* http://www1.eere.energy.gov/geothermal/powerplants.html (last visited Aug. 5, 2012).



The amount of water used for geothermal energy in the designs described above varies. A closed loop air-cooled system is generally a non-consumptive use of water. Estimates of water consumption involved in a flash steam water-cooled process vary significantly, depending on the definition of what "water" should be included in the consumption figure. The Geothermal Energy Association ("GEA") argues that "geothermal reservoir fluids are not fresh or potable and cannot be used for other purposes due to their temperature and mineral content."[56] In essence the argument is that the geothermal "fluid" or water should not be considered part of the consumable water resource as it is not "fresh" water. The GEA estimates freshwater requirements for a water cooled plant at 5 gallons of fresh water per MWh.[57] The National Renewable Energy Laboratory estimates freshwater requirements for a water cooled plant at 5 to 19 gal/MWh.[58] In contrast, the Department of Energy Geothermal Technologies Program estimates between 2,700 and 4,5000 gal/MWh for evaporative cooling,[59] while the Department's 2006 report to Congress on the interdependence of water and energy used a consumptive use of 1,4000 gal/MWh.[60]

In addition to how much "water" geothermal generation consumes, questions have arisen as to who owns and therefore who gets to regulate the heat source contained within the water – the state or the federal government.[61] *Rosette v. United States* presented the issue in the New Mexico Supreme Court of whether heat in water is a geothermal resource belonging to the United States or an attribute of a water right subject to control by the State of New Mexico. In *Rosette*, the state court held that it did not have jurisdiction over plaintiff's claim when the plaintiff alleged ownership over the hot water underneath the plaintiff's surface estate. The court found that if it were to assert jurisdiction over the case it would be doing more than simply

[56] Kagel, A.; Bates, D.; Gawell, K. *A Guide to Geothermal Energy and the Environment.* (Washington, DC: Geothermal Energy Association, 2007).
[57] *See id.*
[58] NAT'L RENEWABLE ENERGY LAB., A REVIEW OF OPERATIONAL WATER CONSUMPTION AND WITHDRAWAL FACTORS FOR ELECTRICITY GENERATING TECHNOLOGIES, (2011), *available at* http://www.nrel.gov/docs/fy11osti/50900.pdf. The NREL derived these figures from three main sources: Kagel, A., *supra* note 56.; CLARK, C.; ET AL., ENERGY SYSTEMS DIVISION, ARGONE NATIONAL LABORATORY,; WATER USE IN THE DEVELOPMENT AND OPERATION OF GEOTHERMAL POWER PLANTS (Sept. 2010) *available at* http://www1.eere.energy.gov/geothermal/pdfs/geothermal_water_use.pdf. CALIFORNIA ENERGY COMM'N, 2007 ENVIRONMENTAL PERFORMANCE REPORT OF CALIFORNIA'S ELECTRICAL GENERATION SYSTEM. (2008).
[59] U.S. DEP'T OF ENERGY, GEOTHERMAL TECHNOLOGIES PROGRAM "GEOTHERMAL FAQS" *available at* http://www1.eere.energy.gov/geothermal/faqs.html (last visited Aug. 5, 2012).
[60] U.S. Dep't. of Energy, Energy Demand on Water Resources – Report to Congress on the Interdependency of Energy and Water (2006), *available at* http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf.
[61] *Rosette v. United States*, 142 N.M. 717 (2007); *Rosette v. United States*, 64 F. Supp. 2d 1116 (D.N.M. 1999).

adjudicating a water right, it would also be determining the ownership of a geothermal resource. Accordingly, the court rejected the argument that state control over water rights extends to control over federally owned mineral interests that are contained in water. The Federal District Court of New Mexico held that language of the statutory mineral reservation to the Government in the Stock-Raising Homestead Act included geothermal steam and associated geothermal resources, therefore the mineral reservations on a landowner's land "grants under the Act are therefore effective to reserve to the United States geothermal resource as an 'another mineral in the lands so entered and patented…"[62] *Rosette* demonstrates how geothermal resources are somewhat amorphous in respect to classification. There is no uniform approach to defining geothermal resources with respect to water rights, or the lack thereof, as reflected in state regulation of geothermal energy.

Some states have chosen to specifically exempt the "use" of water for geothermal purposes from state regulation. In Arizona, as a general matter, any well drilled to obtain and use groundwater is subject to the Arizona water code. However, Arizona statutes specifically provide that geothermal resources and their development shall be exempt from the water laws of the state unless such resources are commingled with surface or ground waters or such development causes impairment of, or damage to the groundwater supply.[63] Several Arizona statutes address water quality concerns and effects on the aquifer in connection with geothermal energy generation. Anyone engaged in drilling a well for geothermal resources underlying a usable groundwater aquifer must case the bore hole in a watertight manner from the land surface to the geothermal producing zone or to a depth sufficient to prevent damage or contamination of the aquifer.[64] Arizona statutes further direct that the disposal of water or brines from a geothermal well shall not damage or contaminate the underlying groundwater aquifer or pollute any stream, river or body of surface water.[65] Finally, if the Arizona Oil and Gas Conservation Commission found that it would be in the interest of maintenance of the underground geothermal resource, prevention of subsidence of the land surface or maintenance of the quality of surface and other ground waters, the Commission may require reinjection of the geothermal effluent or other water supplies into the producing zones.[66]

Some states approach the regulation of water use for geothermal energy production by attempting to classify the resources as mineral or water resources, which is not an easy task. Montana recognizes that geothermal resources are neither a mineral or water resource, but rather that the resources are closely related to both minerals and water the use of which affects and is affected by other use of water resources.[67] If geothermal development on state trust land requires utilization of water, the lessee may apply for a water right to access those resources.[68] In Nevada, a consumptive use of water brought to the surface outside of a geothermal well is subject to the appropriation procedures of Nevada statutes.[69] Water is not subject to

[62] *Rosette v. United States*, 64 F. Supp. 2d 1116, 1125 (D.N.M. 1999) (internal quotation marks omitted) (internal citations omitted).
[63] ARIZ. REV. STAT. ANN. § 27-667 (A) (1980).
[64] ARIZ. REV. STAT. ANN. § 27-652 (1980).
[65] *Id.*
[66] *Id.*
[67] MONT. CODE. ANN. § 77-4-104 (1974).
[68] MONT. CODE. ANN. § 77-4-108 (1974).
[69] NEV. REV. STAT. ANN. § 534A.040 (1975).

appropriation procedures and requirements if: (1) the water removed from an aquifer or a geothermal reservoir to develop geothermal resources is returned to or re-injected into the same aquifer or reservoir; and (2) the reasonable loss of water is a result of a geothermal well test or the temporary failure of all or part of a system that removes water from an aquifer or geothermal reservoir.[70]

Geothermal resources are not considered water rights by some states that explicitly recognize that water related to geothermal resources are not regulated as a water right. In New Mexico, a permit from the Office of the State Engineer is not required for the use of ground water over 250 degrees Fahrenheit as incident to the development of geothermal resources.[71] The State does however require all diverted ground water to be re-injected as soon as practicable into the same ground water source from which it was diverted.[72] New Mexico statutes specify that no groundwater right is established through this procedure.[73] Washington recognizes that geothermal resources are neither a mineral resource nor a water resource, and are therefore the private property of the holder of title to the surface land above the resource.[74] These states may exempt geothermal resources as water resources on account of the location of the geothermal resources, specifically because the geothermal resources are normally below aquifers being accessed for other purposes.

Alternatively, there are states that classify geothermal resources as water resources. In Utah geothermal fluids are deemed to be a special kind of underground water resource, related to and potentially affecting other water resources of the state.[75] In Utah, the utilization or distribution of geothermal fluids for their thermal content and subsurface injection or disposal constitutes a beneficial use of water resources of the state.[76] Additionally, Utah recognizes the date of an application to appropriate geothermal fluids as the priority date between the geothermal owner and the owners of rights to water other than geothermal fluids.[77] Similarly, Wyoming's statutes classify underground water as any water, including hot water and geothermal steam, under the surface of the land or the bed of any stream, lake, reservoir, or other body of surface water, including water that has been exposed to the surface by an excavation such as a pit.[78]

Other states take a more circumspect approach to regulating geothermal resources by recognizing that the development of geothermal resources may not be a traditional beneficial use but may affect other water users. Alaska requires that any permit to drill a geothermal well contain sufficient information to determine whether the well will interfere with a prior water, oil, or gas right.[79] Similarly, the Colorado water code provides that the doctrine of prior appropriation is recognized with respect to geothermal resources, but that the doctrine should be

[70] *Id.*
[71] N.M. STAT. ANN. § 71-5-2.1 (1978).
[72] *Id.*
[73] *Id.*
[74] WASH. REV. CODE ANN. § 78.60.040 (2011).
[75] UTAH CODE ANN. § 73-22-8 (1981).
[76] *Id.*
[77] *Id.*
[78] WYO. STAT. ANN. § 41-3-901 (1957).
[79] ALASKA STAT. § 41.06.060 (1980).

modified to permit the full economic development of the resource.[80] Colorado further recognizes that when a geothermal resource is found in association with geothermal fluid which is tributary groundwater, the geothermal resource is a public resource.[81] Colorado requires a water permit to access geothermal resources, specifically providing that all applications to appropriate groundwater to use geothermal energy shall be considered an application to appropriate geothermal fluid.[82]

The classification of geothermal resources in some states is discretionary, specifically left to be determined by state agencies. For example in Idaho, when determining reasonable ground water pumping levels, the director of the Idaho Department of Water Resources is required to consider and protect the thermal and/or artesian pressure values for low temperature geothermal resources and for geothermal resources to the extent that the director determines such protection is in the public interest.[83] In Idaho, the right to the use of low temperature geothermal resources is acquired through appropriation.[84] Similarly, in Oregon, the state attempts to classify geothermal resources as either a water or mineral resource. The classification is dictated by the temperature of the resource, if the bottom hole temperature of a well that was initially 250 degrees Fahrenheit falls below 250 degrees, the State Geologist and the Water Resources Director, after consulting with the well owner, determine the agency with the regulatory responsibility for the well, and implicitly how the resource is classified.[85] The authority of the Oregon Water Resources Department to regulate the appropriation of water is not limited by any section of the Oregon statutes discussing geothermal resources.[86] Oregon permits a geothermal heating district to purchase, sell and hold interests in water and real property.[87]

2. Solar Energy Generation and Water Use

Solar energy generation presents some controversial and interesting policy, economic and regulatory issues with regard to water use in the renewable energy arena. The different available technologies generally define the parameters of the debate. Solar energy can be generated through two very different technologies: photovoltaic ("PV") and concentrating solar thermal ("CST"), the choice between the two will generally make water an issue or non-issue. PV technology converts sunlight directly into electricity using semiconductors, typically made from purified crystallized silicon or other thin-filmed materials. As indicated in Table 1, solar energy generated using PV consumes very small amounts of water in the generation process. CST uses large arrays of reflective material to heat a fluid to create steam to spin a turbine. As indicated in Table 2, depending on the type of cooling technology employed, CST can use relatively large volumes of water per megawatt generated. Accordingly, the type of CST technology employed will drive water demands and considerations.

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[80] COLO. REV. STAT. ANN. § 37-90.5-102 (1983).
[81] COLO. REV. STAT. ANN. § 37-90.5-104 (1983).
[82] COLO. REV. STAT. ANN. § 37-90.5-107 (1983).
[83] IDAHO CODE ANN. § 42-226 (1987).
[84] IDAHO CODE ANN. § 42-233 (1987).
[85] OR. REV. STAT. ANN. § 522.025 (1975).
[86] OR. REV. STAT. ANN. § 516.135 (1975).
[87] OR. REV. STAT. ANN. § 523.050 (1975).

a. Photovoltaic Solar Energy Generation

Photovoltaic solar energy coverts sunlight directly into electricity utilizing solar panels to capture sunlight combined together to create one system, referred to as a solar array. The size of the array depends on the use; a typical home uses about 10 to 20 solar panels to power the home, whereas hundreds of solar arrays are interconnected to form large utility-scale PV systems for large electric utility or industrial applications. Water use associated with the development of PV solar energy projects is nominal. The primary water use in connection with PV solar generation is the washing of the photovoltaic panels. In light of the small water use component, some states have been looking for ways to stream line the approval process for these projects, specifically with regard to water use.[88]

Since 2009 ten photovolaic solar energy projects have been approved on BLM lands. One project, the Silver State Solar Energy Project in Nevada is currently operational.[89] This project uses advanced film PV modules and serves the needs of approximately 9,000 average Nevada homes per year. The project area is about 600 acres and yields approximately 122,000MWh annually.[90] The PV projects approved by the BLM range in BLM capacity from 45MW-1,000MW. Many solar energy developers are still looking to PV technology instead of CST for solar energy projects for a variety of reasons. Two solar energy projects: Calico Solar Energy Project located in, San Bernardino County, California, and Blythe Solar Power Project, in Riverside County, California, were originally CST projects that changed to PV technologies based in part on concerns regarding water use associated with CST.

PV offers other benefits, including less water use, over CST. The installation cost for a utility-scale PV plant is lower ($3-3.8/W) than that of a CST ($5.79/W).[91] As discussed more fully below, CST technologies operating dry-cooling or hybrid-cooling systems in order to decrease water use, increase cost and, depending on the design, may affect performance. PV systems also have limitations compared to CST. CST systems produce more electrical energy per unit of capacity because they are typically located where solar resources are higher, use solar tracking and the resources are usually deployed with several hours of thermal energy storage capacity. PV systems have less capacity for storage, and the peak power for PV is determined by the size, efficiency, and location of the collector area while the capacity is determined by the local source and the system's ability to track the sun. Materials needed in PV technology such as tellurium and indium could be subject to shortages if production levels increase. Finally, PV systems generally require more acreage than CST systems. For example, in Nevada, the El Dorado Energy Plant, a PV plant, is constructed on 80 acres and uses 5 acres per GWh/year; Nevada Solar One, a CST plant, is constructed on 300 acres and averages 130 GWh/year.[92]

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[88] *See e.g.*, Cal. SB 267, *supra*, note 8.

[89] R. WISER, ET AL., LAWRENCE BERKELY NAT'L LAB. TRACKING THE SUN II: THE INSTALLED COST OF PHOTOVOLTAICS IN THE U.S. FROM 1998–2008 (October 2009), *available at* eetd.lbl.gov/ea/emp/reports/lbnl-2674e.pdf.

[90] FIRST SOLAR, ENBRIDGE ACQUIRES 50-MW NEVADA SOLAR PROJECT FROM FIRST SOLAR (Mar. 22, 2012) *available at* http://investor.firstsolar.com/releasedetail.cfm?ReleaseID=658871 (last visited Aug. 7 2012).

[91] U.S. DEP'T OF ENERGY, SUNSHOT VISION STUDY (Feb. 2012), *available at* http://www1.eere.energy.gov/solar/pdfs/47927_executive_summary.pdf.

[92] ZOË MONTGOMERY, ENVIRONMENTAL IMPACT STUDY: CSP V. CDTE THIN FILM PHOTOVOLTAICS (Nov. 30 2009), *available at*

Accordingly, despite water use concerns CST will remain a player in the solar arena due to other considerations.

b. Concentrating Solar Thermal Energy Generation

There are four main types of CST systems: linear concentrator, dish/engine, parabolic trough and power tower systems. All four systems use water but to varying degrees. Linear concentrator systems collect energy from the sun by using long, rectangular, curved mirrors that are tiled towards the sun. The reflected sunlight heats a fluid flowing through the tubes, which is then used to boil water in a conventional steam-turbine generator to produce electricity.[93] The dish/engine system uses a mirrored dish to concentrate sunlight into a thermal receiver, which absorbs and collects heat and transfers it to an engine generator. The system uses the fluid heated by the receiver to move pistons and create mechanical power which is then used to run a generator or alternator to produce energy.[94] The parabolic trough uses a linear parabolic reflector to concentrate light into a receiver positioned along the reflector's focal line; the receiver tube is positioned above the mirror and filled with a working fluid. The reflector follows the sun during daylight hours by tracking along a single axis; the working fluid is heated as it flows though the receiver and is then used as a heat source for the power generation system.[95] The power tower system uses a large field of flat, sun-tracking mirrors (heliostats) to focus and concentrate sunlight onto a receiver on the top of a tower. A heat-transfer fluid in the receiver is used to generate steam, which is used in a conventional turbine generator to produce electricity.[96]

CST plants require water to condense steam, provide make-up water for the steam cycle, for mirror washing and for cooling. Water cooling for thermoelectric power plants may be accomplished by using once-through cooling, which withdraws large volumes of water (23,000-27,000 gal/MWh) from a body of water and returns it to that source at an elevated temperature.[97] This system does not consume any water in the cooling process but does increase the temperature, and hence the evaporation rate, from the body of water. Alternatively, CST power plants may be cooled by a recirculating evaporative cooling process that withdraws a lesser amount of water (500-650 gal/MWh) but consumes most of the water directly through evaporation. Air-cooling (also referred to as "dry-cooling") is also available; it rejects the heat of the steam cycle directly to the air and withdraws water only for the steam cycle, using 10% of the consumption of an evaporative cooled plant. Hybrid wet/dry cooling technologies also exist, most commonly in the form of hybrid designs in CST plants. These designs reduce water

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http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/1551/Environmental%20Impact%20Study-CSP%20vs.%20CdTe%20thin%20film%20photovoltaics.pdf?sequence=1 (last visited Aug. 7, 2012).

[93] NAT'L RENEWABLE ENERGY LAB., CONCENTRATING SOLAR POWER BASICS, *available at* http://www.nrel.gov/learning/re_csp.html (last visited Aug. 8, 2012).

[94] *Id.*

[95] *Id.*

[96] *Id.*

[97] U.S. DEP'T OF ENERGY, CONCENTRATING SOLAR POWER COMMERCIAL APPLICATION STUDY: REDUCING WATER CONSUMPTION OF CONCENTRATING SOLAR POWER ELECTRICITY GENERATION REPORT TO CONGRESS, *available at* www1.eere.energy.gov/solar/pdfs/csp_water_study.pdf.

consumption by separating wet and dry units that operate in parallel or use water to cool the air by evaporation.[98]

There are advantages and disadvantages to wet-cooling and dry-cooling technologies. Dry cooling is becoming more prevalent in new power plants because of state and federal water restrictions. An air-cooled system operates at a lower efficiency than a water-cooled plant. A dry-cooled plant uses significantly less water than a wet-cooled plant; generally such a plant requires about 80 gal/MWh for cycle make-up and mirror washing. The disadvantages of dry cooling include higher capital costs, higher auxiliary operating power requirements, fan noise and an overall lower plant performance. Once through, water cooling is limited in application and is not typically available for a solar power plant given the large amounts of water it requires. Evaporative water cooling is the most common cooling method for power plant cooling. The use of either direct or indirect cooling can eliminate over 90% of the water consumed in a water-cooled CST. However, such a technology not only results in a reduced output of power but also adds an estimated 2-10% to the cost of generating electricity, depending on the plant location and other factors. The use of a hybrid system is estimated to reduce the energy cost penalty to below that of air-cooling alone while still saving about 80% of the water compared to a water-cooled plant.[99]

Table 2: Comparison of consumptive water use of various power plant technologies using various cooling methods[100]

Technology	Cooling	Gallons MWhr	Perform. Penalty*	Cost Penalty**
Coal/Nuclear	Once-Through	23,000-27,000***		
	Recirculating	400-750		
	Air Cooling	50-65		
Natural Gas	Recirculating	200		
Power Tower	Recirculating	500-750		
	Combination Hybrid Parallel	90-250	1-3%	5%
	Air Cooling	90	1.3%	
Parabolic Trough	Recirculating	800		
	Combination Hybrid Parallel	100-450	1-4%	8%
	Air Cooling	78	4.5-5%	2-9%
Dish/Engine	Mirror Washing	20		
Fresnel	Recirculating	1000		

For using a less water intensive cooling technique:
* = Annual energy output loss is relative to the most efficient cooling technique.
** = Added cost to produce the electricity.
*** = Majority of this amount is returned to the source but at an elevated temperature.

[98] *Id.*
[99] *Id.*
[100] *Id.*

Due to the generally water intensive nature of conventional CST technologies, implementing CST in the water constrained western United States presents many challenges. Some western states, in an effort to work with CST technology have implemented restrictions on the use of water in CST projects. The California Energy Commission recommends that new CST projects under its regulatory control use dry-cooled technology, unless the project has degraded water readily available.[101] Some projects are exploring the use of reclaimed water,[102] or opting for dry or hybrid cooling technologies.[103] Regulators in California recently approved several of the first large scale solar thermal plants in two decades after developers agreed to use dry cooling technologies for one of the projects and recycled wastewater from neighboring communities for another, rather than relying on the limited Mojave Desert aquifer.[104]

In 2010, the Arizona Corporation Commission ("ACC") prohibited the use of groundwater for a solar power plant as originally proposed by the developer. The issue came before the ACC when the Hualapai Valley Solar ("HVS") filed an application with the ACC to construct a 340 MW solar power plan in Mohave County. HVS represented that the solar power plant would require 2,400 acre-feet of groundwater every year for cooling purposes, and requested the water from the Hualapai Valley Aquifer. The proposal was objected to by area residents and environmental groups based on the proposed water use. After hearings, the ACC proposed an amendment to HVS's certificate of approval that prohibited the use of groundwater at the solar power plant. As a result, HVS intends to use dry cooling for the power plant, and intends to use effluent for all project water needs.[105]

There are currently six states with CST projects. In Arizona there are four projects, which include the Maricopa Solar Project and the Solana Generating Station. California is home to 23 projects, including the Ivanpah Solar Electric Generating Station and NextEra Beacon Solar Energy Project. Nevada has four projects including Nevada Solar One. Colorado, Florida, and Hawaii each have one solar power project in the state. Examples of projects in the west using CST technology and receiving regulatory approval are as follows:

Beacon Solar Energy Project – California

When the California Energy Commission approved NextEra's 250 MW Beacon Solar Energy Project in August of 2010, it was the first all-concentrating solar plant to be commissioned in California in 20 years.[106] The Beacon plant will use wet-cooled parabolic trough technology. The project will employ a wet cooling tower, where the low-pressure steam exhaust will be cooled by evaporation after passing through a heat exchanger. Over 90% of the project's water needs will be met with recycled water from nearby wastewater treatment

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[101] *See* CALIFORNIA ENERGY COMM'N, COMPARISON OF ALTERNATIVE TECHNOLOGIES FOR CALIFORNIA POWER PLANTS ECONOMIC, ENVIRONMENTAL AND OTHER TRADEOFFS, *available at* www.energy.ca.gov/reports/2002-07-09_500-02-079F.PDF
[102] *See* CAL. WATER CODE § 462 (1974).
[103] *See* discussion of Ivanpah Solar Electric Generating System at page 17, *infra*.
[104] *Id.*, *see also* discussion of Beacon Solar Project at page 6, *infra*.
[105] *See* Arizona Corp. Comm'n. Decision 71957, November 1, 2010.
[106] News Release, California Energy Comm'n, California Energy Comm'n Licences First Solar Thermal Power Pland in 20 years (Aug. 25, 2010) *available at* http://www.energy.ca.gov/releases/2010_releases/2010-08-25_beacon.html (last visited Aug. 5, 2012).

facilities in the towns of California City or Rosamond. The plant will require 456 million gallons of water annually to operate and cool. The plant is expected to start operations in 2014.[107]

Abengoa Mojave Solar Project - California

The Abengoa Mojave Solar Project was the second commercial-scale CST plant to be commissioned by the California Energy Commission. Like the Beacon project, it uses a 250 MW parabolic trough system; however, it will be substantially more water efficient, consuming approximately 277 million gallons per year due to advanced water recycling and reuse techniques. The plant will still use wet cooling technology, but will collect the condensate from the generator's reject streams after being run through reverse-osmosis filters in a service water-storage tank for recycling. Further water storage will be available when discharge exceeds the treatment system demand. The treatment system will draw recycled service water first rather than pumping virgin makeup water from the site's groundwater wells. The project is under construction and is expected to commence operations in 2013.[108]

Ivanpah Solar Electric Generating System - California

The Ivanpah Solar Electric Generating System is the world's largest CST plant under construction. When it is completed it will nearly double the amount of solar thermal energy produced in the United States.[109] The project also received the largest financial backing from the United States for a renewable energy project. The Department of Energy loaned $1.37 billion to BrightSource Energy, Inc. to complete the project. Unlike other recent California CST projects, the 370 MW Ivanpah Solar Electric Generating Station will use a central power tower rather than a parabolic trough system. The Ivanpah project will use dry cooling, enabling the plant to consume only 33 million gallons of water per year. The project took nearly four years to receive final approval. Ivanpah was the first solar project to file for approval with the California Energy Commission in 2007. However, from the beginning the project met with resistance from environmental groups concerned that the project would displace a large population of desert tortoises from their native habitat in the Mojave Desert, and concerned with water use.[110]

Nevada Solar One –Nevada

Acciona Energeria's Nevada Solar One project has been operational since 2007. It was the first large-scale solar plant developed since 1990. It uses a parabolic trough system and has a 64-MW generating capacity. The project uses evaporative cooling technology, generating water

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[107] NAT'L RENEWABLE ENERGY LAB., NEXTERA BEACON SOLAR ENERGY PROJECT (2011), *available at* http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=88 (last visited Aug. 7, 2012).
[108] NAT'L RENEWABLE ENERGY LAB., ABENGOA MOJAVE SOLAR PROJECT (Oct. 20, 2011) *available at* http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=57 (last visited Aug. 5, 2012).
[109] BRIGHTSOURCE, THE IVANPAH SOLAR PROJECT NAMED 2012 ENERGY PROJECT OF THE YEAR (Apr. 24, 2012) *available at* http://www.brightsourceenergy.com/the-ivanpah-solar-project-named-2012-energy-project-of-the-year (last visited Aug. 5, 2012).
[110] NAT'L RENEWABLE ENERGY LAB., IVANPAH SOLAR ELECTRIC GENERATING STATION (July 25, 2011) *available at* http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=62 (last visited Aug. 5, 2012).

from the Colorado River to cool the steam cycle.[111] This project uses 400 acre-feet of water per year, approximately 6 acre-feet of water per MW.

3. Wind Generation and Water Use

Other than water use in the construction of a wind project, there is universal agreement that the generation of wind energy involves virtually no water use. In terms of water considerations, if water truly is the limiting resource at a particular site with both ample wind and solar resource, wind may be the preferred choice.

4. Biomass and Water Use

Biomass sources are widely varied and can be used to produce heat, liquid fuels, and electricity. Water use for biomass energy is variable because of the many sources of biomass that can be used to produce energy, from various crops to wood and forest debris. The water use associated with biomass energy production is generally the same as water use for irrigation purposes dependent on the type of crop involved.

IV. FEDERAL REGULATION AND POLICIES RELATING TO WATER USE FOR RENEWABLE ENERGY GENERATION

Although water resource allocation and regulation is generally governed by state law, rights to water also can arise under federal law. Moreover, because of the significance of a sustainable energy supply, the federal government has become increasingly interested in water issues as they relate to the generation of energy including renewable generation. Specific "regulation" of water use for renewable energy generation on federal lands will generally involve two considerations. First, state law and regulation will play a role to the extent that state law applies to the governance of water resources even on federal lands. Second, compliance with the National Environmental Policy Act necessarily involves evaluating environmental impacts including water use. Federal law as it relates specifically to water resources will generally only come into play to the extent that the specific project seeks to secure federally recognized reserved rights or rights quantified to an Indian Tribe or Nation. While deference to state water laws will remain paramount, several issues at the federal level are worthy of note.

A. Federal and Indian Water Rights And Renewable Energy Projects

Generally, when withdrawing lands from the public domain for federal purposes, the federal government can either explicitly or implicitly "reserve" water rights necessary to satisfy the federal purposes of the federal reservation.[112] The federal purpose can be to satisfy the needs of an Indian homeland in the case of an Indian reservation,[113] or water necessary for instream flows to support national forest purposes.[114] Siting of a project on federal lands will generally

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[111] NAT'L RENEWABLE ENERGY LAB., NEVADA SOLAR ONE (Sept. 7, 2011), *available at* http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=20 (last visited Aug. 5, 2012).
[112] *See, e.g.*, *U.S. v. New Mexico*, 438 U.S. 696 (1978).
[113] *Winters v. U.S.*, 207 U.S. 564 (1908).
[114] *U.S. v. New Mexico*, *supra* note 112.

require adherence to state law and regulation with regard to acquisition and use of the water supply necessary for a renewable project.[115] While Indian water rights may be available in some circumstances to support renewable energy generation, non-Indian federal rights are generally not available for purposes of use in energy projects as the very nature of their existence is that they are dedicated to another purpose. However, in the siting of projects, renewable developers should look to opportunities on tribal lands and potential use of established Indian water rights while also being mindful of existing federal (usually senior) reserved rights appurtenant to federal lands.

Indian water rights may be available to support renewable energy development but present a number of challenges. Due to their implicit nature, Indian water rights remain unquantified, and therefore uncertain and subject to challenge, until adjudicated through state general stream adjudications or through settlement of claims and congressional approval of those settlements. Moreover, absent specific federal approval, even once quantified Indian water rights generally cannot be used off reservation absent specific authorizations.[116] However, many Indian water rights settlements are being effectuated west-wide.[117] A central feature of many of these settlements is to be able to use the quantified water for tribal economic development both on and off reservation including energy development.[118] Most settlements provide for congressionally approved off-reservation use or leasing.[119] Off-reservation transfers and use will generally be governed by state law.[120]

B. Federal Renewable Energy Developments and Water Use

The fact that the regulation of water use is generally a matter of state law presents interesting issues in the energy context which has a strong federal regulatory and policy presence. Where water is needed to fulfill a federal policy such as increased generation of energy from renewable sources, the extent of the role states may play in limiting certain kinds of renewable energy production by controlling water resources remains to be seen. To date, the federal government has not chosen to interfere with state regulatory choices in this arena. Indeed, it appears that the federal government, as much as the individual states, is concerned with ensuring that renewable energy is not developed with a blind eye to water use.

Pursuant to the Energy Policy Act of 2005, the Department of Interior ("DOI") is "encouraged" to approve at least 10,000 MW of renewable energy projects on federal public lands by 2015.[121] Thirty-one utility scale renewable energy projects have been approved by the

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[115] Non-Indian federal rights are not available for purposes of use in energy projects as the very nature of their existence is that they are dedicated to another purpose.
[116] *See* 25 U.S.C.A. § 177 (2012).
[117] *See, e.g.*, Arizona Water Settlements Act, Public Law 108-451, 118 Stat. 3478 (2004); Northwestern New Mexico Rural Water Projects Act, Pub. L. No. 111-11; 123 Stat. 1367 (2009).
[118] *See generally* L. OF WATER RIGHTS AND RESOURCES § 9:45; Northern Cheyenne Indian Reserved Water Rights Settlement Act of 1999, Pub. L. 102-374 106 Stat 1186 (1996); Northwestern New Mexico Rural Water Projects Act, Pub. L. No. 111-11; 123 Stat. 1367 (2009).
[119] *See generally* L. OF WATER RIGHTS AND RESOURCES § 9:48; Fort Hall Indian Water Rights Act of 1990, Pub. L. 101-602, 104 Stat. 3059 (1990).
[120] *See generally id.*
[121] Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594, 600 (2005).

DOI since 2009 as part of its effort to advance renewable energy.[122] Seventeen of these projects are solar projects, and ten of these seventeen use PV technology.[123] As noted above, two projects, Calico Solar Energy Project and Blythe Solar Power Project, both located in California, originally proposed use of CST but changed the projects to PV due in part to water resource concerns.

In a further effort to prioritize renewable energy goals, in accordance with Secretarial Order 3285, the DOI prioritized a set of "fast-track projects" that are to receive an "expedited permitting process".[124] The DOI classified seventeen renewable energy projects as renewable energy priority projects. Nine of these projects are solar, six are wind, and two are geothermal. All but one of the solar projects use PV technology, while one is CST and uses a CST power tower. The solar energy projects are located in Arizona, California, and Nevada. The projects are in the process of environmental compliance and permitting and are not yet operational. None of the projects propose wet-cooling technologies.

In a further effort to facilitate renewable energy development, the DOI issued a Final Programmatic Environmental Impact Statement ("PEIS" or "Solar PEIS") in July 2012[125] which addresses the environmental, social, and economic impacts associated with the development and implementation of agency specific programs that would facilitate environmentally responsible utility-scale solar energy development in Arizona, California, Colorado, Nevada, New Mexico and Utah.[126] The PEIS identifies prime areas for solar development, approves seventeen large-scale energy projects on public lands, and outlines the procedure for approval of similar projects.[127] 285,000 acres are designated as priority areas for development: development will be allowed on approximately 19 million additional acres. A majority of the land surveyed, more than 78 million acres, will be closed for solar development based on the DOI's balancing of factors including the potential conflict of development with biological, cultural, and historical resources. The PEIS addresses water resources for the approved projects on an individual basis but does not include any general recommendations for utility-scale solar developments and water use.

The DOI, primarily through NEPA initiatives, has worked to identify the best places for renewable energy development and the best places for conservation with the goal of minimizing siting conflicts. In addition to the Solar PEIS, the DOI has worked to identify the best locations for renewable energy projects inclusive of the examination of the availability of water resources, through local Bureau of Land Management ("BLM") offices. The BLM in Arizona is in the process of preparing an Environmental Impact Statement ("EIS") to identify lands across that

[122] Press Release, Dep't of the Interior, Salazar Approves First-Ever Commercial Solar Power Energy Project on American Indian Trust Lands (June 21, 2012) *available at* http://www.doi.gov/news/pressreleases/Salazar-Approves-First-Ever-Commercial-Solar-Energy-Project-on-American-Indian-Trust-Lands.cfm (last visited July 2, 2012).
[123] *Id.*
[124] Secretarial Order 3285, March 11, 2009 *available at* http://solareis.anl.gov/documents/docs/SOenergy.pdf.
[125] DEP'T OF THE INTERIOR, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (PEIS) FOR SOLAR ENERGY DEVELOPMENT IN SIX SOUTHWESTERN STATES (July 2012) *available at* http://www.solareis.anl.gov/documents/index.crm (last visited Aug. 8, 2012).
[126] *Id.* at ES-3.
[127] *Id.* at ES-4.

state which may be suitable for the development of renewable energy. The emphasis of the EIS will be on lands that are previously disturbed, developed, or where the effects on sensitive resources, such as water, would be minimized, and on lands that are near existing or planned transmission. The BLM intends to use the results from the final EIS to amend its land use plans across Arizona to identify areas that are most suitable for large-scale utility wind, solar and geothermal resources.[128]

In 2010, pursuant to a House Conference Report, Congress directed the DOI and the Forest Service to report on the criteria used for siting renewable energy projects on federal lands including the extent to which protection of water resources will be considered.[129] In May 2011, the agencies issued a Joint Report to Congress ("Joint Report")[130] raising environmental concerns with renewable energy development, specifically water consumption associated with solar energy projects. The Joint Report indicates that while "siting decisions, stipulations, and good management practices can help minimize environmental concerns, an effective monitoring program is needed to collect data and continue to observe all effects."[131] The Joint Report includes a section dedicated to water use for solar facilities, noting, among other issues, that the amount of water use varies depending on the technology employed. The Joint Report indicates that solar projects in dry environments may reduce water requirements by using reclaimed water for cooling or by using organic solvents in closed-systems instead of water. The Joint Report briefly comments on water use in other renewable technologies including wind and biomass, noting that water is generally not an issue with regard to generation of energy from these renewable resources. The Joint Report recognizes that under the Federal mandate, Federal resource management agencies must develop, maintain and revise land use plans as needed. It acknowledges that part of the process of developing land plans now involves a consideration of the water-energy nexus, stating that "consideration must be given to the competition between energy development needs and water constraints, particularly in areas potentially impacted by climate change or prolonged drought."[132] The Joint Report directs that DOI agencies should identify how much water is used for various energy production technologies and incorporate that information into decision-making regarding energy development. The Joint Report explicitly recognizes that the responsibility to allocate water supplies is held by states, and that federal agencies should take into account state water allocation processes.

Other federal policies affecting the development of water supplies for renewable energy projects include the National Water Availability and Use Assessment Program which provides general guidance regarding water use on a national level including concerns with energy development.[133] This program is intended to provide a more accurate assessment of the water resources of the United States. Similarly, the United States Geologic Survey ("USGS") Energy

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[128] *See* BUREAU OF LAND MGMT, RESTORATION DESIGN ENERGY PROJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (May, 2012) *available at* http://www.blm.gov/az/st/en/prog/energy/arra_solar/DEIS.html (last visited Aug. 5, 2012).
[129] H.R. Rep. 111-316 at 75-6 (2010)(conference report).
[130] U.S. DEP'T OF INTERIOR AND U.S. DEP'T OF AGRIC., NEW ENERGY FRONTIER: BALANCING ENERGY DEVELOPMENT ON FEDERAL LANDS: A JOINT REPORT TO CONGRESS ON SITING ENERGY DEVELOPMENT PROJECTS ON FEDERAL LANDS, (May 2011).
[131] *Id.* at 18.
[132] *Id.* at 46.
[133] 42 U.S.C. § 10368 (2009).

Resources Program provides information concerning water use and withdrawals associated with eight sectors of water use, including thermoelectric power generation. 42 C.F.R. §16516 provides that DOI may make guarantees for renewable energy projects that generate electricity or thermal energy and facilities that manufacture related components, but that in doing so the Secretary may consider factors including the effect of the project in meeting a State or region's environment (including climate change) and energy goals. Water use and the effect on state water resources would certainly appear on the list of state and regional concerns with regard to energy development.

C. Federal Agency Decisions Relating To Water Use In Renewable Energy Projects

There are few federal administrative or court decisions relating directly to water use and renewable energy development. Challenges which have been or are being litigated relate generally to the need to consider impacts on water resources in the development of renewable supplies. In *Save Medicine Lake*[134] challengers appealed a BLM decision to approve a plan of operations for developing geothermal resources in the Medicine Lake Highlands of northern California. One of the many challenges to the decision was based on allegations that the BLM failed to consider potentially significant impacts to the quantity and quality of groundwater in the Medicine Lake Highlands aquifer. The IBIA found that the appellants failed to show there was a communication between the geothermal reservoir and the overlying aquifer such that groundwater would recharge the reservoir. The IBIA also did not find merit in the appellants' argument that the BLM failed to take into account that the re-injection of geothermal fluids made into the reservoir may contaminate the overlying aquifer. The IBIA upheld the BLM's decision since the BLM had provided for monitoring and, if necessary, mitigation of any adverse impacts to the groundwater from the production and re-injection of geothermal fluids.

In *Backcountry*,[135] appellants challenged the BLMs issuance of ROWs for an electrical transmission line and one of the projects was a renewable energy project. One allegation was that the BLM failed to adequately address adverse impacts to groundwater from increased energy and other development caused by the project that would obtain water from the underground basins crossed by the transmission line. The IBIA held that the challengers failed to present evidence to show any impact on groundwater that was not adequately addressed in the EIR/EIS.

V. MECHANISMS FOR SECURING WATER SUPPLY AND SITING CONSIDERATIONS

In determining where to site a project or what mechanism to utilize to secure a water supply, one must first assess the water demand for the project. The volume of water use will often drive the determination as to the best suited acquisition mechanism and source of water as well as influence siting considerations. For example, effluent will not be an available source if the demand of the project exceeds the local sources of available effluent supply. Certainty of supply will be imperative in siting and security of a water supply for any energy project and renewable energy projects are no exceptions. The need for certainty may thus play a role if there

[134] *Save Medicine Lake Coalition, et al.* 156 IBLA 219 (February 7, 2002).
[135] *Backcountry Against Dumps, et al.*, 179 IBLA 148 (May 14, 2010).

is a choice between ground or surface supply. While not an exhaustive list, some considerations for mechanisms for securing supply and siting follow.

A. Mechanisms for Securing Supply

1. New Appropriation

In parts of many states, both groundwater and surface water supplies are considered fully or over allocated – *i.e.* water supplies are fully appropriated and the only mechanism for acquiring a water supply is through the acquisition of existing water rights from another user. However, in some instances, there may be water available for a new appropriation. In that instance considerations should include: (1) the sustainability of the physical supply; (2) other rights that may exist or that could call out the project's junior right even if successfully established, given that a new appropriation will bear the date of the initiation of the project; (3) the ability to secure back up supply; and (3) the specific state legal and regulatory requirements for securing and protecting an appropriation, if feasible.

2. Acquisition of Existing Water Rights

If a new appropriation of water is not an available option, the acquisition of existing water rights from existing users through lease or purchase may be a viable option for securing a renewable energy project water supply. Unlike an appropriation, where the cost of the actual water is usually the application fee, acquisition of any significant volume of water will need to be factored into project costs. Prior to acquisition, hydrologic as well as the regulatory feasibility of transferring the place, purpose of use and point of diversion should be analyzed under the relevant state's legal and regulatory requirements. As discussed above, the transfer will likely require, at a minimum, an examination of the effect of the change on existing users, and whether the change is in the public interest. While withdrawal of water for thermoelectric generation represents by far the largest category of withdrawal, the majority of water in the West is consumed in agriculture.[136] Accordingly, most purchases or leases of rights will be a change from agriculture use to an industrial use, a controversial "public interest" question in many states.

3. Supply of Water From a Municipality or Utility

A project water supply may be available through service from a municipal or regulated utility if the project is located within the municipal or utility service area and the utility has excess water rights capacity. Generally, if the project is located within the municipal or utility service area, state law normally precludes discrimination within classes of users and if capacity is available the municipality or utility may be obligated to serve. The utility normally must provide service pursuant to its extant rules and regulations. However, utility service rules and

[136] Thermoelectric generation accounts for a greater proportion of freshwater use by withdrawal or diversion vis-à-vis agricultural use (41% vs. 37%), but agricultural use far outpaces energy generation with regard to actual consumption of water (81% vs. 3%). *See* NAT'L ENERGY TECH. LAB., ESTIMATING FRESHWATER NEEDS TO MEET FUTURE THERMOELECTRIC GENERATION REQUIREMENTS, (September 30, 2010), Appendix A, Fig. A-1, *available at* http://www.netl.doe.gov/energy-analyses/pubs/2010_Water_Needs_Analysis.pdf.

regulations will often permit or require negotiation of special contracts. Cost and the obligation to provide for extension of infrastructure necessary to serve will be predominant factors subject to negotiation.

4. Use of Effluent or Water Reuse

As discussed above, use of effluent or water reuse may not only be an option to explore, but a required source of supply depending on the location of the proposed project. California currently prohibits use of freshwater for thermoelectric generation in any significant volume.[137] Even if not required, if available in sufficient volumes, effluent may be an attractive option for a supply source given that it can be acquired and used relatively free of state regulation.[138] The appropriate contract with the owner of the effluent will need to be negotiated. With regard to water supply considerations, location of renewable projects in conjunction with reclamation or desalination facilities can be considered.

B. Siting Considerations

As with almost any energy project, it is generally the site that chooses the renewable project as opposed to the reverse. That said, where there are options, various issues should be considered with regard to siting and water. The first consideration with regard to water supply and siting are the permitting and water resource regulatory regime of a particular state under consideration. For example, in California the project may be limited to non-potable sources.[139] In Arizona, wet-cooling and reliance solely on groundwater may not be an option.[140] Moreover, some states have preferences for certain kinds of uses.[141] Those that do may prefer domestic or municipal needs which will need to be addressed in the context of a request for an appropriation or change of use. Other states take into consideration the use of water for energy generation where the power generated will serve only out of state customers.[142]

Some consideration should be given to whether surface, groundwater or a combination of both is best suited to the project needs. While surface water sources may be subject to greater variability and shortages in times of drought than groundwater, the use of groundwater, while not demonstrating the kind of variability to the extent of some surface supplies, raises the question of sustainability if the resource is from a mined or non-recharging aquifer.

Location on federal public lands, state land or private land should factor into the water supply analysis. While state law will generally govern supply acquisition, in addition to the inevitable NEPA compliance, various federal policies may come into play which could create incentives or disincentives for certain approaches to water supply.[143]

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[137] *See*, discussion *supra*, note 38. *See also* CAL. PUB. RES. CODE § 25008 (1991).
[138] *See supra*, note 35.
[139] CAL. PUB. RES. CODE § 25008 (1991).
[140] *See* Arizona Corp. Comm'n. Decision 71957, November 1, 2010.
[141] Section III(a) *supra*.
[142] *See* Section III(a), *supra*.
[143] *See* Section III(a) *supra*.

Finally, location on Indian lands presents both opportunities and challenges with regard to water supply.[144] Where a tribe's rights are quantified through adjudication or settlement, water rights may be available in large quantities to support a renewable project. However, absent quantification the use of Indian water rights raise significant questions of uncertainty due to potential challenges by non-Indian users. Moreover, absent a settlement and congressional authorization specifically authorizing use for industrial or commercial purposes, Indian water rights are generally limited to traditional on-reservation uses and leasing may be subject to federal approvals.[145] Despite these challenges, renewable energy development is moving forward on tribal lands. The first utility-scale solar facility on tribal lands is a PV plant. One of the stated reasons for the chosen technology was water resource considerations.

On June 29, 2012 the Department of Interior approved the first utility-scale solar power plant on tribal land. The Moapa Band of Paiutes received approval for a 350MW solar power plant that will be located on 2,000 acres of reservation land in Southern Nevada. The Final Environmental Impact Statement ("FEIS") notes that the proposed PV technology minimizes the use of water resources. The FEIS states that PV consumes no water in operations and uses insignificant amounts of water for cleaning modules, which occurs 2 to 4 times per year.[146] The FEIS considered technology options, and specifically noted that concentrated solar technologies require significant use of water in the generation of power, which is a scarce resource in Nevada.[147] The project requires 380 acre feet during the construction phase and no more than 20 to 40 acre feet per year for operations and maintenance.[148] The Tribe's water rights have been quantified; the tribe has 2,500 acre-feet per annum of groundwater and 3,500 acre-feet per annum of surface water from the Muddy River. The Tribe's water rights are recognized for "municipal" use. Generally, Nevada law requires water for an energy project to be permitted for industrial use; however, as the FEIS recognizes, within the reservation the Tribe is not required to follow state law procedures. The FEIS approved of groundwater to be used for construction and operation, which will be supplied by two existing Reservation wells using tribal water rights.[149]

VI. CONCLUSION

Water supply will be an essential component for the development and generation of renewable energy projects in the western United States. The type of renewable resource (solar, wind, geothermal) and the technology used to generate power from that resource will dictate the

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[144] For a good discussion on issues relating to siting of renewable projects on Indian lands generally, *see* de la Torre, Kelly, and Thompson, Robert S. III, "The Indian Energy Promotion and Parity Act of 2010: Opportunities for Renewable Energy Projects in Indian Country", *Natural Resources Development on Indian Lands*, Paper No. 8. (Rocky Mt. Min. L. Fdn. 2011). The authors specifically note that development of renewable resources on tribal lands "lags far behind the progress made on non-tribal lands, due primarily to cumbersome procedures, additional regulatory requirements and policy challenges . . . ." *Id.* at 2.

[145] *See Winters v. U.S.*, 207 U.S. 564 (1908) (purposes of use related to purposes of reservation); 25 C.F.R. § 131(c) (1966); 25 U.S.C. § 177 (2007).

[146] DEP'T OF THE INTERIOR, FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS) FOR K ROAD MOAPA SOLAR FACILITY (March 2012) *available at* http://projects2.pirnie.com/MoapaSolar/documents/FEIS%20Vol%201%20-%20Report.pdf

[147] *Id.* at 2-12.

[148] *Id.* at 2-33.

[149] *Id.* at 3-92.

nature and extent of the water considerations for any particular renewable energy project. Physical supply coupled with state law and regulation will generally govern the availability of sufficient water resources available for renewable energy generation and influence the kinds of projects which are developed. Federal laws, policies and initiatives will also play a role as Congress and the executive branch press for more renewable energy but also mandate consideration of the water-energy nexus.