1 Ariz. J. Envtl. L. & Pol'y 91

Arizona Journal of Environmental Law & Policy
Fall 2010

Article
Robert Glennon[a1]Andrew M. Reeves[aa1]

*91 SOLAR ENERGY'S CLOUDY FUTURE

ABSTRACT

With governments and environmental groups both clamoring for clean alternatives to fossil fuels, the future of solar energy looks bright. To date, however, solar power produces less than one percent of the U.S.'s electricity needs and, despite unprecedented subsidies since the 2009 passage of the American Recovery and Reinvestment Act, very few utility-scale solar projects have broken ground. Solar remains an emerging technology not yet price competitive with fossil fuels, but this efficiency gap alone does not account for the lack of a burgeoning utility-scale solar market--especially when subsidies are considered. Instead, as this article explains, large land and water requirements for utility-scale solar technologies, the arduous permitting process required for proposed sites on public lands, disincentives created by a preference for agriculture, and stringent objections from politicians and environmentalists toward actually siting utility-scale solar projects better explain the state of solar power in the United States. This article will suggest that solar companies would be wise to focus their efforts to site their projects on private or tribal lands. And, it will suggest that, if solar is ever going to contribute significantly to this country's energy needs, we must minimize disincentives and strike a balance between the opposing environmental goals of preserving pristine land and reducing carbon emissions.

*92I. INTRODUCTION

The future of solar energy looks bright. The environmental community is united behind the idea of an emissions-free, renewable alternative to fossil fuels, and a flurry of new companies, spurred partially by an infusion of venture capital from Silicon Valley, is lowering the costs of solar with creative inventions and improved technologies.[1] Worldwide, companies from Spain to China are entering the solar energy field. In 2009, a Chinese solar energy company, Suntech, announced plans to build a photovoltaic plant in the United States[2] and, in 2010, selected Goodyear, Arizona as its first American-based solar panel manufacturing site.[3] A host of U.S. companies, such as BrightSource Energy and Tessera Solar North America, are currently involved in developing utility-scale solar projects domestically as well.[4]

The U.S. government has also demonstrated a strong interest in renewables and is subsidizing solar energy, especially through the American Recovery and Reinvestment Act.[5] Various state legislatures, in similar fashion, have offered inducements to develop solar energy projects, both at the residential and utility scale.[6] Twenty-nine states and the District of Columbia have renewable portfolio standards (RPS) that require utility companies to produce or acquire some portion of their marketable energy from renewable supplies, such ***93** as solar or wind,[7] and Congress is attempting for the fifth straight session to establish a national RPS, a major step already taken by other industrial nations such as Japan.[8] Many local governments have also created incentives for both citizens and utility companies to install solar. In 2005, Tucson, Arizona, for instance, began to award permit fee reimbursements of up to $1,000 for builders who install approved solar energy systems.[9]

Additionally, the U.S. Department of Defense (DOD) has shown a substantial interest in producing its own renewable supplies for various military installations, including Nellis Air Force Base in Nevada, Luke Air Force Base near Phoenix, and Davis-Monthan Air Force Base in Tucson, Arizona. At Nellis, DOD activated a 72,000 panel photovoltaic array in 2007 that is expected to provide 25 percent of its power needs[10] and Luke Air Force Base recently announced plans for a 17 megawatt solar plant.[11] In the coming year, Davis-Monthan expects to add 14.5 megawatts of solar capacity to the 9.3 megawatts it has already installed making it the largest solar-generating base in the DOD.[12]

Perhaps equally important in the current recession, solar power is creating jobs. In the area of photovoltaics (PV) alone, growth has been unprecedented. While the number of companies involved with traditional forms of power generation--from nuclear to coal--has remained relatively constant, the number of new companies dealing primarily in PV grew by 347 percent from 1999 to 2008 while providing job increases of nearly 560 percent.[13] In a single year, from 2007 to 2008, the number of companies involved with PV grew from 136 to 206, a growth of more than 50 percent.[14] All in all, in 2008, 89 large-scale solar thermal or ***94** photovoltaic generation facilities were operational in the United States[15] producing approximately 864 thousand megawatt hours of electricity.[16] By the end of 2010, the Obama Administration expects that another 38 facilities will be running, adding another 613 megawatts[17] of clean, renewable energy to the nation's electrical power supply[18] while also providing an increase in lucrative "green collar" jobs.[19]

Thus, the solar power industry is uniquely positioned to help the United States reach its energy and economic goals and avoid the worst effects of climate change and global warming. But there are storm clouds on the horizon. As a matter of fundamental economics, solar power remains an emerging technology that is not competitive with fossil fuels. And while the *idea* of solar energy is appealing to every environmental organization, the *reality* of siting specific projects has turned out to be a contentious issue. The land mass required for utility-scale solar power installations is enormous.[20] The plants are usually located far from urban areas, requiring upgrade or replacement of existing transmission lines--another contentious issue.[21] And finally, there is the problem of water, which is intricately connected with the demand for energy.[22]

In 2006, the U.S. Department of Energy predicted that the country's demand for energy will grow by 53 percent over the next twenty-five years.[23] The National Energy Policy Development Group calculated in 2001 that the country will need 393,000 megawatts of new electrical power capacity[24] by 2020.[25] That amount of power would require that we build ***95** more than one power plant per week for the next twenty-five years.[26] Yet, since 2007, Georgia, Idaho, Arizona, and Montana have denied permits for new power plants because there was not enough water to run them.[27]

The United States' energy policy has almost totally ignored the water demands associated with various kinds of energy production. The energy industry consumes substantial quantities of water and the water industry, in turn, needs substantial quantities of energy. The roughly 60,000 water systems and 15,000 wastewater systems in the United States use about three percent of the nation's electricity to deliver and treat water and wastewater.[28] And global climate change is expected to put strains not only on the availability of fresh water but also on the amount of energy generated by our hydroelectric facilities.[29] Our thirst for energy to power our cell phones, light our homes, feed our Internet inquiries, and run our automobiles seems unlimited.[30] But our water supply is not.[31]

This article will first explain, in Part II, the water and land uses associated with various types of solar energy production, and compare the pros and cons of photovoltaic versus concentrated solar power. It will then address the economics of the industry in Part III, focusing special attention on the importance of government subsidies and RPS plans to assess the viability of a predominantly solar future. This future depends, in part, on the recently released rental rates for public land usage determined by the Bureau of Land Management (BLM). In Part IV, the article will discuss the arduous permitting process for siting solar plants on public lands while assessing the shortcomings of the BLM's Programmatic Environmental Impact Statement (PEIS). Part V will address the various environmental and political objections that have arisen in relation to siting solar projects, and will argue that some projects on public lands should be built, especially on lands with a history of use, such as by off-road vehicles, that has compromised those lands as high-quality habitat. Finally, by looking beyond public lands, Part VI will suggest as an alternative, the desirability of solar companies focusing their development efforts on private and tribal lands. ***96** The reallocation of both land and water from existing low-value farms to new solar production facilities offers a viable political, environmental, and economic alternative to siting projects on federal lands.

Ultimately, the article will attempt to show that--though the clouds on solar energy's horizon are dark and ominous--the future of solar power can be a bright one. It will take a major reorientation of federal incentives, an increasing commitment to the research and development of improved solar technologies, and a willingness of local citizens and environmental

organizations to accept a significant number of solar projects on both private and public lands near their communities. If solar is ever to become more than a marginal force in this country's commitment to greener energy production, we must provide enhanced financial incentives to solar companies, utilities, and consumers; we must ensure that our environmental permitting system provides a deliberate, transparent process that does not erect endless and innumerable obstacles to actually siting renewable power projects; and we must recognize that solar energy has amazing potential to help us address climate change if, and only if, we address the money, land, and water issues associated with solar power.

II. SOLAR POWER TECHNOLOGIES, WATER CONSUMPTION, AND LAND FOOTPRINTS

It seems sensible to locate utility-scale solar facilities in the American Southwest, which obviously enjoys an abundance of sunshine. But some solar technologies use enormous quantities of water, a scarce resource in deserts. And all utility-scale solar projects, no matter their fundamental technologies, require large tracts of land.

A. Water Use for Various Solar Technologies

There are two basic kinds of solar power systems: photovoltaic cells (PV) and concentrating solar power (CSP). The first type, PV, converts solar radiation directly into electrical current.[32] On the upside, photovoltaic systems require a minimal amount of water (essentially to wash periodically the solar panels and operating equipment) and can be built in stages--a major incentive for private companies requiring short-term profitability.[33] Additionally, PV systems need not be built to utility scale. With continued improvement in "smart metering" and "smart grid" technology, private residents will continue to benefit from installing these solar panels while the owners of warehouses and urban commercial buildings may be able to install larger PV arrays on their rooftops to offset operational costs and create revenue by selling energy back to the grid.[34] On the downside, however, PV ***97** systems present a major intermittency problem as PV cells are currently incapable of storing the energy they produce.[35] Thus, when the sun is absent, either from uncooperative weather or darkness, PV cells are largely ineffectual.

The second type of utility-scale solar technology is CSP. A major advantage to CSP plants is their ability to address the intermittency problem that is such a liability for PV systems. Using thermal storage, hybridization with natural gas, or molten salts, CSP facilities can dispatch power to the grid even after the sun has set.[36] CSP plants employ four different approaches: solar trough; linear Fresnel; power tower; and dish/engine.[37] The first three use a steam cycle whereby an energy source is used to generate enough heat to boil water, to create exhaust steam, to spin a turbine that generates electricity.[38] These three CSP technologies operate like coal, natural gas, or nuclear plants with one exception--the CSP technologies use the sun's heat instead of coal, nuclear fuel, or natural gas to boil water and begin the generation process.[39]

All power plants involving a steam cycle use water to create steam. This water is highly purified and continuously recycled.[40] The steam cycle begins when a heat source (here, concentrated sunlight) is applied, turning water into steam. The steam then turns the turbines, generating electricity.[41] After leaving the turbines, the steam is passed through a ***98** condenser where it is cooled and condensed into liquid water.[42] This liquid water is then returned back to the heat source to begin the steam cycle once again.[43]

Because the water in the steam cycle is continuously recycled, the amount of water consumed by the steam cycle itself is quite small. On the other hand, substantial quantities of water are generally used in the cooling cycle.[44] In most cooling cycles, cooling water is passed through the condenser where it picks up heat from the hot steam. The ultra-pure steam does not mix with the cooling water.[45] Rather, as the hot steam comes into contact with cool tubes of cooling water inside the condenser, the heat from the steam is transferred to the cooling water.[46] This heat transfer warms up the cooling water as it simultaneously cools and condenses the steam.[47] Appendix 1 shows diagrams of water-cooled solar power plants.

In an "open-loop" cooling system, cooling water is passed through the condenser only once before being returned to the environment.[48] Large quantities of cooling water are removed from a river or other large body of water in an open-loop system. However, nearly all of that water is quickly returned, albeit at a higher temperature.[49]

In a "closed-loop" cooling system, the cooling water is not returned to the environment but is recycled after passing through the condenser. Although the cooling water is recycled, significant quantities are lost with each turn of the cycle. This occurs

for two reasons. First, before the cooling water can be reused, it must itself be cooled. In drier climates, this cooling generally occurs in large cooling towers,[50] where a significant portion of the water is intentionally evaporated to chill the water.[51] Much as the human body is cooled by sweat that evaporates from the skin, some of the cooling water must evaporate in order to cool the water that remains. A second reason why cooling water is lost in a closed-loop system has to do with the fact when water evaporates it leaves behind natural salts.[52] Left unchecked, these salts would reach concentrations so high that they would damage the equipment. In order to prevent such a problem from occurring, a portion of the cooling ***99** water must be discharged from the cooling cycle (called "blowdown") and replaced with fresh water.[53]

A third cooling system is air or "dry-cooling" which does not use any cooling water. Here, steam cools by transferring its heat through the walls of the condenser directly to the surrounding air.[54] The process is similar to a car's radiator which transfers heat to the air under the hood or (when the driver turns on the radiator) to the air in the passenger compartment of the vehicle. Although effective when ambient air temperatures are low (such as in the winter), air/dry-cooling is less efficient in the hot summer months —– especially in desert areas where temperatures frequently exceed 120 degrees.[55] One power plant using air/dry-cooling technology was found to produce five percent less energy over the course of a year, thereby increasing the electricity cost seven to nine percent over a water-cooled plant.[56] Appendix 2 shows a diagram of a dry cooled solar power plant.

One problem associated with closed-loop, wet-cooled CSP plants is water consumption. Table 1 summarizes the "Water Use Intensity"--the number of gallons of water required at the power generation facility to produce one megawatt hour of electricity--for various power producing technologies.

TABLE 1: WATER USE AND CONSUMPTION AT POWER PLANTS BY VARIOUS SOURCES OF ELECTRIC POWER GENERATION[57]

PLANT TYPE	COOLING PROCESS	WATER USE INTENSITY (GAL/MWH)		
		STEAM CONDENSING		OTHER USES[58]
		WITHDRAWAL	CONSUMPTION	
Fossil / biomass	Open-loop	20,000-50,000	~300	~30
	Closed-loop[59]	300-600	300-480	
	Air/Dry	0	0	
Nuclear	Open-loop	25,000-60,000	~400	~30
	Closed-loop	500-1,100	400-720	
	Air/Dry	0	0	
Natural Gas Combined Cycle	Open-loop	7,500-20,000	100	7-10
	Closed-loop	~230	~180	
	Air/Dry	0	0	
Coal Integrated Gasification Combined-Cycle	Closed-loop	~250	~200	130-140
Geothermal Steam	Closed-loop	~2000	~1400	Not Available
Concentrating Solar Power: Trough	Closed-loop	760-920	760-920	8
	Air/Dry[60]	0	0	78
Concentrating Solar Power: Tower	Closed-loop	~750	~750	8

	Air/Dry[61]	0	0	90

***101** Two paradoxes emerge from this data. First, if water scarcity resulting from consumption is a major concern, why not utilize open-loop technology as, across the board, it *consumes* less water than closed-loop systems? In short, despite consuming less actual water, the other environmental hazards of open-loop systems are considerable.[62] Because, in a standard open-loop system the power plant is located near a river or other large body of water, the water reintroduced into the source is returned at a much higher temperature than when it was originally extracted. This temperature differential can wreak havoc on the ecosystems connected to the water supply.[63]

The second paradox involves closed-loop systems. If CSP plants use closed-loop thermal technologies similar to traditional coal, natural gas, and nuclear plants, why is it that (with the exception of geothermal steam) they consume, on average, 300 percent more water? The answer is that solar plants are less efficient at electricity production, and therefore require more water for steam production used in generating electricity through turbine electricity production.[64] Thus, utilizing data from Table 1, it can be seen that, while a closed-loop nuclear and closed-loop CSP tower system may each withdraw 500 gallons of water to be used for energy-production, the nuclear plant--able to achieve steam production at a much more efficient rate--will likely *consume* about 350 gallons of the water while the CSP plant will consume all of it.[65] Simultaneously, the 500 gallons will be used more efficiently in the nuclear plant and will be able to produce one-megawatt hour of electricity.[66] With the CSP tower, however, the 500 gallons will likely only produce about two-thirds of a megawatt hour of electricity.[67]

Apart from the possibility of utilizing air/dry-cooling technology, a hybrid system that has both wet-cooling and air/dry-cooling capabilities is possible. Though more expensive, hybrid systems are attractive because, when ambient air temperatures are lower, air/dry-cooling can effectively be utilized and, in the summer, when high temperatures make air/dry-cooling less effective, wet-cooling can be employed.[68] Still, as a consequence of the ***102** added cost of maintaining a dual system, the overwhelming preference for utilities is wet-cooling.[69]

In Arizona, for instance, the U.S. Bureau of Land Management has received thirty-two requests for solar plants to be located on federal land and twenty-eight of these plants intend to employ some form of CSP technology--many of which are likely to be wet-cooled.[70] With mounting pressure from environmental groups, politicians, and concerned citizens, however, it seems likely that some of these projects will change their plans to embrace dry- or hybrid-cooling technology.[71] Further, in California, the California Energy Commission (CEC) is opposed to the use of fresh water for power plant cooling[72] and the Nevada State Engineer in a 2002 ruling stated:

> [T]he State Engineer does not believe it is prudent to use substantial quantities of newly appropriated ground water for water-cooled power plants in one of the driest places in the nation, particularly with the uncertainty as to what quantity of water is available from the resource, if any ....[73]

A fourth CSP technology has been developed by Stirling Energy Systems, which uses parabolic-shaped dish reflectors to focus sunlight on a generating unit that produces electricity directly without requiring cooling water.[74] The first commercial-scale Stirling dish system, developed by Tessera Solar North for a project in Peoria, Arizona, came on-line in December 2009.[75] But the disadvantage is that the technology has thus far not allowed for thermal storage, which makes it of less use to utilities that need consistent, uninterruptable power. Still, as with PV systems and CSP technologies utilizing air/dry-cooling, the Stirling ***103** system requires significantly less water than wet-cooling systems and can be used if economic and performance penalties can be reduced or tolerated.

B. Land Use for Various Solar Technologies

In addition to water consumption issues, the land use impacts of solar energy are considerable. Sandia National Laboratories, a government-owned, contractor-operated (GOCO) facility run by the Lockheed Martin Corporation, has produced an estimate of the land requirements for various kinds of electrical power generation. According to their data, to produce 1,000 megawatts of power, a coal plant requires 640-1,280 acres of land, as does a nuclear plant; a natural gas combined-cycle plant requires at least 640 acres; but a concentrating solar thermal plant would require approximately 6,000 acres.[76] Wind power requirements would be even higher, a staggering 46,000 acres per 1,000 megawatts.[77] Table 2 provides estimates of the land requirements for various types of technologies.

TABLE 2: LAND REQUIREMENTS FOR VARIOUS SOURCES OF ELECTRIC POWER GENERATION[78]

PLANT TYPE	PLANT SIZE (MW)	LAND AREA (ACRES)	UNUSABLE LAND SIZE
Coal/biomass or gasification w/ steam turbine	500-1000	640	640
Nuclear Steam	500-1000	640	640
Natural Gas Combined-Cycle	200-500	320	320
Geothermal Steam	200-500	320	320
Concentrating Solar	500	3000	Varies by Technology[79]
	1000	~6000	Varies by Technology
Wind	500	23000	640 acres
	1000	46000	1280 acres
Photovoltaic[80]	1000	12160	Varies by Technology[81]

***104** If the applications BLM has received for solar projects in Arizona are any indication, however, the land situation is much, much worse. The twenty-eight CSP applications that have not significantly begun the environmental impact statement (EIS) process have requested 425,873 acres of public land.[82] These companies have estimated an aggregate generating capacity of 18,575 megawatts.[83] Assuming the applicants have not woefully overestimated the amount of land they require, Arizona's new CSP systems would require ***105** approximately 22,927 acres for every 1000 megawatts of power produced[84]--nearly four times the amount suggested by Sandia Labs. Tucson Electric Power's rule of thumb for PV requires eight acres of land per megawatt of power produced, putting the PV figure for 1000 megawatts at 8,000 acres.[85] Either way, the landmass footprints necessary for utility-scale solar power are staggering.[86]

Still, as one solar company pointed out in a June 2010 report, it is now possible to build solar fields without concrete foundations and extremely limited grading and leveling of land, allowing for vegetation in solar fields to co-exist with mirrors.[87] In the future, such technological advances may be needed in order to overcome the large land requirements for solar energy production.[88]

III. THE ECONOMICS OF SOLAR PRODUCTION

Production of PV has been growing rapidly in recent years.[89] Indeed, it is the world's fastest-growing energy technology.[90] With increasing demand, the costs for installing such systems have dropped.[91] Yet the unfortunate reality is that most PV systems are not economically viable at utility scale when compared with other low-cost fuel options. It costs Tucson Electric Power Company (TEP), for instance, 3 ½ to 4 ½ cents per kilowatt-hour for energy produced in its coal-fired plants; PV systems cost 16 to 18 ½ cents per kilowatt- ***106** hour.[92] Arizona Public Service (APS), Arizona's largest utility company, purchases power from the Palo Verde Nuclear Generating Station at a cost of 1.65 cents per kilowatt hour.[93] In contrast, under APS's recently completed purchase agreement with the nearby Solana Generation Station, a PV facility still under construction, APS will buy 53 megawatts of power yearly for a decade--at a cost of approximately 14 cents per kilowatt hour.[94]

CSP systems are potentially economically viable but, at this point, concrete data concerning costs remain unavailable as utility-scale CSP projects are still in the preproduction stages. Nathaniel Bullard, a solar analyst at Bloomberg New Energy Finance, has calculated that the cost of electricity at BrightSource's Ivanpah project, a massive CSP plant being constructed in the Southern California desert, will be "lower than photovoltaic power and about the same as natural gas. Of course no one knows for sure until the plant is built."[95] Thus, in all likelihood, without significant subsidies in the coming years--before technological advances can drive the cost discrepancies between solar and other forms of power down further--even CSP plants will prove difficult to make profitable.[96]

Nevertheless, thanks to the implementation of a number of renewable portfolio standards (RPS), a certain degree of state-level subsidization is taking place. State RPSs impose a government mandate that utilities generate or acquire a certain percentage of renewable power regardless of increased energy procurement costs to utility providers.[97] In most states, RPS goals can be achieved by any combination of solar, wind, biomass, landfill gas, ocean, geothermal, municipal solid waste, or hydroelectric, hydrogen, or fuel cell technologies.[98] California is the most aggressive of the American states in pushing for high renewable portfolio standards.[99] Utilities in California must generate, per legislation, 20 ***107** percent of their electrical supply from renewable sources in 2010.[100] By executive order, one-third of the state's electricity must come from renewables by year 2020--a major challenge for utility companies and a boon for solar energy producers.[101] Table 3 lists the RPS standards for Western states. Though other states' standards are less ambitious than California's, all states listed in this table have made a strong commitment to renewable energy.

TABLE 3: RPS STANDARDS FOR WESTERN STATES[102]

STATE	AMOUNT	YEAR	ORGANIZATION ADMINISTERING RPS
Arizona	15%	2025	Arizona Corporation Commission
California	33%	2020	California Air Resources Board[103]
Colorado	30%	2020	Colorado Public Utilities Commission[104]
Montana	15%	2015	Montana Public Service Commission
New Mexico	20%	2020	New Mexico Public Regulation Commission[105]
Nevada	25%	2025	Public Utilities Commission of Nevada
Oregon	25%	2025	Oregon Energy Office[106]
Washington	15%	2020	Washington Secretary of State

In the case of TEP, Arizona's RPS is plainly one of the reasons why TEP has been so aggressive in developing green alternatives to its coal-fired plants. In its 2010 Renewable Energy Standard and Tariff (REST) Implementation Plan, for example, TEP sought approval to purchase power from FRV Tucson Solar's proposed twenty megawatt PV solar ***108** plant and Renewable Fuel, LLC's proposed five megawatt CSP facility.[107] In addition, TEP is seeking to expand its PV facility in Springerville, Arizona by 1.8 megawatts in 2010 and to begin work on a 1.6 megawatt single-axis solar tracker located at Tucson International Airport.[108]

As exciting as these developments are for residents who support green technology, there are significant concerns with the likely cost of aggressive RPS plans. While solar companies certainly benefit from the pressing mandate for renewable energy, utility companies are left with the increased bill. Currently, consumers pay a small portion of this cost, approximately

three dollars a month in the case of TEP, and major federal tax breaks for building solar plants help account for the rest.[109] As end-date RPS goals approach, however, more of the additional costs will be passed to consumers, a contentious issue if there was ever one. As the *New York Times* recently reported:

> Even as many politicians, environmentalists and consumers want renewable energy and reduced dependence on fossil fuels, a growing number of projects are being canceled or delayed because governments are unwilling to add even small amounts to consumers' electricity bills.[110]

In addition to RPS plans, federal tax and treasury payment incentives have helped reduce the cost of solar energy as the federal government has introduced a number of programs in the last decade aimed at increasing the production of renewable energy.[111] In 2009, the American Recovery and Reinvestment Act granted a thirty percent tax credit for the installation of renewable systems.[112] However, new systems built after 2012 will be ineligible for this credit, and continuing incentives for pre-existing systems (e.g. credits for providing excess power to municipal grids) are set to expire in 2016.[113] A strong correlation between new solar projects and major tax incentives is intuitive, but the actual data are confounding. According to the U.S. Energy Information Administration, in 2009 and 2010, ***109** 38 solar projects began construction.[114] In the next two years, from 2011 to 2012, another eight projects are expected to begin.[115] In 2013, though, the Administration reports that *not a single new utility-scale solar project is slotted to begin*.[116] There are many projects on the drawing board as solar companies have entered numerous purchase power agreements with utilities but, as explained below, it remains unclear how many of the proposed plants will ever be built. Thus, uncertainty about future subsidies has created disincentives for new companies to enter the solar arena.

In June 2010, the Bureau of Land Management (BLM), stewards of much of the United States' public land, provided its own disincentive toward a cleaner energy future when it issued prospective rental rates for the use of BLM lands--areas that, theoretically, could be the most cost-effective for solar companies to utilize.[117] Based on regulations published by the National Agricultural Statistics Service (NASS), rental fees will involve both a base-rent, determined by right-of-way acreage, and a megawatt capacity fee, based on the type of project (PV, CSP, etc.).[118] The fees will vary county-by-county and, somewhat puzzlingly, are derived from the perceived agricultural value of proposed sites.[119] In Pima County, Arizona, for instance, where relatively little large-scale agriculture occurs, the base-rental fee for 2010 will be $15.70 per acre.[120] A few hours away in Yuma, Arizona, however, where a number of massive, Colorado River-irrigated industrial farms are located, the base-rental fee will be approximately twenty times as high, at $313.88 per acre.[121] BLM apparently chose to tie its rental rates to agriculture due to an assumption that solar plants will preclude any other use of the plant's site.[122]

As a further disincentive built into the announced rental fees, BLM has opted to charge different megawatt capacity fees for different types of solar projects. These will be: $5,256 per megawatt for photovoltaic (PV) solar projects; $6,570 per megawatt for ***110** concentrated solar power projects without storage capacity (parabolic trough, power tower and solar dish/engine); and $7,884 per megawatt for concentrated solar power projects with storage capacity of three hours or more.[123] The logic? According to BLM, "[t]he MW capacity fee captures the increased industrial use value of the authorization, above the limited rural/agricultural land value captured by the base rent."[124] Or, in other words, BLM will allow private developers to use federal land that, without private capital, innovation, and ingenuity would generate no revenues to BLM on the condition that BLM receive a large percentage of the increased worth of the land. Using different rates for the various types of projects reflects a belief that PV projects are less efficient than CSP projects and, as a result, they are deemed less valuable (their "capacity factor" is 20 percent, in the BLM's estimation, while CSP's is between 25-30 percent).[125] To developers, though, the message is clear: largescale PV projects, thanks to their inherent inefficiencies, will cost less in rent.

BLM's approach makes sense as a way to ensure an adequate return to the federal government and thus to protect the interests of taxpayers. However, from the perspective of encouraging solar projects on federal lands, which is what Congress mandated in the 2005 Energy Policy Act,[126] the rental standards are a deterrent to locating solar facilities on federal lands. Additionally, Section 1701(a)(9) of the Federal Land Policy Management Act--the Act generally controlling public land use in the United States--provides that "the United States receive fair market value of the use of the public lands and their resources ..."[127] Thus, from a legal perspective, charging differing rates for what is arguably the same "use of the public lands," generating solar power, is suspect.[128]

For a better understanding of BLM rental rates, it is helpful to apply them to one of the projects in Arizona that has been "fast-tracked" by BLM for development. The Sonoran Solar Energy Project will be located in Maricopa County and will require approximately 3,700 acres of land. According to the rental rates above, the acreage fee will be $696,858 a year.[129] In

addition, the Project--a CSP system involving a parabolic trough with thermal storage capacity--is expected to have a capacity of 375 megawatts. As a result, the megawatt capacity fee will be $2,956,500.[130] Thus, once fully operational, BLM fees alone will cost the ***111** Sonoran developers more than $3.5 million per year.[131] An alfalfa farmer, on the other hand, would pay less than $700,000 for rights to the same land! Obviously, the incentive structure here is problematic. If solar is ever going be a viable energy alternative, BLM is going to have to stop disincentivizing it and remove its own land valuation calculations from those appropriate for the agricultural industry or, at the least, treat farmers and solar power operators the same and abandon megawatt capacity fees.[132]

Solar companies, quite simply, face future difficulties without further subsidies and the removal of disincentives. Otherwise, our solar industry may well disappear, a situation that, until recently, seemed incomprehensible. Recent developments in Spain offer clues as to how such a relative doomsday scenario might occur. In June 2010, solar industry executives, after meeting with Deputy of Industry Minister Pedro Marin, announced that the government would refuse to honor prices set in a 2007 law that guaranteed fixed subsidies to companies that produce clean energy for twenty-five years.[133] This move will essentially cut the revenue of most of the country's PV plants by thirty percent.[134] In addition, the government has announced its intentions to significantly reduce future subsidies on solar projects that have yet to be built, virtually guaranteeing that solar projects will no longer be a viable part of the Spanish economy.[135] Industry executives, having invested more than $22 billion in solar projects in the last three years, are understandably irate. As Tomas Diaz, director of external relations at the Photovoltaic Industry Association in Madrid, put it: "It's incomprehensible that the government is doing this. We feel cheated."[136] Diaz estimated that the decision would induce bankruptcy proceedings for most of Spain's 600 PV operators.[137]

IV. THE PERMITTING PROCESS

In the Energy Policy Act of 2005,[138] Congress instructed the Department of Interior and Department of Energy to collaborate in order to place at least 10,000 megawatts of non-hydroelectric renewable energy on federal land.[139] The act has set off a frantic land-grab as solar and wind energy companies have rushed to obtain permits for projects in Arizona, ***112** California, Colorado, Nevada, New Mexico and Utah.[140] In Arizona alone, BLM has received thirty-two solar energy applications that would encompass approximately 466,565 acres of public land.[141] Nothing in the act, however, has changed the arduous permitting process that companies must navigate in order to break ground on public land.[142] Currently, 585 megawatts of utility-scale solar power are operational--all of which are on private land.[143] At the end of the 2009 fiscal year, oil, gas, and geothermal companies had received 31,133 leases for 27,800,932 acres of BLM-managed land--with 1,927 new leases issued in 2009--while solar had received zero permits.[144] Though fourteen utility-scale solar projects ***113** were within striking distance of receiving BLM permits in 2010, only eight had been permitted as of November 2010.[145]

The permitting process is both time and cost intensive; one commentator has noted that preparing a single Environmental Impact Statement (EIS) can cost millions of dollars and take up to twelve years.[146] Additionally, a coalition of government agencies, including the National Park Service and the Fish and Wildlife Service, and environmental organizations, including the National Resources Defense Council, have urged that solar plants be located on disturbed lands, or lands that have already had significant use and where prior activities have ceased.[147] Abandoned mines, developed oil and gas fields, fallowed agricultural lands, brownfields,[148] former landfills, and inactive gravel pits illustrate the kinds of lands that would be desirable to use for solar projects. In response to the concerns of environmental groups worried about land impact and businesses fretting over the cost and length of the permitting process, BLM has:

- Removed from consideration sensitive lands, such as wilderness areas and other lands with high conservation values;[149]

- Identified twenty-four Solar Energy Study Areas, where it seems most sensible to consider locating solar power plants;[150]

- Embarked on a solar Programmatic Environmental Impact Statement (PEIS), aimed at addressing broad issues of policy in connection with all applications for solar plants on federal lands. It is then hoped that, in the future, the PEIS will enable developers to undergo a less time-consuming permit process as they will already have a model to work from.[151]

Consistent with these actions, BLM's Restoration Design Energy Project is attempting to identify disturbed or previously developed sites in Arizona.[152] In concept, this ***114** is a great idea. In execution, the reality is somewhat different. After two years of trying to identify such lands, BLM has come up with fifty-nine potential "wastelands" totaling 156,366 acres.[153] This sounds impressive, but in fact, only 25,360 acres of land on these proposed sites are managed by the BLM--just a tiny fraction of the 466,565 acres of land associated with the thirty-two pending solar power plant applications in Arizona.[154]

Despite setbacks, BLM has received high praise from the business community *and* the environmental community. Yet, the jury is out as to how successful the PEIS will be in reducing the time between application and construction. Various factors have delayed the release date of the draft PEIS until late 2010, which in turn will push back the release of the final PEIS until 2011 or 2012. The PEIS will identify in advance particular areas that are likely candidates for solar projects, but that general conclusion is not going to satisfy the obligation of BLM to do an individual EIS with all of the attendant consultations with the Fish and Wildlife Service and other requirements under the National Environmental Policy Act (NEPA).[155] A cynic might suggest that what the PEIS will have accomplished is to say: "Here is some land where maybe we will let you build." Moreover, even after applicants successfully survive the EIS process, they will then need to secure approval from state public utility commissions, something that can easily add another year to a project start-date.[156]

This process does not allow for the kind of swift and definitive decisionmaking that the business community needs in a world where the time-value of money is critical and where many solar companies are thinly capitalized. In 2009, one California solar outfit, Ausra, for instance, abandoned plans for its Carrizo Energy Solar Farm as the permitting process continued to stall.[157] Even more recently, Tessera Solar North America backed out of a planned partnership with the city of Phoenix to build a 250-megawatt power plant on a city-owned landfill.[158] Peter Wilt, Tessera's senior director of development, explained that Arizona's utility companies have shown greater interest in smaller projects more likely to ***115** receive fast-track status for permits.[159] "We're not getting a whole lot of traction on the market," Wilt said.[160] Smaller companies have faced similar problems including Boulder, Colorado's Simple Solar, which filed for Chapter 11 bankruptcy in May 2010[161] and New Jersey-based EPV Solar, which filled out Chapter 11 paperwork in February 2010.[162]

In early 2010, in an attempt to deal with these delays, Secretary of the Interior Ken Salazar announced plans for BLM to "fast-track" certain solar projects.[163] In April 2010, BLM released its draft EIS for the Sonoran Solar Energy Project, in Maricopa County, Arizona, a CSP trough project that would use 4,000 acres and generate 375 megawatts of power.[164] This draft EIS could serve as a guide for future EISs and is thus a matter of considerable importance. As the preferred alternative in the draft EIS, BLM would permit the company to have a wet-cooled solar thermal project.[165] BLM considered a dry-cooled system, but rejected it, in part, because the water is available and an analysis of the water needs of the project, between 2,300 and 3,000 acre-feet per year, would not result in a substantial drop in the water table or adverse impacts on adjacent groundwater wells.[166] This may seem controversial or even absurd, given that the project is in the desert west of Phoenix, but with the particular hydrogeology of the site near the Gila River, there is substantial groundwater available.[167] Thus, it would be premature to read into this draft EIS the assumption that BLM will be as sanguine when it comes to wet-cooled projects in other areas that do not have the same access to substantial quantities of groundwater.

The draft EIS also rejected as an alternative a utility-scale photovoltaic system, in part because no PV system on this scale has ever been constructed anywhere in the world. Here, BLM laid emphasis on the problem of PV not being dispatchable (i.e. able to be stored). The draft EIS also rejected alternative solar technologies, including Stirling engines and power towers because, according to BLM, they are development-stage options.[168] Despite this (or possibly due to rapid advancements in technology), APS included a proposal in its 2010 Renewable Energy Standard and Tariff (REST) Implementation Plan to include ***116** Stirling technology within the Arizona Corporation Commission's (ACC) approved definitions of renewable technologies available for tax incentives.[169] The ACC approved the plan[170] indicating, hopefully, that BLM may soon change its tune concerning these technologies.

A final (though major) problem with the permitting process is the issue of transmission line right-of-ways.[171] The nation's transmission grid is woefully outdated for the energy needs of the 21st Century.[172] What the solar industry needs, though, is not long-term resolution of the transmission grid problem, but upgrading of certain smaller-length segments that will allow particular projects to come on-line promptly.[173] But it is a thorny problem for BLM to figure out how to allocate right-of-way permits. In addition, the permitting, construction, and maintenance of transmission lines creates additional cost burdens that will likely be passed to consumers. The California Public Utilities Commission has estimated, for instance, that seven new major transmission lines will need to be built, at a cost of $12 billion, for the state to meet its 2020 RPS goal.[174] The likelihood that such enormous costs will not affect utility rates seems, at best, far-fetched.

V. ENVIRONMENTAL AND POLITICAL OBJECTIONS

The environmental community, for years, has invested its political capital, as well as enormous sums of money, in trying to obtain climate change legislation and incentives for renewable energy. Every environmental organization supports the idea of utility-scale solar projects. But the consensus breaks down when specific sites are proposed for solar plants. The idea of solar plants seems to be more appealing than the reality. BrightSource Energy, for instance, found its Ivanpah CSP project being resisted by the very environmental groups that had previously proclaimed their support for renewable power facilities.[175] In this process, some national environmental organizations are at loggerheads with local chapters.[176]

***117** The National Park Service is also concerned with the visual blight that will be created by incredibly tall solar towers; BrightSource Energy's towers, for instance, could range anywhere from 400 to 800 feet in height. The scale of several solar projects, as big as six square miles, is also a problem.[177] The Park Service is also worried about the cumulative impact of multiple projects on the value and resources of the parks and monuments under its jurisdiction.[178]

The environmental community has reacted with equal alarm to proposals for large numbers of wet-cooled CSP plants in the Southwestern deserts. Even modest amounts of groundwater pumping could dry up rare and critical seeps and springs, thus threatening endangered species.[179] Environmental groups have criticized virtually every proposal for solar power plants due to their impact on federal land, which--in addition to concerns over scarce water[180]--will be graded flat and sterilized in many cases.[181]

To gauge how difficult it is to site a solar project on federal land, considering BrightSource Energy's Ivanpah project is useful. The company thought it had found the perfect site: it is adjacent to Interstate 15, across the highway from a natural gas power plant, next to a thirty-six-hole golf course, and five miles from a major casino and an outlet mall.[182] The land itself has been used for decades for grazing and off-road vehicles, and a dozen eight- to twelve-foot wide trails criss-cross the site.[183] A transmission corridor containing two high-voltage network lines bisects the site. The site does not contain any Desert Wildlife Management Areas (DWMA), Areas of Critical Environmental Concern (ACEC), Wildlife Habitat Management Areas (WHMA), or any other designated critical habitat.[184]

The Ivanpah site has no endangered species, but a survey documented seventeen desert tortoises--a threatened species.[185] The BLM has classified the area as Category 3 ("least important") habitat for the desert tortoise. The site averages fewer than four tortoises per square mile. "Typical" habitat contains from ten to twenty tortoises and high-quality ***118** habitat has 250 tortoises per square mile.[186] In the Ivanpah Valley, more than 630,000 acres are already designated as critical habitat for the tortoise.[187]

In the EIS process, the Center for Biological Diversity (CBD), the local chapter of the Sierra Club, and Defenders of Wildlife (as well as other groups) intervened to express concerns about the Ivanpah proposal.[188] In response, BrightSource Energy reduced the site's footprint by twelve percent in order to omit an area that the environmental organizations considered valuable tortoise habitat.[189] This action also reduced the site's generating capacity from 440 megawatts to 392 megawatts. That loss of forty-eight megawatts represents more than one-quarter of all the PV installed in California in 2009.[190] In July 2010, the California Energy Commission (CEC) staff report proposed a mitigation plan that BrightSource has endorsed that will relocate the tortoises, monitor them, and fence off the relocation area from predators.[191] The CEC plan will require the company to spend more than $20 million on this relocation effort.[192] The BLM's Supplemental Draft EIS endorsed this downsized project, but CBD still considerd the project unacceptable.[193]

***119** The final decision on the Ivanpah project came from the BLM in October 2010.[194] SCE and PG&E have signed purchase power agreements (PPA) to take the electricity generated at Ivanpah.[195] In October 2010, BrightSource broke ground on the project just before the expiration of ARRA payments (in lieu of tax credits) for construction.[196] Five other BLM projects in California--most notably Solar Millennium's Blythe Solar Power Project, a parabolic trough project with 1,000 megawatts of rated capacity, and Tessera Solar's Imperial Valley Project, a Stirling dish project with 709 megawatts of rated capacity--received final BLM approval in October and November of 2010 as well.[197] These approvals (along with the approval of NextLight's Silver State North project and Amargosa's Farm Road Solar Project in Nevada[198]) represent the first utility-scale solar projects that have ever been approved on public lands. These projects, in the aggregate, will have a rated capacity of approximately 3,500 megawatts of power upon completion[199] and seemingly represent a fundamental shift in the

BLM's commitment to approving renewable energy projects on public land--a change that should be applauded.[200] Important to note, though, is that all eight of these projects had completed their Final EISs by September 2010.[201] Of the other six projects "fast-tracked" by the BLM, only one has thus far completed its Final EISs: the Silver State South project in Nevada with a rated capacity of 267 megawatts.[202] While it seems likely that this project will receive approval before year's end, thereby being eligible for Stimulus money, the other five fast-track projects may be in trouble. And Arizona, ***120** despite hoping to be a national leader in solar power, does not yet have any of its thirty-two projects proposed on public lands at the Final EIS stage, including the fast-tracked Sonoran Solar Project.[203] After losing out on the $10 billion earmarked in the Stimulus for renewable energy projects,[204] it will be interesting to see how many of these projects continue with their plans to move forward.

Economic and permitting concerns aside, the issue of transmission lines also creates interstate conflicts and resistance from the environmental community. For example, the Audubon Society is concerned about a proposed SunZia Southwest Transmission Project designed to carry power over two 500-kilovolt (kv) lines from central New Mexico to Phoenix, Arizona and eventually to Southern California.[205] The proposed route would be through the lower San Pedro River Valley, an area designated "an Important Bird Area of Local Significance."[206] The project is enormous in scale. It would involve constructing as many as 300 sixteen-story towers that would run the length of the valley with an access easement up to 1,000 feet wide, and access roads to each of the 300 towers.[207] To put this in perspective, this is nearly ten times as many sixteen-story structures that currently exist in Arizona. The planners of SunZia have requested a one-mile-wide corridor from BLM for future expansion. Given the scale of this project, it is easy to understand the Audubon Society's concern for an area that is home to more than 400 bird species, and is one of the most important north-south migratory bird flyways in North America.[208]

Still, to the engineers and managers of solar power companies like BrightSource, who ardently believe they are changing the world by producing carbon-free electricity, it is naturally frustrating to have the environmental community oppose their specific sites. As *Newsweek* recently reported, the classic acronym for resistance to older power producing technologies such as coal and nuclear, NIMBY (Not In My Backyard), has been replaced among frustrated renewable energy developers with a newer one: BANANA (Build Absolutely Nothing Anywhere Near Anyone).[209] Speaking at Yale University in 2008, Governor Arnold Schwarzenegger expressed his concern over this mentality: "They say that we want renewable energy, but we don't want you to put it anywhere. I mean, if we cannot put solar power plants in the Mojave Desert, I don't know where the hell we can put them."[210]

***121** The Governor's comments were in response to environmental organizations' complaints about proposed solar projects in the Mojave Desert.[211] These groups range from relatively obscure ones, such as the Center for Community Action and Environmental Justice, to big-hitters such as the Sierra Club's California/Nevada Desert Committee. Terry Frewin, the committee's chairman, has criticized the Sierra Club's national leadership for its tacit support of large-scale solar projects, recently admonishing that "[r]emote solar arrays destroy all native resources on site, and have indirect and irreversible impacts on surrounding wildernesses ..."[212] In response, Carl Zichella, then-western renewable projects director for the Sierra Club, said "We don't take a back seat to anyone in caring for the desert."[213] The Club, however, did not withdraw its support for the project. Thus, on the national level, the Sierra Club's support for solar projects remains unchanged.[214]

At the most basic level, *all* undisturbed land is habitat for some species. But not all habitat is equally valuable for the protection of critical species. Unfortunately, objective criteria do not exist for determining the size or locations of tracts of public land that should be sacrificed for solar projects.

In December 2009, the issue of the Mojave Desert was again catapulted to national significance as Senator Dianne Feinstein (D-CA) introduced the California Desert Protection Act of 2010 (S.2921).[215] Although still in Committee, if passed the bill would essentially carve out another 1.7 million acres of public land for protection. Not surprisingly, based on previous reactions to large-scale solar projects, thirteen environmental groups (from the Death Valley Conservancy to The Wilderness Society) and the cities of Barstow, Desert Hot Springs, Hesperia, Indio, Palm Springs, San Bernardino and Yucaipa immediately expressed their support for the legislation.[216] But it is also worth noting that some solar companies, like Abengoa Solar, and major utility companies, have expressed support for the bill as well.

Edison International, the parent company of Southern California Edison, which provides power to 13 million Californians, recently expressed support for S.2921 and sent its ***122** Executive Vice President for Power Operations, Pedro Pizarro, to testify before the Senate Committee on Natural Energy and Resources. Pizarro stated that "when projects impact federally protected species or their habitat, the process for permitting renewable energy development on public lands is significantly

slower than projects proposed on private lands, taking years instead of months. The bill addresses this inequity by allowing projects on public lands to mitigate environmental impacts by providing funding to help purchase or rehabilitate additional BLM lands."[217]

Addressing these concerns, Senator Feinstein recently noted:

> [T]he federal renewable energy permitting system [is] broken. Until recently, the BLM process has operated on a first-come, first-serve basis. And it didn't distinguish between a viable project and a speculative one. In fact, over the past five years, more than 100 applications have been submitted to build utility-scale renewable energy projects on public lands--and not a single project has received a permit. Under this status quo, no one wins.[218]

In the proposed bill, Feinstein has called for streamlining the BLM permitting process and for requiring the Forest Service and the Department of Defense to research the possibility of locating solar projects on lands under their control. Whether these additions will successfully combat the "NIMBY/BANANA" effect is hard to predict but, at the moment, the proposal is generating substantial support, even from BLM.[219] Regardless of what happens, though, something must change for the United States to become serious about developing utility-scale solar projects.

The solar energy industry is also being buffeted by other political factors. Senator Jon Kyl (R-AZ), a former water lawyer in Arizona, has no interest in seeing Arizona's scarce water resources used for power plants, when much of the power generated in these plants would be exported to California. In May 2010, Senator Kyl's office issued a report, "Deploying Solar Power in the State of Arizona: A Brief Overview of the Solar-Water Nexus."[220] To Senator Kyl, "placing additional demands on Arizona's water supply in order to export 'renewable energy' to other states that have greater energy demands is ***123** unsustainable."[221] Yet, the policy recommendations of Senator Kyl's report simply ask BLM to insist that all environmental impact statements for solar projects that would use wet-cooling include an analysis of an alternative that conserves water.[222] But, of course, that is exactly what BLM did with the draft environmental impact statement of the Sonoran Solar Energy Project--which ended up favoring a wet-cooled option.

We would go further. BLM should have a heavy presumption against allowing wet-cooling technologies on public lands. As the process moves forward, BLM should insist that CSP plants embrace dry-cooling. Or, if they want to use wet-cooling, they should be required to use reclaimed water from municipal treatment plants. In Arizona, this is already being done at the Palo Verde Nuclear Station, a thermal nuclear generating plant, which uses reclaimed water from the city of Phoenix.[223] What BLM should not do is to permit new wet-cooled CSP plants that would require drilling new groundwater wells in the Mojave Desert.

V. SO, WHAT SHOULD WE DO?

The response from the environmental community to proposed plants on federal lands has ranged from being apprehensive (because they like the idea of renewable projects, but will not sign on until they see the whole process played out) to total opposition by some organizations, such as the Center for Biological Diversity (CBD) and the Alliance for Responsible Energy Policy. To CBD, the problem is site selection.[224] It feels that it would be far better to put PV on flat roofs in urban environments than to disturb intact desert habitat. Locating projects in proximity to end-users avoids the need for new transmission corridors and the efficiency loss present with long-distance power lines.[225]

Given the problems faced by CSP in terms of water use, transmission lines, and land footprint, it seems painfully obvious to many people, like those at CBD, that the nation's best solution for renewable solar is a massive system of photovoltaic cells located on rooftops in urban areas. Just imagine if every Costco, Sam's Club, Wal-Mart, and parking structure had PV systems on their roofs! Currently, Southern California Edison (SCE) has plans to do just that. In March 2010, SCE announced plans to purchase enough photovoltaic panels to generate 200 megawatts of solar power on otherwise unused warehouse rooftops.[226]

***124** Advantages to PV systems include its flexibility: they can be developed on rooftops in small-scale distributed power systems, or as large-scale central power plants. Disturbed lands are appropriate for PV systems, allowing for their installation with minimal impact on the existing environment. And, locating them in urban areas eliminates the transmission line problem. Additionally, rooftop solar is becoming more popular and has been encouraged by tax credits at the state level. In

Massachusetts, for instance, homeowners can receive a credit of fifteen percent for the cost and installation of a PV system (up to $1,000) against their state income taxes.[227] Hawaii is even more generous providing for a credit of up to thirty-five percent of the purchase and installation price of installing PV (up to $5,000).[228] In 2009, California's Solar Rooftops program was so generous that it basically gave away the panels, and resulted in the installation of 168 megawatts of PV power capacity.[229] Some utilities have even gone so far as to team up with municipalities to provide the benefits of solar with no capital investment on the part of their customers/residents.[230] APS, for instance, will soon launch its Flagstaff Community Power Project that will combine "distributed energy" technology with a "smart" distribution system at no additional cost to Flagstaff residences.[231]

Due to certain drawbacks, PV systems will be part of the solution but not a miracle cure for our energy problems. First, even with tax incentives, PV is expensive.[232] Second, the energy industry prefers large-scale projects over distributed power systems. Overcoming this entrenched preference will not be easy. Some utilities, such as Tucson Electric Power, seem to have made the transition seamlessly, driven by the need to satisfy RPS requirements. Many companies, though, have not.[233] Third, there is a reason why utilities have this preference: the logistics of siting PV systems on rooftops in urban areas are a headache. Must the utility rent the space? Buy the space? Who will install the system? How will it be operated and maintained? These considerations deter utilities from entering into ***125** innumerable contracts or other arrangements with existing landowners of flat roofs. A fourth drawback with PV systems is the inability to generate energy when the sun is not shining.[234] A fifth drawback, and perhaps the Achilles' heel of utility-scale PV systems as a silver-bullet solution to our energy problem, is its extremely large land footprint as discussed in Part II(B).

In short, roof-top PV is not the cure-all solution to our energy needs. It will be very difficult for roof-top PV to reduce significantly our reliance on fossil-fuel based electricity. Notwithstanding these limitations, PV should play an important part in renewable energy development as we move forward. It avoids both transmission line problems and a fight over siting systems on delicate and untouched lands. We should encourage utilities, businesses and homeowners to install PV systems by ensuring that the level of subsidies and incentives are adequate to encourage the requisite level of installation.

Although roof-top solar may not provide a complete solution to our energy crisis, some groups, like CBD, also advocate taking a fresh look at energy conservation.[235] Of course it makes sense to save energy, but conservation will not reduce current consumption enough to offset the predicted future demand for power.[236] Thus, other forms of renewable energy, especially CSP projects, will be needed to meet our energy needs.

How much land is necessary for solar and wind projects depends on the objective. If the goal is to meet the RPS standards for the electricity of a single state, say California (thirty-three percent), the numbers can be quite high. Based on 2008 retail consumption statistics, for California to achieve its RPS goal with a mixture of one-third wind, one-third PV, and one-third CSP, would require 656,357 acres of land, or approximately 1,025 square miles; this in a state where BrightSource's 3,600 acre Ivanpah project has been controversial.[237] That project's footprint is a mere 5.6 square miles, yet California would ***126** need to find at least 270 square miles for renewable CSP projects alone--the most efficient land-user of renewable technologies--in order to satisfy its RPS standards. Of course, if the objective of establishing renewable energy projects is to address the problem of climate change on a global scale (for example, by reducing the atmospheric concentration of CO_2 to 450 parts per million) the land needs are much, much greater.

It will be extremely challenging to find enough land on which to site projects able to generate enough solar power to end American reliance on traditional power sources such as fossil fuels. As is shown by Table 4, in 2008, for instance, 4,119,000 thousand megawatt hours of electrical power were generated in the U.S.[238] The "big four" of electricity production--coal,[239] natural gas,[240] nuclear[241] and conventional hydroelectric power[242] - accounted for 3,929,821 thousand megawatt hours, or more than 95 percent, of this power. In contrast, CSP and PV systems combined accounted for only 864 thousand megawatt hours of electricity - less than .02 percent of America's electricity needs.[243] Thus, just to replace the amount of megawatt hours of electricity currently generated by coal plants, we would need 2,300 times more power generated by solar plants.

In addition to concerns over land use, utility-scale solar power presents problems with "capacity factor"-- the measure of how much power a project is *capable* of instantaneously producing versus how much power it *actually* produces over a set period of time. For example, when a new solar project is proposed that is said to produce 450 megawatts of power, what is really meant is that, if operating with perfect efficiency under ideal conditions, the plant instantaneously produces 450 megawatts of power.[244] If we add time to the equation--and are still operating at full capacity with perfect efficiency--this plant would produce 450 megawatt hours of power every hour. In a given year, then, assuming the plant will run at full capacity, around

the clock, and without interruption, it would produce 3,942,000 megawatt hours of electricity.[245] Due to efficiency problems, deadweight loss from limited storage potential and technological inadequacies, and intermittency problems resulting from darkness and inclement weather, solar power plants generally have a capacity factor (the ratio of average production to rated capability) of twenty to thirty percent.[246]

***127** In 2008, the Energy Information Administration estimated that solar power projects had 536 megawatts of rated capacity.[247] If operating with perfect efficiency, these plants would have produced 4,695,360 megawatt hours of electricity. Instead, they produced 864,000 megawatt hours, meaning, on the whole, the average capacity factor for solar turned out to be about 18.4 percent.[248] By contrast, the average capacity factor for nuclear power plants in the same time period was about 91.34 percent.[249] Thus, it is important to be wary of assuming that "megawatts" and "megawatt hours" are synonymous and, further, of failing to address capacity factor when thinking about increases in utility-scale solar. Megawatt hours give a better picture of where solar currently stands and, further, how far it will have to go to make an impact on energy needs. Table 4 helps illustrate these concerns.

TABLE 4: POWER GENERATION IN 2008 BY ENERGY SOURCE[250]

TECHNOLOGY	NET ELECTRICITY GENERATION (THOUSAND MEGAWATT HOURS)
Coal	1,985,801
Petroleum	46,243
Natural Gas	882,981
Other Gases	11,707
Nuclear	806,208
Hydroelectric Conventional	254,831
Other Renewables	126,212
Wind	55,363
Solar Thermal and Photovoltaic	864
Wood and Wood Derived Fuels	37,300
Geothermal	14,951
Other Biomass	17,734
Pumped Storage	-6,288
Other	11,692
All Energy Sources Total	**4,119,388**

In light of concerns over land use, siting solar plants on already disturbed, private agricultural land is one solution and provides a valuable avenue for reallocating land and water resources from an economically low-value activity to a higher-value one. Solar companies can, and should, purchase land and water rights from the private sector and locate wet-cooled CSP plants on private lands. In recent years, Arizona Public Service Company, the largest electric utility in Arizona, has partnered with solar power companies to ***128** build two large-scale CSP projects on private land.[251] The land for the Solana Generating Station currently under construction, for instance, involves utilizing more than three square miles of land that had previously been used to grow alfalfa.[252] The plant is expected to require 75% less water than was needed for agricultural uses.[253] This reallocation of water--from farming to power generation--offers a lesson for the country as a whole.[254] As the United States confronts inevitable water shortages, we need to insist that power companies, developers, and other water users offset the impact of their new uses by persuading existing water consumers to use less. This makes a great deal more sense than drilling new groundwater wells on sensitive federal lands.

Not only will wet-cooled CSP plants use less water than the farms, but the revenues generated from energy production will be many times that generated by farming. A recent study for the San Diego region found that farms in the Imperial Irrigation District that grow alfalfa use four times as much water as would a CSP power plant, and produce alfalfa that retails for about $600-900 per year per acre. The gross income of a 100-megawatt solar plant, at ten cents per kilowatt, is approximately $42,000 per year per acre.[255] Making the situation worse, alfalfa is grown year-round in the Imperial Valley, including during the summer when air temperatures often reach 115 degrees. Alfalfa grown under such hot conditions has little nutritional value, and consequently generates even less income for the farmer.[256]

The message to solar companies and to electric power utilities looking to satisfy RPS rules is that it is better to locate projects, as Arizona Public Service Company has, on private land involving the reallocation of both the land and water. This process is easier, faster, and cheaper in the long-run for the companies and the utilities. In addition, using fallowed agricultural land is less likely to generate resistance from environmental groups.[257]

A recent example comes from California‘s Westlands Water District, one of the largest irrigation districts in the United States. Years of irrigation have caused salt and selenium buildups that have led the federal government to request that up to 200,000 acres ***129** of farmland in the district be fallowed.[258] A 2010 proposal for a Westlands Solar Park would dedicate 30,000 previously-irrigated acres for an enormous solar project, which would eventually have a generating capacity of 5,000 megawatts--easily the largest solar project in the United States.[259] To put this in perspective, the landmass involved is about forty-seven square miles--comparable to a city the size of Anaheim or San Francisco.[260] Despite Westland‘s proposed size, many farmers in the region are supportive of the proposal because the fallowed land would reduce water demand in the already water-strapped region thereby assuring better water distribution among active farms.[261]

Another proposal by the Los Angeles Department of Water and Power would locate a 5,000 megawatt facility on the dry bed of Owens Lake.[262] And a third proposal comes from the Cadiz Real Estate company which is considering converting more than 10,000 acres of Mojave Desert farmland into a solar plant.[263] Each of these projects is in the early stages of development, yet they illustrate a viable alternative to siting projects on public lands.

The California Energy Commission reports that in 2009, solar power accounted for 0.4% of California’s energy production.[264] If California is ever going to reach its lofty RPS goals, it must find an additional 21,000 megawatts of rated capacity for renewable energy.[265] For solar to play a significant role in this process, though, a major amount of construction of solar plants must occur on public lands. Although the CEC approved nearly 3543 megawatts of rated solar capacity for large-scale projects in 2010, the Commission only has another 962 megawatts of solar capacity for large-scale projects under review.[266] This tiny backlog is worrisome.

***130** Native American lands present another interesting possibility for siting solar projects. Keith Harper, a member of the Obama-Biden transition team, has stated that “Obama‘s top energy priorities ... will be difficult to accomplish without closer partnerships with the country‘s 562 federally recognized tribal communities.”[267] Also recognizing this reality, Congressman Raul Grijalva (D-AZ), in a 2007 hearing before the House Committee on Ways and Means, estimated the solar power potential of tribal lands to be about 4.5 times the annual electricity needs of the United States.[268] Although his estimate seems quite optimistic in light of the large footprint of solar projects, his sentiment is on point and highlights the fact that tribal lands are a potentially untapped resource for solar projects. From the perspective of solar land requirements, it is worth noting that nearly thirty-five percent of the State of Arizona consists of tribal lands.[269] Some of these reservations are located

near the thirty-two projects proposed on BLM-managed land that investors have already expressed an interest in.[270] Moreover, tribal lands may present far fewer hurdles to overcome in successfully implementing solar projects than BLM lands.

First, as part of the Energy Policy Act of 2005, federal agencies were granted authority to institute preferential purchase agreements for any "energy product" or "energy byproduct" produced by business entities that are majority-owned by an Indian tribe.[271] The Act was "intended to provide support to tribal governments in the development of energy resources on Indian lands, ... to provide incentives for partnership with tribes that want to develop their resources[,]"[272] and to "authorize individual Indians and tribal governments to enter into energy development leases or business agreements *without Federal review* ...."[273]***131** Thus, under certain scenarios, it is possible that solar projects on tribal land could be implemented and acted upon without the need for the costly and time-intensive NEPA review that has hindered so many solar proposals.[274]

Second, unlike the NIMBY phenomenon witnessed in many communities where solar projects have been proposed, a number of tribes have already expressed interest in developing solar projects. For instance, Chief Gordon Plains of the T'Sou-ke Nation in British Columbia, Canada has said:

> It's good to be a part of using the gifts that the creator gave us in helping us to take care of Mother Earth. It is now appropriate that First Nations take the lead in demonstrating how to live without fossil fuels once again.[275]

Two-time Green Party vice-presidential nominee and famed environmental and Native American activist, Winona LaDuke, has become a major advocate for tribal solar development in recent years. "Honor the Earth", an organization founded by LaDuke, has devoted two recent publications to precisely this issue.[276] Previous energy-related projects on tribal lands, it should be noted, have often been seen as disastrous. As reporter Phil Taylor has observed: "tribes are consistently shortchanged in the deals, earning pennies on every dollar that goes to the mining firms and electric utilities whose operations are fully dependent upon the reservations ... 90 percent of what tribes pay for their energy leaves the reservation."[277] Still, a number of tribal leaders believe that, with the right training and support, tribally-owned solar projects could "change the energy paradigm in Native communities from one of exploitation to one of equity ...."[278]

In Arizona, even the Navajo Nation - home to a number of the West's most productive coal mining operations - has begun to contemplate a shift toward renewable ***132** energies such as solar. The most recent Navajo presidential election featured, for the first time ever, an environmentalist on the presidential ticket.[279] Earl Tulley, Vice-Presidential candidate and founder of Diné Citizens Against Ruining Our Environment, recently stated "At some point we have to wean ourselves [from coal] ... We need to look at the bigger picture of sustainable development."[280] With the EPA cracking down on nitrogen oxide emissions from Navajo coal plants - and two coal mines having shut down in the last five years - more and more Navajo have begun to agree with Tulley and, recently, the Navajo Green Economy Commission was established by the tribal council to promote environmentally friendly ventures.[281]

Third, siting solar projects on tribal land will not magically alleviate the energy-water nexus issues previously discussed--especially if these projects employ wet-cooled CSP rather than PV technology. Nevertheless, tribes may enjoy an advantage in this respect as well. In 1908, the United States Supreme Court decided a pivotal case in the history of tribal lands, *Winters v. United States*.[282] The case involved the 1888 establishment of the Fort Belknap Reservation in Montana and addressed whether the Gros Ventre and Assiniboine tribes had relinquished their water rights to the land when they relinquished control of it (purportedly to shift from a nomadic to agrarian way of life) to the federal government.[283] In oft-cited language, Justice McKenna, writing for the majority of the Court, determined that they did not, stating:

> [I]t would be extreme to believe that ... Congress destroyed the reservation and took from the Indians the consideration of their grant, leaving them a barren waste--took from them the means of continuing their old habits, yet did not leave them the power to change to new ones.[284]

Since then, tribal water rights have often been referred to as "Winters rights." And, although tribes have often come upon a daunting chasm separating their legal rights to water (the "Winters rights") and the actual water itself ("wet water" is, sadly, actually employed to point out this distinction), courts have recently begun following through on the promise that the *Winters* decision presented over a century ago. In the seemingly endless battle over Colorado River water, for instance, the U.S. Supreme Court has remained steadfast in determining that approximately 950,000 acre-feet of the 7.5 million acre-feet of mainstream Colorado water allotted to Arizona, Colorado, and Nevada should go to the Chemehuevi, Cocopah, Fort Yuma, Fort Mojave, and Colorado River Indian Reservations.[285] Nominally ***133** for "irrigable" use, there is some indication in the

decision that tribes could, alternatively, utilize this water for energy production[286] - a far more profitable endeavor.

Finally, although few large-scale solar projects have broken ground on tribal lands, that may soon change. In February 2009, one of the country's least populous tribes, the Augustine Band of Cahuilla Indians in California, began operating a 15,000 panel PV system on its land that is expected to produce up to 1.1 megawatts of power annually.[287] As Michael Lombardi, Augustine Casino gaming commissioner, noted "[w]e've thrown a pebble in the pond that I'm sure will ripple across Indian Country."[288] With the ARRA recently allotting $54.8 million to tribes for "energy efficiency improvements in Indian Country,"[289] we can only hope the ripple spreads far.

Still, as is seemingly true with all solar projects, there are problems that need to be addressed. For one, like a lot of BLM managed land, a number of reservations are remote, a situation that raises the problem of constructing new transmission lines. Additionally, there are major incentive issues that have kept private backers hesitant about throwing in with tribes rather than BLM. Because tribes, pursuant to the IRS Tax Code of 1986, are taxexempt entities, they are ineligible for the 2.1 cent per kilowatt-hour tax benefit (for the first ten years of a facility's operation) guaranteed by the ARRA[290] that has lured a number of private companies into the solar sector. For so-called "casino-rich" tribes able to build their own solar facilities, this does not present a problem because their tribal revenue is taxexempt and, as a result, tax incentives are a moot point. For other tribes who would like to partner with private firms, the problem arises because companies pairing with tribes only receive 50 percent of the credit, rather than the full 100 percent they would receive by investing on state land. Rep. Grijalva has noted that "[t]his situation puts tribes at a ***134** tremendous disadvantage when trying to attract renewable energy projects to their lands"[291] and has introduced a bill, the Fair Allocation of Internal Revenue Credit for Renewable Electricity Distribution by Indian Tribes Act, to combat the problem.[292] Whether the Grijalva bill passes or not, the message concerning solar projects on tribal lands is clear: given the right incentive structure, these projects could be a successful component in moving toward a more sustainable future.

VI. CONCLUSION

The current controversy, raised by Senator Kyl, over exporting electricity to California has rekindled some of the historic tensions among Western states over the Colorado River and water use more generally. California has been at the cutting edge of *setting* aggressive renewable portfolio standards, but, until very recently, it has acted much more slowly in actually *granting* permits for building renewable power plants in California. Further, California has made it very difficult for solar plants to use wet-cooling technology, seemingly without regard to whether adequate water resources may be available. The California Energy Commission will approve the use of cooling techniques only if alternative water supplies and alternative cooling technologies prove to be "environmentally undesirable" or "economically unsound."[293] If Senator Feinstein's proposed California Desert Protection Act of 2010 passes, the likelihood of future utility-scale solar projects in the most reliably sunny part of the Golden State will become even more remote.

As a final irony, a proposal by Abengoa Solar for a 1,765 acre solar power development on former alfalfa fields near Barstow, California has run into opposition. The California Energy Commission is going to require the company to acquire and protect almost an identical number of acres of farmland elsewhere in California, along with the water rights, so that this farmland can be irrigated.[294] This is in keeping with the state's farm-preservation policies, but it cuts against the goal to facilitate renewable energy projects.

To us, what this suggests is that, despite big talk, California still does not have the right incentives. As Arizonans, we often find ourselves wishing that our state acted as aggressively as California on a variety of environmental issues. But in this instance, when we look across the Colorado River into California, we see a state that expects to satisfy its aggressive renewable portfolio standards in large measure by importing wind energy from New Mexico through a transmission line that will ravage one of our favorite rivers, the Lower San Pedro River; and by importing electricity generated by planned concentrating ***135** solar power projects in Arizona, which will tap Arizona's scarce groundwater resources and impose visual blight across beautiful swaths of federal land.

Solar energy may have a bright long-term future, because the technology is already there and it is improving. But we fear that the price signals and incentives are still not adequate to get the United States off our reliance on cheap coal and foreign oil. The BLM approval process is ongoing and it may indeed end up permitting many solar projects on federal lands. At this juncture, it is simply too early to tell. But, if Congress fails to extend incentives from the American Recovery and

Reinvestment Act (treasury payments worth one-third the total of construction costs for solar projects sited on public land) set to expire in December, it is unclear how many proposed projects on federal land will be able to move forward. Thus, as an alternative to siting projects on public lands, solar companies should focus their attention toward private and tribal lands, where a number of utility-scale projects could be built.

Solar energy's short-term future, however, is cloudy. The hoped-for streamlined permitting process has not taken hold. National environmental groups are at odds with local chapters. The realization of solar energy's water needs, transmission line access, and land requirements are generating pushback from both sides of the political aisle. Delays in permitting are putting thinly capitalized solar companies at risk of going under. Financial markets are hesitant to lend to solar companies. BrightSource Energy's Ivanpah project remains viable because it is one of the few utility-scale projects in California that has thus far received a Department of Energy loan guarantee.[295] Two Arizona-based utility-scale projects--Tessera Solar's proposed 250 megawatt plant near Buckeye and Lockheed-Martin's 290 megawatt Starwood Solar I project in the Harquahala Valley-- were recently abandoned due to financing and permitting issues.[296] In July 2010, Abengoa's project, the Solana project, finally received a loan guarantee from the DOE but the wait took over 18 months.[297] Simply put: if solar companies lack water, land, and money, then solar will never become more than a marginal player on the energy stage.

***136 APPENDIX 1: SOLAR POWER PLANT WATER COOLING TECHNOLOGIES**

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

***137 APPENDIX 2: SOLAR POWER PLANT AIR COOLING TECHNOLOGY**

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

Footnotes

a1 Robert Glennon is the Morris K. Udall Professor of Law and Public Policy at the University of Arizona, Rogers College of Law. He is the author of Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters (Island Press, 2002), and Unquenchable: America's Water Crisis And What To Do About It (Island Press, 2009).

aa1 Andrew Reeves is a third-year student at the University of Arizona James E. Rogers College of Law and the 2009-2010 recipient of the Sol Resnick Water Resources Fellowship.
We are very grateful to Erik Bakken, Matthew Bingham, Kirsten Engel, Joshua Fershee, Mike Hightower, Dan McGlothlin, Nathan Mee, Marc Miller, Martin Pasqualetti, Keely Wachs, Connie Ward, and Gary Woodard for helpful comments on earlier drafts and Barbara Losi for producing Appendices 1 and 2.

1 Solar energy is the largest recipient of venture capital "cleantech" funds. Mark Osborne, *Solar and Solyndra Top Venture Capital Funding in 2009, Says Cleantech Group Report*, PV-TECH.ORG (Jan. 8, 2010), http://www.pv-tech.org/news/_a/solar_and_solyndra_top_venture_capital_funding_in_2009_says_ cleantech_group/. In the second quarter of 2010 alone, venture capital and private equity funds invested over $5.0 billion in clean technology and renewable energy companies--many of them whose primary focus is solar power. *See, e.g.*, Press Release, Pipeline Clean Energy, 2Q10 venture capital and private equity investment in Clean Technology and Renewable Energy exceeded $5 billion (July 9, 2010) (on file with author). Also, big investors have been purchasing solar startups. Siemens bought CSP provider Solel for $400 million while Areva purchased California-based CSP provider Ausra. Richard Weiss, *Siemens to Buy Solel for $418 Million to Expand Solar Business*, BLOOMBERG, (Oct. 15, 2009, 5:31 AM), http://www.bloomberg.com/apps/news? pid=newsarchive&sid=a5uyJbtZqpB0; David R. Baker, *Engineering Giant Areva Buying Solar Firm Ausra*, SFGATE.COM, Feb. 9, 2010, http:// articles.sfgate.com/2010-02-09/business/17872810_1_areva-solar-power-power-plants.

2 *See* Ajay Kamalakaran, *Suntech to Construct Solar Plant in Arizona*, REUTERS (Nov. 15, 2009), http://www.reuters.com/article/idUSTRE5AF0P520091116.

[3] *See* Carrie Watters, *Suntech to Open First U.S. Solar Plant Site in Goodyear*, ARIZ. REPUBLIC, Jan. 27, 2010, *available at* http:// www.azcentral.com/community/swvalley/articles/2010/01/27/20100127swv-suntech0127-ON.html.

[4] *See Utility-Scale Solar Projects in the United States: Operational, Under Construction, and Under Development*, SOLAR ENERGY INDUSTRIES ASSOCIATION (Nov. 5, 2010) [hereinafter *Utility-Scale Solar Projects*], http:// www.seia.org/galleries/pdf/Major%20Solar%20Projects.pdf.

[5] The American Recovery and Reinvestment Act (ARRA) is commonly referred to as "The Stimulus." *See generally* American Recovery and Investment Act of 2009, Pub. L. No. 111-5, § 1102 (2009) (codified as amended at 26 U.S.C.A. § 48 (West 2010)).

[6] *See infra* Part III.

[7] RPS Policies, DSIRE, http://www.dsireusa.org (follow "Summary Maps" hyperlink; then follow "RPS Policies" hyperlink). It is important to note, though, that only sixteen states have specific goals or incentives for solar power. California, for instance, has no such requirements, thereby creating incentives for the "importation" of renewable power from other states or Mexico. *Id.* For general information on solar incentives, the Database of Solar Incentives for Renewables & Efficiency (DSIRE) is an excellent resource. *See generally* DSIRE, http://www.dsireusa.org (last visited Nov. 15, 2010).

[8] *See Global Renewable Energy Policies and Measures*, INTERNATIONAL ENERGY AGENCY, http://www.iea.org/textbase/pm/?mode=re& id=3591&action=detail (last visited Nov. 3, 2010) (summarizing a breakdown of Japan's RPS plan). *See generally Renewable Electricity: Hearing before the S. Comm. on Energy and Natural Res, 111th Cong.* (Feb. 10, 2009) (statement of Sen. Jeff Bingaman (DNM)).

[9] Tucson, Ariz, Resolution No. 20193 (Sept. 27, 2005).

[10] *See* Ryan Whitney, *Nellis Activates Nation's Largest PV Array*, NELLIS AIRFORCE BASE PUBLIC AFFAIRS (Dec. 18, 2007), http:// www.nellis.af.mil/news/story.asp?id=123079933.

[11] Ryan Randazzo & Rebekah L. Sanders, *Luke Air Force Base May Become a Solar Force*, ARIZ. REPUBLIC, July 24, 2010, at A1.

[12] *Davis-Monthan AFB to Add 14.5 MW Solar Array*, INSIDE TUCSON BUSINESS, Oct. 01, 2010.

[13] *See generally*U.S. ENERGY INFO. ADMIN., SOLAR PHOTOVOLTAIC CELL/MODULE MFG. ACTIVITIES 2008, Table 3.16 (Dec. 29, 2009) (calculated from federal employment data) [hereinafter *SOLAR PHOTOVOLTAIC MFG. ACTIVITIES*].

[14] *See id.* at Table 3.18.

[15] U.S. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2008, Table 1.2 (Jan. 2010).

[16] *Id.* at Table ES1.

[17] *See infra* Part V (discussing the frequently overlooked difference between megawatts and megawatt hours).

[18] ELECTRIC POWER ANNUAL 2008, *supra* note 15 at Table 1.4.

[19] Phil Angelides, California businessman and one-time candidate for California Governor, has described a "green collar job" as one that "has to pay decent wages and benefits that can support a family. It has to be part of a real career path, with upward mobility. And it needs to reduce waste and pollution and benefit the environment." Bryan Walsh, *What Is a Green-Collar Job, Exactly?*, TIME, May 26, 2008, *available at* http:// www.time.com/time/health/article/0,8599,1809506,00.html.

[20] *See infra* Part II.B.

[21] *See infra* Part V.

[22] *See infra* Part II.A.

[23] *See*RON PATE ET. AL., SANDIA LABORATORIES, OVERVIEW OF ENERGY-WATER INTERDEPENDENCIES AND THE EMERGING ENERGY DEMANDS ON WATER RESOURCES 2 (2007) [hereinafter *SANDIA REPORT*], *available at* http:// www.circleofblue.org/waternews/wpcontent/uploads/2010/09/SANDIA-research-needs2007-1349C_revised.pdf.

[24] Megawatts are generally discussed in terms of capacity, rated capacity, or generated capacity, and should not be confused with megawatt hours--an actual expression of the energy produced by a plant. These two notions are frequently confused. *See infra* Part V, note 243 and accompanying text.

[25] NATIONAL ENERGY POLICY DEVELOPMENT REPORT, RELIABLE, AFFORDABLE, AND ENVIRONMENTALLY SOUND ENERGY FOR AMERICA'S FUTURE 5-10 (2001), *available at* http://www.pppl.gov/common_pics/national_energy_policy/national_energy_ policy.pdf.

[26] *See* Robert Glennon, UNQUENCHABLE: AMERICA'S WATER CRISIS AND WHAT TO DO ABOUT IT 60 (2009) [hereinafter *UNQUENCHABLE*].

[27] *Id.* at 61.

[28] *See*NAT'L RES. DEF. COUNCIL WATER EFFICIENCY SAVES ENERGY: REDUCING GLOBAL WARMING POLLUTION THROUGH WATER USE STRATEGIES (2009), *available at www.nrdc.org/water/files/energywater.pdf.*

[29] *See, e.g., Climate TechBook: Hydropower*, PEW CENTER ON GLOBAL CLIMATE CHANGE, http://www.pewclimate.org/technology/factsheet/hydropower (last visited Nov. 3, 2010). *See generally*MARTIN PASQUALETTI ET AL., ARIZONA WATER INSTITUTE, WATER AND ENERGY SUSTAINABILITY WITH RAPID GROWTH AND CLIMATE CHANGE IN THE ARIZONA-SONORA BORDER REGION (June 2009), *available at* http:// www.azwaterinstitute.org/media/Scott final report 08.pdf.

[30] A recent study from the Institute of Electrical and Electronics Engineers (IEEE) estimates that 150,000 liters of water are needed, daily, to power Internet searches. *See generally*INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS SPECTRUM, SPECIAL REPORT: WATER VS. ENERGY, IEEE SPECTRUM (2010), *available at* http://spectrum.ieee.org/static/special-report-watervsenergy (last visited Nov. 7, 2010).

[31] *See generally*UNQUENCHABLE, *supra* note 26.

[32] For a basic explanation of how PV cells function, *see generally* Gil Knier, *How do Photovoltaics Work?*, SCIENCE@NASAHEADLINE NEWS, http:// science.nasa.gov/sciencenews/science-at-nasa/2002/solarcells (last visited Oct. 23, 2010).

[33] *See*MUKUND R. PATEL, WIND AND SOLAR POWER SYSTEMS 143 (CRC. PRESS LLC., 2ND ED. 2006) (summarizing the benefits of PV, especially in relation to construction).

[34] There is no precise consensus on the exact meaning of the terms "smart metering" or "smart grid". Generally, though, the idea is that--unlike most of the antiquated metering technology of the 1960s that is still employed--electricity meters and the electrical grid itself would become automated using 21st century technology. This would allow for more accurate readings, instantaneous information for utility companies about consumption and generation allowing them to respond more quickly to fluctuations and blackouts, and consumers would be able to see, in real time, what their electricity is costing so they can become "smarter" consumers. *See* Joel Achenbach, *The 21st Century Grid*, NATIONAL GEOGRAPHIC 122 (July 2010). This topic was recently discussed in the Senate Committee on Energy and Natural Resources. *See generally Smart Grid Initiatives and Technologies: Hearing Before the S. Comm. on Energy and Natural Res.*, 111th Cong. (Mar. 3, 2009) [hereinafter *Smart Grid Hearing*].

[35] Scientists are working on utility-scale storage technology for PV systems but, so far, none are commercially viable. *See, e.g.*, Anne Trafton, '*Major Discovery' from MIT Primed to Unleash Solar Revolution*, MIT NEWS (July 31, 2008), http://web.mit.edu/newsoffice/2008/oxygen-0731.html.

[36] *See Parabolic Trough Thermal Energy Storage Technology*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/csp/troughnet/thermal_energy_ storage.html (last visited Nov. 3, 2010) (containing information on storage technology for CSP).

[37] *See*U.S. DEP'T OF ENERGY, CONCENTRATING SOLAR POWER COMMERCIAL APPLICATION STUDY: REDUCING WATER CONSUMPTION OF CONCENTRATING SOLAR POWER ELECTRICITY GENERATION 7 (2006) [hereinafter *CSP COMMERCIAL/WATER STUDY*], *available at* http://www1.eere.energy.gov/solar/pdf/csp_water_study.pdf.

[38] *Id.* at 7-10.

[39] *Id.*

[40] H. Wilson Sundt Generating Station, How Electricity is Made, slide 20 (unpublished PowerPoint presentation) (on file with ARIZ. J. ENVTL L. & POL'Y) [hereinafter *How Electricity is Made*].

[41] *CSP COMMERCIAL/WATER STUDY*, *supra* note 37, at 8.

[42] *Id.*

[43] *Id.*

[44] *Id.* at 7.

[45] How Electricity is Made, *supra* note 40.

[46] *Id.* at slides 27-28.

[47] *Id.* at slide 28.

[48] Another term for this technology is "once-through water cooling." *See CSP COMMERCIAL/WATER STUDY*, *supra* note 37, at 12.

[49] *See id.*

[50] Some conventional power plants, such as fossil fuel or nuclear, that use a closed-loop cooling system utilize cooling ponds rather than cooling towers. U.S. DEP'T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER 19 (Dec. 2006) [hereinafter *ENERGY DEMANDS ON WATER: REPORT TO CONGRESS]*. This paper will only discuss tower-cooled systems as pond-cooled systems are not generally used with CSP technology.

[51] *See id.*

[52] *Id.*

[53] *Id.*

[54] *Id.* at 13.

[55] *Id.* at 13-14.

[56] *Id.* at 14.

[57] Except where otherwise indicated by additional footnotes, all data comes from *ENERGY DEMANDS ON WATER: REPORT TO CONGRESS*, *supra* note 50 at 38 (some information from the original table, which is Table V-1, is excluded).

[58] "Other Uses" includes water for other cooling loads such as gas turbines, equipment washing, emissions treatment, and facility restrooms.

[59] All numbers for closed-loop cooling relate to cooling cycles that involve a cooling tower (as opposed to a cooling pond).

[60] Air/dry cooling for CSP technologies involves very little water. *See*CSP COMMERCIAL/WATER STUDY, *supra* note 37, at 17 (facts not included in the original table, which is Table 2).

[61] *See*CSP COMMERCIAL/WATER STUDY, *supra* note 37, at 17

[62] *See*JIM MCKINNEY ET AL., CALIFORNIA ENERGY COMMISSION, 2005 ENVIRONMENTAL PERFORMANCE REPORT OF CALIFORNIA'S ELECTRICAL GENERATION SYSTEM (June 2005), *available at* http://www.energy.ca.gov/2005publications/CEC-700-2005-016/CEC-700-2005-016.PDF.

[63] *Id.*

[64] *See*CSP COMMERCIAL/WATER STUDY, *supra* note 37, at 11-12 (containing a more detailed explanation of efficiency loss in Rankine cycles).

[65] Simply dividing consumption by withdrawal rates yields these results. Thus, for a closed-loop CSP tower system, the consumption rate would be 100% (750 gallons withdrawn divided by 750 gallons consumed). With closed-loop nuclear, Table 1 reveals a range for both withdrawal and consumption. Still, by leveling the range through simple averaging, the useful data produced would be 800 gallons for withdrawal and 560 gallons for consumption--a consumption rate of 70%.

[66] This amount assumes the lower end of the spectrum for water use intensity in Table 1 for nuclear.

[67] Table 1 indicates that approximately 750 gallons of water are required to produce one megawatt hour of electricity. Thus, with 500 gallons, only 2/3 of a megawatt hour would be produced.

[68] *See*CSP COMMERCIAL/WATER STUDY, *supra* note 37, at 15.

[69] *See* Marc Miller & Nathan Mee, *Oil vs. Sun: How Close is Sustainable Electric Power?*ARIZONA LEGAL STUDIES, DISCUSSION PAPER NO. 10-26, July 2010, at 8, *available at* http://papers.ssrn.com/so13/papers.cfm?abstract_ id=1650692##.

[70] *Pending Solar Projects*, U.S. DEP'T. OF INTERIOR BUREAU OF LAND MGMT., http://www.blm.gov/az/st/en/prog/energy/solar/pend-solar.html (last visited Nov. 17, 2010).

[71] Solar Millennium recently did just this. *See*TODD WOODY, *Solar Developer Abandons Water Plans*, N.Y. TIMES GREEN BLOG (Nov. 16, 2009, 2:47 PM), http://green.blogs.nytimes.com/2009/11/16/solar-developer-abandons-water-plans.

[72] In a February 2010 status conference before the California Energy Resources Conservation and Development Commission (a part of the CEC), Commissioner Kenneth Celli clarified for Nextera Energy's legal counsel that "the project must dry cool or show that dry cooling is not technically, legally, or economically feasible, or would create a significant environmental impact." *See*CAL. ENERGY RES. CONSERVATION & DEV. COMM'N., DECISION AND SCOPING ORDER: APPLICATION FOR CERTIFICATION FOR THE GENESIS SOLAR ENERGY PROJECT, Docket No. 09-AFC-8 (Feb. 2010) *available at* http:// www.energy.ca.gov/sitingcases/genesis_solar/documents/2010-02-16_ Transcript.pdf.

[73] NEVADA STATE ENGINEER, Ruling No. 5115 (April 18, 2002), *available at* http://images.water.nv.gov/images/rulings/5115r.pdf.

[74] *See*CSP COMMERCIAL/WATER STUDY, *supra* note 37, at 10-11.

[75] Press Release, Tessera Solar, SRP and Tessera Solar Announce 1.5 MW Maricopa Solar Plant (Aug. 19, 2009) (on file with author).

[76] It is important to note that these figures do not account for "land use intensivity." Some forms of power production, like coal, have a much more dramatic impact on the lands they are sited on than others.

[77] MIKE HIGHTOWER, SANDIA LABORATORIES, RENEWABLE ENERGY DEVELOPMENT IN THE SOUTHWEST: SUSTAINABILITY CHALLENGES & DIRECTIONS (2009) [hereinafter *RENEWABLE ENERGY IN THE SOUTHWEST*], *available at* http:// www.swhydro.arizona.edu/renewable/presentations/thursday/hightower.pdf. *See infra* Table 2, note 87 and accompanying text (illustrating how wind farm arrays require large acreage but, in actuality, do still allow much of the land to be used for both agriculture or grazing).

[78] *Id.*

[79] The original table lists "unusable land size" for concentrating solar as "all". *But see infra* note 87 (showing that some cutting edge CSP designs do allow for mirrors to be installed in such a way that grazing is still possible).

[80] This data was extrapolated from a report from The National Renewable Energy Laboratory, a Department of Energy national

laboratory. U.S. DEP'T OF ENERGY, PV FAQs (Feb. 2004), *available at* http:// www.nrel.gov/docs/fy04***o***sti/35489.pdf.

[81] This refers to the difference between PV arrays that are ground-mounted and those that are roof-mounted. Rooftop PV of any kind, of course, does not impact land at all. Ground-mounted PV may allow for some grazing.

[82] *Pending Solar Projects*, s*upra* note 70 (compiled from applicant data for concentrated solar projects provided on the BLM website).

[83] *Id.*

[84] *Id.* It should be noted that it is likely, in requesting so much land, a number of these companies are planning for future expansion.

[85] Interview with Erik Bakken, Manager of Corporate Environmental Services and Land Use Department, Tucson Electric Power, in Tucson, Ariz. (June 21, 2010).

[86] The *Solar Vision Study*, set to be released soon by the U.S. Department of Energy, is far more confident in thinking land footprints will not be as big of a concern as technology improves. They estimate that, for 10% of the United States electricity needs to be met by solar power, only 460,000 hectares (~1,136,685 acres) of land will be required. *See*U.S. DEP'T OF ENERGY, *Chapter 8: Solar Power Environmental Impacts and Siting Challenges, in*SOLAR VISION STUDY 5-6 (Draft, May 28, 2010) [hereinafter *SOLAR VISION STUDY*]. Still, this represents over twice as much land as has currently been requested for permitting in Arizona and, though it may seem like an insignificant amount to some, it is hard to write-off altering the use of millions of acres of land as trivial.

[87] BRIGHTSOURCE ENERGY, BRIGHTSOURCE ENERGY OVERVIEW 25 (2010) (on file with the author); RENEWABLE ENERGY IN THE SOUTHWEST, *supra* note 77.

[88] One of the most exciting developments in solar technology is being carried out at the University of Arizona Steward Observatory. Under the leadership of Roger Angel, a world-famous optical scientist, the University of Arizona team is using its expertise in building mirrors for telescopes to build light-focusing technologies for PV cells. The idea is to increase the efficiency of PV cells, and thus lower the cost and footprint, by concentrating incoming solar rays just as telescope mirrors concentrate starlight. To learn more about Roger Angel's ideas about solar, *see* Roger Angel, *Solar Energy as a Major Replacement for Fossil Fuel*, MIT WORLD: DISTRIBUTED INTELLIGENCE (Oct. 9, 2007), http://mitworld.mit.edu/video/523/.

[89] *See supra* Part I.

[90] *See* Robert Kropp, *Solar Expected to Maintain its Status as the World's Fastest Growing Energy Technology*, SOCIAL FUNDS (Mar. 3, 2009), http:// www.socialfunds.com/news/article.cgi/2639.html.

[91] *See id.*

[92] Interview with Erik Bakken, *supra* note 85.

[93] *See* Ed Hiserodt, *Solar Power Generation: Boom or Boondoggle*, THE NEW AMERICAN, Apr. 14, 2010.

[94] Jonathan Lesser & Nicolas Puga, *PV vs. Solar Thermal: Distributed Solar Modules are Gaining Ground on Concentrated Solar Thermal Plants*, PUB. UTILIS. FORTNIGHTLY, July 2008.

[95] Mark Boslet, *Is Ivanpah the World's Most Efficient Solar Plant?*, GREENTECHSOLAR, June 23, 2010, http://www.greentechmedia.com/articles/read/is-ivanpah-the-worlds-most-efficient-solarplant.

[96] *See generally* Miller & Mee, *supra* note 69 (discussing the economics of solar power).

[97] If a national carbon tax plan were implemented, though this currently seems unlikely, this would provide another very strong incentive for investment in non-carbon producing power generation technologies like solar.

[98] *Renewable Energy Technologies*, OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEP'T OF ENERGY, http:// www.eere.energy.gov/basics/renewable_energy/index.html (last visited Nov. 2, 2010); *Introduction to Federal Renewable Energy Goals and FEMP Services*,OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEP'T OF ENERGY, http:// www1.eere.energy.gov/femp/pdfs/re_webinar_110410.pdf (last visited Nov. 2, 2010).

[99] *See generally* Lauren Sommer, *California Leads in Clean Energy, But Challenges Loom*, NAT'L PUB. RADIO. Aug. 16, 2010, http:// www.npr.org/templates/story/story.php?storyId=129128750.

[100] *See*CAL. PUB. UTIL. CODE § 399.11 (West 2010); CAL. PUB. RES. CODE § 25740 (West 2010).

[101] *See* Cal. Exec. Order No. S-14-08 (Sept. 15, 2009), *available at* http://gov.ca.gov/executive-order/13269. This Executive Order is non-binding and, as a result, represents more of a goal than a mandate. The current RPS standard of 20% by 2010, though, is the most ambitious at the moment.

[102] *See generally* RPS Policies, *supra* note 7.

[103] *See*CAL. PUB. UTIL. CODE § 399.11 (West 2010); CAL. PUB. RES. CODE § 25740 (West 2010), *supra* note 100.

[104] The 30% by 2020 standard is specifically for investor-owned utilities. Colorado's elective cooperatives must achieve a 10% goal by 2020. *See Colorado: Incentives/Policies for Renewables & Efficiency*, DSIRE (Sept. 27, 2010), http://www.dsireusa.org/incentives/incentive.cfm?Incentive_ Code=CO24R&re=1&ee=1.

[105] This standard applies to investor-owned utilities. For rural electric cooperatives, the standard is 10% by 2020. *See New Mexico: Incentivies/Policies for Renewables & Efficiency*, DSIRE (Aug. 23, 2010), http://www.dsireusa.org/incentives/incentive.cfm?Incentive_ Code=NM05R&re=1&ee=1.

[106] This standard applies to large utilities. For smaller utilities, the standard is set at 5 to 10% by 2025. *See Oregon: Incentivies/Policies for Renewables & Efficiency*, DSIRE (June 3, 2010), http:// www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR22R&re=1&ee=1.

[107] *See Tucson Electric Power: 2010 Renewable Energy Standard and Tariff Compliance Report*, ARIZ. CORP. COMM'N (Apr. 1, 2010), http:// www.azcc.gov/divisions/utilities/electric/environmental.asp.

[108] *Id.*

[109] *See Details about the Renewable Energy Standard Tariff*, TUCSON ELECTRIC POWER (containing details about the Renewable Energy Standard Tariff), http://www.tucsonelectric.com/company/news/REST.asp. (last visited Nov. 17, 2010); *see supra* note 5 (providing information on federal incentives).

[110] Matthew L. Wald & Tom Zeller Jr., *Cost of Green Power Makes Projects Tougher Sell*,N.Y. TIMES, Nov. 7, 2010, at A1.

[111] *See, e.g.*, 42 U.S.C. § 13317 (2006) (rewarding payments of 2.1 ¢/kWh for the first ten years of a plant's operation); 26 U.S.C.A. § 48 (2010) (providing substantial tax credit incentives for the manufacture and production of renewable energy sources).

[112] *See* American Recovery and Investment Act of 2009, Pub. L. No. 111-5, § 1102 (2009) (codified as amended at 26 U.S.C.A. § 48 (West 2010)). Importantly, these tax incentives (which are generally geared toward smaller projects), should not be confused with the ARRA incentives--treasury payments in lieu of tax benefits--discussed later, *infra* p. 135 (related to construction of utility-scale projects).

[113] *Id.*

[114] ELECTRIC POWER ANNUAL 2008, *supra* note 15 at Table 1.4.

[115] *Id.*

[116] *Id.*

[117] Such lands may be more cost-effective, especially because contiguous sections of land that are not government-owned may be difficult to acquire. Another benefit of siting on public land is that a fixed rental rate is involved (avoiding the need for purchase), and companies need only work with one party--the government. Nevertheless, as permitting difficulties have increased, many companies have shifted toward seeking private land. *See, e.g.*, Michael Kanellos, *Is Bureaucracy Killing Solar?*, GREENTECH MEDIA, Mar. 26, 2010, http://www.greentechmedia.com/articles/read/is-bureaucracykillingsolar/.

[118] BUREAU OF LAND MGMT., SOLAR ENERGY INTERIM RENTAL POLICY, INSTRUCTION MEMORANDUM NO. 2010-141 (June 10, 2010) [hereinafter *BLM INSTRUCTION MEMORANDUM*], http:// www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_ instruction/2010/IM_2010-141.html.

[119] *Id.*

[120] *Id.*

[121] BLM INSTRUCTION MEMORANDUM, *supra* note 118 (providing the available rates).

[122] *See id. But see supra* note 87 and accompanying text (some solar technologies allow for limited grading thereby allowing for grazing).

[123] BLM INSTRUCTION MEMORANDUM, *supra* note 118

[124] *Id.*

[125] *Id.* "Capacity factor" establishes the distinction between potential and actual power production and can be expressed with the equation (A / P x 8760), where A = actual megawatt hours of electricity produced by a plant in a given year, and P = the rated capacity (as expressed in megawatts). P is multiplied by 8760 as there are 8760 hours in a year. *See infra* Part V, note 243 and accompanying text.

[126] *See* Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594, 660 (codified as amended in scattered sections of 16 U.S.C.A. and 42 U.S.C.A.).

[127] 43 U.S.C. § 1701(a)(9) (2006).

[128] Section 1701(a)(9) has a provision related to statutorily defined rates (as opposed to fair market value) but, for the purposes of the BLM rental rates for solar, this is inapplicable. The BLM rates have been established by the agency, not by statute.

[129] 3,700 acres x $188.34/acre rate for Maricopa County.

[130] 375 megawatts x $7,884/megawatt for CSP projects with storage capacity.

[131] These figures don‘t even account for the 3-4 mile long high-energy tie-line that will need to be built to connect the facility to the closest substation.

[132] Though beyond the scope of this article, mitigation costs accrued by solar power companies leveled to offset damage to natural resources (such as habitat and water) are another--and very significant--over-looked cost. The discussion of tortoise relocation, *infra* p. 117-118, for instance, provides one such example.

[133] Ben Sills, *Spain May Cut Income 30% for Operating Solar Plants*, BLOOMBERG BUSINESSWEEK (June 16, 2010, 1:07 PM), http:// www.businessweek.com/news/2010-06-16/spain-may-cut-income30-for-operating-solar-plants-update1-.html.

[134] *Id.*

[135] *Id.*

[136] *Id.*

[137] *Id.*

[138] *See* Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594, 660 (codified as amended in scattered sections of 16 U.S.C.A. and 42 U.S.C.A.).

[139] *Id.*

[140] *See* Robert Glennon, *When Renewable is not Sustainable*, IN THESE TIMES, Sept. 1, 2009; Robert Glennon, Op-Ed., *Is Solar Power Dead in the Water?*,WASH. POST, June 7, 2009.

[141] *See Pending Arizona BLM Solar Projects*, BUREAU OF LAND MGMT., http://www.blm.gov/az/st/en/prog/energy/solar/pend-solar.html (last updated Sept. 21, 2010).

[142] For solar projects, the BLM‘s requirements are detailed in the “Environmental Review” section of its Solar Energy Development Policy:
The scope of the environmental analysis required by the National Environmental Policy Act (NEPA) for a solar energy development project should address all aspects of the solar project, including direct, indirect, and cumulative effects of the proposed action.

The scope of the NEPA analysis and the compliance requirements with the Endangered Species Act, the Migratory Bird Treaty Act, the National Historic Preservation Act, and other laws for a solar energy development right-of-way application should address the installation and maintenance of solar collectors, water for steam generation and cooling purposes, oil or gas used by backup generators, thermal or electrical storage, turbines or engines, access roads and electrical inverters and transmission facilities. The scope and level of site clearance should include the areas of proposed surface disturbance and areas potentially affected by the project.
The level of NEPA analysis will be determined by project scoping and the anticipated potential impacts on the environment. The level of analysis will reflect the amount of land needed for the solar energy collection and associated support facilities, the amount of surface to be disturbed, water requirements, and potential impacts on wildlife and other resources. It may be possible to combine the required environmental review process for a solar energy development project with other required State or local environmental requirements. This would streamline the process and be consistent with Departmental policy on intergovernmental cooperation.
BLM INSTRUCTION MEMORANDUM, *supra* note 118.

143 *See Utility-Scale Solar Projects*, *supra* note 4.

144 BUREAU OF LAND MGMT., PERFORMANCE AND ACCOUNTABILITY REPORT FOR FISCAL YEAR 2009 Table 3-13 (2009).

145 *Sec. Salazar Approves Second Large-Scale Solar Energy Project on Public Lands in Nevada*, BUREAU OF LAND MGMT (Nov. 15, 2010), http:// www.blm.gov/wo/st/en/info/newsroom/2010/November/NR_11_15_2010.html.

146 *See* Katie Kendall, Note, *The Long and Winding "Road": How NEPA Noncompliance for Preservation Actions Protects the Environment*, 69 BROOK. L. REV. 663, 665 (2004).

147 *See infra* Part V.

148 Brownfields are sites that "the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." 42 U.S.C. § 9601(39)(A) (2006).

149 Despite this, it is problematic that the BLM neglected to account for the proximity of 'non-sensitive' BLM lands to national parks, wildlife refuges, and fragile lands managed by other federal or state agencies.

150 *See Solar Energy Development Fact Sheet*, BUREAU OF LAND MGMT. http://www.blm.gov/az/st/en/prog/energy/solar/4-tracks.html (follow "List of Proposed Project Sites") (last updated Oct. 27, 2010).

151 *Id.*

152 *Id.*

153 *See Restoration Design Project*, BUREAU OF LAND MGMT. http:// www.blm.gov/az/st/en/prog/energy/arra_solar.html (last updated Apr. 20, 2010); *Turning Brownfields Green with Renewable Energy*, The Wilderness Society, Jan. 15, 2010, *available at* http://wilderness.org/content/pr-energy-20100115.

154 *Id.* In fact over 80% of the land nominated for analysis (approximately 125,902 acres) is agricultural land, further supporting the contention that, in the future, solar power companies should seriously look at fallowing agricultural land and converting it to solar sites. For more on this argument, *see infra* Part V.

155 *See*42 U.S.C.A. §§ 4321-35 (West 2010).

[156] In Arizona, for instance, utilities must abide by ARIZ. REV. STAT. ANN. §§ 40-207, 360.02-360.13 (2010). It is possible, in Arizona, for a company to receive approval from the Arizona Corporation Commission prior to completing an EIS. Nevertheless, both processes are time-consuming.

[157] *Carrizo Energy Solar Farm Dropped*, SUSTAINABLEBUSINESS.COM, Nov. 5, 2009, http://www.sustainablebusiness.com/index.cfm/go/news.display/id/19184.

[158] Lynh Bui, *Phoenix Loses Solar Power Deal with Tessera Solar North America*, ARIZ. REPUBLIC, Sept. 28, 2010.

[159] *Id.*

[160] *Id.*

[161] *See* Alicia Wallace, *Boulder's Simple Solar Files for Chapter 11 Bankruptcy Protection*, COLO. DAILY, May 20, 2010.

[162] Matt Fair, *Robbinsville Solar Company in Bankruptcy*, TIMES OF TRENTON, Mar. 13, 2010, at A01.

[163] *Salazar, Abbey Describe Progress of Solar Energy on Public Lands*, BUREAU OF LAND MGMT, (Jan. 28, 2010), http://www.blm.gov/wo/st/en/info/newsroom/2010/january/NR_01_28_2010.html.

[164] Notice of Availability of Draft EIS for the Proposed Sonoran Solar Energy Project, 75 Fed. Reg. 20377-20378 (Apr. 19, 2010); *Draft EIS for Sonoran Solar Energy Project*, BUREAU OF LAND MGMT., http://www.blm.gov/az/st/en/prog/energy/solar/sonoran_solar/maps/DEIS.html (last updated Apr. 16, 2010)[hereinafter *Draft EIS*].

[165] *Draft EIS*, *supra* note 164.

[166] *Id.*

[167] *Id.*

[168] *Id.*

[169] *See* In the Matter of Arizona Public Service Company Application for Approval Its Renewable Energy Standard and Tariff Implementation for 2010, Arizona Corporation Commission, Docket No. E-01345A-09-0338 (Decision No. 71459, Jan. 11, 2010).

[170] *Id.*

[171] *See generally* Jim Rossi, *The Trojan Horse of Electric Power Transmission Line Siting Authority*, 39 ENVTL. L. 1015 (2009).

[172] *See generally* Joel Achenbach, *The 21st Century Grid*, NATIONAL GEOGRAPHIC 122 (July 2010)

[173] For example, the recently approved Lucerne Valley and Imperial Valley projects in Southern California have a projected generation capacity of 754 megawatts, but existing transmission lines only have a capacity of 345 megawatts. Felicity Barringer, *Solar Power Plants to Rise on U.S. Land*, N.Y. TIMES, Oct. 5, 2010.

[174] *See*CAL. PUB. UTILS. COMM'N, 33% RENEWABLES PORTFOLIO STANDARD IMPLEMENTATION ANALYSIS PRELIMINARY RESULTS 7 (2009).

[175] *See, e.g.*, Rebecca Smith, *Green Battle Rages in Desert: Mojave Protection Bill Would Put Prime Solar-Power Sites Off Limits*, WALL ST. J., Dec. 23, 2009, at A6.

[176] *See* discussion of the Mojave Desert *infra* Part V.

[177] The majority of BLM fast-track projects are at least this size (3,840 acres). *See Fast-Track Renewable Energy Projects*, BUREAU OF LAND MGMT., http://www.blm.gov/wo/st/en/prog/energy/renewable_energy/fast-track_ renewable.html (last updated Oct. 26, 2010).

[178] *See, e.g.*, Rita Beamish, *Desert Clash in West Over Solar Potential, Water, ASSOCIATED PRESS, April 18, 2009*, http:// www.usnews.com/science/articles/2009/04/18/desert-clash-in-west-oversolarpotential-water.html.

[179] Robert Glennon, Op-Ed., *Is Solar Power Dead in the Water?*,WASH. POST, June 7, 2009, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/06/05/AR2009060501988.html.

[180] *See, e.g., Environmental Concerns Threaten Solar Power Expansion in California Desert*ASSOCIATED PRESS, Apr. 18, 2009, http:// www.foxnews.com/story/0,2933,517053,00.html.

[181] SOLAR VISION STUDY, *supra* note 86, at Sec. 8.2.3.

[182] *See generally*BRIGHTSOURCE ENERGY, *supra* note 87.

[183] *Id.* at 44.

[184] *Id.*

[185] Memorandum from BrightSource Energy on Ivanpah Solar Energy Generation System (ISEGS) Environmental Leadership (May, 2010) (on file with the author).

[186] *Id.*

[187] *Id.*

[188] *See, e.g.*, Todd Woody, *Major California Solar Project Moves Ahead*, N.Y. TIMES GREEN BLOG (March 17, 2010, 3:56 PM), http:// green.blogs.nytimes.com/2010/03/17/major-california-solarprojectadvances/. The objections of these groups may have been more valid than first suspected. In November, as BrightSource broke ground on the Ivanpah project, 23 tortoises were found in the first two square miles of the project site (rather than the sixteen or seventeen first estimated in BrightSource's own impact survey of the entire 5.6-square mile site). This has led some to contend that the permitting process is not stringent enough. As a U.S. Geological Survey biologist commented in response to the tortoise discrepancy, "We need more accurate information at [the] front end to see where these projects should be .... This is public land, and the tortoises are a public resource." David Danelski, *Desert: Energy Developers Need Better Tortoise Counts, Officials Say*, THE PRESS-ENTERPRISE, Nov. 4, 2010.

[189] Scott Streater, *Developer Proposes 30,000 Solar Dishes in Calif. Desert*, N.Y. TIMES, Feb. 19, 2010, *available at* http:// www.nytimes.com/gwire/2010/02/19/19greenwire-developer-proposes30000-solar-dishes-in-calif-19323.html.

[190] Telephone Interview with Keely Wachs, Senior Director of Corporate communications for BrightSource Energy (June 9, 2010).

[191] *See* John Kessler, *Energy Commission Staff's Transmittal of Updated Renewable Energy Action Team Agency Guidance for Mitigation Cost Estimates and Desert Tortoise Translocation-Ivanpah Solar Electric Generating System (07-AFC-05)*, CAL. ENERGY COMM. (July 30, 2010), http:// www.energy.ca.gov/sitingcases/ivanpah/documents/2010-07-30_Staffs_Transmittal_of_Updated_REAT_Agency_Guidance_for_Mitigation_Cost_TN-57805.PDF.

[192] Michael R. Blood, *Rare Tortoise Makes Things Hairy for Solar Development*, HUFFINGTON POST, Jan. 2, 2010, http:// www.huffingtonpost.com/2010/01/02/tortoise-solarenergy_n_409257.html.

[193] *See* Ctr. for Biological Diversity comments to *Supplemental Draft EIS for Ivanpah Solar Electric Generating System, DES-09-46*, BUREAU OF LAND MGMT (April 2010) [hereinafter Ctr. for Biological Diversity Comments].

[194] Tiffany Hsu, *BLM Approves Brightsources's Ivanpah solar project*, GREENSPACE BLOG (Oct. 7, 2010, 3:27 PM), http:// latimesblogs.latimes.com/greenspace/2010/10/brightsource-ivanpahblm.html.

[195] *Id.*

[196] *Id.*

[197] *Salazar Approves Sixth and Largest Solar Project Ever on Public Lands*, BUREAU OF LAND MGMT., (Oct. 25, 2010), http:// www.blm.gov/wo/st/en/info/newsroom/2010/october/NR_10_25_2010.html.

[198] *First-Ever Solar Project Approved on Public Lands in Nevada*, BUREAU OF LAND MGMT., (Oct. 13, 2010), http:// www.blm.gov/wo/st/en/info/newsroom/2010/october/NR_10_13_2010.html; *Sec. Salazar Approves Second Large-Scale Solar Energy Project on Public Lands in Nevada*,BUREAU OF LAND MGMT., (Nov. 11, 2010), http:// www.blm.gov/wo/st/en/info/newsroom/2010/November/NR_11_15_2010.html.

[199] *Id.*

[200] Though a number of government agencies, since 2009 when the BLM announced its plan to "fast track" fourteen proposed solar projects, have maintained that they are committed to citing plants on public lands, it is interesting to note that, just a week before approval for the first three California projects occurred, Senators Boxer and Feinstein, along with 25 members of the House of Representatives, wrote Energy Secretary Steven Chu, imploring him to speed up the application approval process for DOE-secured loans--a de facto prerequisite for most companies to secure project funding from banks and private investors. Mark Lifsher, *Two Solar Projects on California Public Land Get Federal OK*, L.A. TIMES, Oct. 5, 2010, http:// articles.latimes.com/2010/oct/05/business/lafienergy-permits-20101006. Also, Sen. Feinstein has, in particular, been pushing BLM for some time to speed up and improve the permitting process. *See infra* notes 214-217 and accompanying text.

[201] *See Fast-Track Renewable Energy Projects*, *supra* note 177.

[202] *Id.*

[203] *Id.*

[204] *See* Lifsher, *supra* note 200.

[205] Hester F. Phillips, Paul Green & Chris McVie, *Power Lines Threaten Lower San Pedro River*, VERMILLION FLYCATCHER, Mar.-Apr. 2010, at 16, *available at* http://www.scribd.com/doc/36421425/March-April-2010-Vermilion-Flycatcher-Tucson-Audubon-Society.

[206] *Id.*

[207] *Id.*

[208] *Id.*

[209] Daniel Stone, *Not in Anyone's Backyard*, NEWSWEEK, Jan. 13, 2010, *available at* http://www.newsweek.com/2010/01/12/not-in-anyone-s-backyard.html.

[210] *Id.*

[211] Another California project, Solargen's proposed Panoche Valley Solar Farm Project, has also come under fire from environmental groups and local citizens despite the fact that, unlike the situation in the Mojave, the plant would be located on private land, would have less of an impact on fragile species, and is already located near transmission lines. *See* Andrea Kissack, *' Big Solar' Struggles to Find Home in California*, NAT'L PUB. RADIO, Aug. 17, 2010, http://www.npr.org/templates/story/story.php?storyId=129129794.

[212] Peter Maloney, *Solar Projects Draw New Opposition*, N.Y. TIMES, Sept. 23, 2008, at SPG2.

[213] *Id.*

[214] *See, e.g.*, *Clean Energy Solutions*, SIERRACLUB.ORG, http:// www.sierraclub.org/energy (last visited Nov. 3, 2010); Tim Dickinson, *Electric Bugaboo*, OUTSIDE ONLINE, May 2010, http:// outsideonline.com/outside/culture/201005/conservationsists-renewable-energy-debate1.html?page=4 (last visited Nov. 3, 2010).

[215] *See* Press Release, U.S. Sen. Dianne Feinstein (D-CA), Sen. Feinstein Introduces Legislation to Balance Conservation, Recreation and Renewable Energy Development in the Mojave Desert (Dec. 21, 2009), *available at* http://feinstein.senate.gov/public/index.cfm?FuseAction=NewsRoom.PressReleases&ContentRecord_id=b3a780d4-5056-8059-7606-3936a2f7945f.

[216] *Id.*

[217] *California Desert Bill: Hearing before the Subcomm. on Pub. Lands and Forests of the S. Comm. on Energy & Natural Res.* 111th Cong. (May 20, 2010) (testimony of Pedro Pizarro).

[218] *California Desert Protection Act: Hearing on S.2921 Before the S. Comm. On Energy & Natural Res.*, 111th Cong. (May 20, 2010) (testimony of Sen. Dianne Feinstein (D-CA)).

[219] Testifying before the Senate Committee on Energy and Natural Resources on May 20th, 2010, Robert Abbey, the director of the BLM, stated that "the Department of the Interior supports the goals of S. 2921 and looks forward to working closely with Senator Feinstein, the Committee, and our federal partners as this bill moves through the legislative process." *California Desert Bill: Hearing before the Subcomm. on Public Lands and Forests of the S. Comm. on Energy and Natural Res.* 111th Cong. (May 20,

2010).

220 Report by the Office of Senator Jon Kyl, DEPLOYING SOLAR POWER IN THE STATE OF ARIZONA: A BRIEF OVERVIEW OF THE SOLAR-WATER NEXUS (May 2010) [hereinafter SENATOR KYL'S REPORT], *available at* http://kyl.senate.gov/solar-water.pdf.

221 *Id.* at 18. *See also* Jon Kyl, Op-Ed., *Understanding Solar Power*, ARIZ. REPUBLIC, June 5, 2010, at B5.

222 SENATOR KYL'S REPORT, *supra* note 220, at 20.

223 *Palo Verde Nuclear Generating Station*, PNM.COM, http:// www.pnm.com/systems/pv.htm (last visited Nov. 3, 2010).

224 Telephone Interview with Ilene Anderson, Biologist, Center for Biological Diversity (June 21, 2010).

225 *See* Ctr. for Biological Diversity Comments, *supra* note 193.

226 Press Release, S. Cal. Edison and SunPower Corp., Southern California Edison Orders 200 Megawatts of SunPower Panels for Large Utility Solar Project (Mar. 10, 2010) (on file with author).

227 830 MASS. CODE REGS. 62.6.1 (2010).

228 Renewable Energy Technologies Income Tax Credit, 2009 Haw. Sess. Laws 154.

229 *See*ITRON, INC. & KEMA, INC., CPUC CALIFORNIA SOLAR INITIATIVE 2009 IMPACT EVALUATION FINAL REPORT (June 2010), *available at* http:// www.cpuc.ca.gov/NR/rdonlyres/70B3F447-ADF5-48D3-8DF0-5DCE0E9DD09E/0/2009_CSI_ Impact_Report.pdf.

230 *See, e.g.*, Patrick O'Grady, *APS Looks to Vie with Out-of-State Solar Companies*, PHX. BUS. J. (Sept. 23, 2010, 5:04 PM), *available at* http:// www.bizjournals.com/phoenix/stories/2010/09/27/story10.html?b=1285560000^ 3996861&s=industry&i=green; *SRP Announces "Community Solar" Programs for School*, LEWIS & ROCA LLP RENEWABLE ENERGY BLOG (Aug. 4, 2010, 12:14 PM), http://www.lrlaw.com/energyblog/blog.aspx?entry=154.

231 *See* Memorandum from Deborah R. Scott, Senior Regulatory Attorney, Pinnacle West Capital Corporation, to Sandra D. Kennedy, Commissioner, Arizona Corporate Commission (Mar. 19, 2010), *available at* http:// images.edocket.azcc.gov/docketpdf/0000108495.pdf. For further discussion of distributed energy and smart technology, see *supra* note 34.

232 One estimate for residential solar panels puts the cost at between $25,000 and $30,000 before rebates. Gregory Dicum, *GREEN Solar Gets Practical/Is It Finally Time to Put Solar Panels on My Roof?*, SFGATE.COM, Jan. 25, 2006, http://articles.sfgate.com/2006-01-25/home-andgarden/17275407_1_ solar-panels-electric-panels-solar-power/.

233 *See generally Smart Grid Hearing*, *supra* note 34.

234 *See supra* Part II.

235 *See, e.g.*, Press Release, Ctr. For Biological Diversity, Poorly Sited Solar Project Edges Closer to Approval (Sept. 9, 2009), http://

www.biologicaldiversity.org/news/press_releases/2009/Ivanpah-project-9-09-2009.html.

236 The U.S. Energy Information Administration's Annual Energy Outlook 2010 estimates that, despite increasing energy efficiency (through technology and conservation), residential energy demand will increase by 24% by 2035 due to population growth and a continuing population shift toward warmer climates. *See*U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2010 65 (May 2010). Recognizing this problem, some states in the West, like Nevada, have initiated statewide conservation plans. *See Energy Efficiency*, NEV STATE OFFICE OF ENERGY, http://energy.state.nv.us/energy-efficiency/ (last visited Nov. 18, 2010).

237 The U.S. Energy Information Administration's 2008 "Electric Power Annual Report" estimates that Californians purchased approximately 268,155,000 megawatt hours of electricity in 2008. ELECTRIC POWER ANNUAL 2008, *supra* note 15. Each technology, then, would be required to produce approximately 29,800,000 megawatt hours. Assuming a generous capacity factor of 33% for all technologies, roughly 30,609 MWs of rated capacity (30,609 MWs x 8760 hours x .33 capacity factor) would be required to meet the RPS goal of 89,400,000 megawatt hours (1/3 of current 2008 consumption). With each technology accounting for 1/3 of the goal, the land breakdown, based on land requirements found in Table 3, would be as follows: CSP, 61,380 acres; PV 124,397 acres; Wind, 470,580 acres. Even relying solely on CSP--the most land efficient of the technologies--183,654 acres of land (approximately 287 square miles) would still be required to reach the RPS goal.

238 ELECTRIC POWER ANNUAL 2008, *supra* note 15, at Table ES1,

239 1,985,801 thousand MWhs. *Id.*

240 882,981 thousand MWhs. *Id.*

241 806,208 thousand MWhs. *Id.*

242 254,831 thousand MWhs. *Id.*

243 ELECTRIC POWER ANNUAL 2008, *supra* note 15, at Table 5.2.

244 This is also known as "rated capacity." This megawatt variability is also known as "rated capacity." *See* Bob Bellemare, *IssueAlert: What is a Megawatt?*, UTILIPOINT INT'L INC., June 24, 2003, http:// www.utilipoint.com/issuealert/print.asp?id=1728 (last visited Nov. 3, 2010).

245 450 megawatt hours times 8,760 hours in a 365-day year.

246 Nuclear, by comparison, has a capacity factor of over 90% and traditional coal plants operate at just over 70%. ELECTRIC POWER ANNUAL 2008, *supra* note 15, at Table 5.2.

247 *Id.* at Table ES1

248 *Id.*

249 *Id.*

250 *Id.* at Table ES1.

[251] *See* Ryan Randazzo, *Plant to Brighten State's Solar Future*, ARIZ. REPUBLIC, Feb. 21, 2008; Press Release, Arizona Public Service, Saguaro Solar Power Plant (June 2010) (on file with author) [hereinafter *Saguaro Solar Plat Press Release*].

[252] *See* Press Release, Arizona Public Service, Solana Generating Station (July 2010) (on file with author) [hereinafter *Solana Generating Station Press Release*]. As a recent report from the National Renewable Energy Laboratory has pointed out, "Solar plants use less water than most agriculture in the Imperial Valley and can bring in more revenues to the local community and offer more and higher paying jobs." SCOTT ANDERS ET AL., SAN DIEGO REG'L RENEWABLE ENERGY GRP., POTENTIAL FOR RENEWABLE ENERGY IN THE SAN DIEGO REGION 178 (2005).

[253] *Solana Generating Station Press Release*, *supra* note 252.

[254] *See generally*UNQUENCHABLE, *supra* note 26.

[255] *See*SCOTT ANDERS ET AL., *supra* note 252, at 178.

[256] *Id.*

[257] *See* Tim Sheehan, *Valley Solar Plant Would be Among World's Largest*, FRESNO BEE, Mar. 15, 2010.

[258] *See generally* Matt Jenkins, *Breakdown*, HIGH COUNTRY NEWS, Apr. 21, 2010, http://www.hcn.org/issues/42.1/breakdown.

[259] *See* Todd Woody, *Recycling Land for Green Energy Ideas*, N.Y. TIMES, Aug. 10, 2010, *available at* http://www.nytimes.com/2010/08/11/business/energy-environment/11solar.html.

[260] According to data from the 2000 U.S. census, Anaheim's area was forty-eight square miles, while San Francisco's was forty-seven. *See California QuickFacts from the U.S. Census Bureau*, U.S. CENSUS BUREAU, http:// quickfacts.census.gov/qfd/states/06000.html (search under "Select a City" for "Anaheim" and "San Francisco") (last updated Aug. 16, 2010).

[261] Woody, *supra* note 259.

[262] *Id.*

[263] *Id.*

[264] *Total Electricity System Power*, CAL. ENERGY COMM'N, ENERGY ALMANAC, http://energyalmanac.ca.gov/electricity/total_system_power.html.

[265] Assuming a generous 30% capacity factor, 21,000 additional megawatts of rated solar would produce approximately 55,188,000 megawatt hours of electricity. Thus, using the same data from 2008, this quantity of solar would account for more than 26% of California's energy production putting the RPS goal of 33% by 2020 within reach. Still, the jump from 27 megawatts of rated capacity to 21,000 is quite a leap for one decade.

[266] *Large Solar Energy Projects: Solar Thermal Projects Under Review*, CAL. ENERGY COMM'N, http://www.energy.ca.gov/siting/solar/index.html (as of Oct. 29, 2010).

[267] Phil Taylor, *Public Lands: Tribes See Brightening of Once-Bleak Energy Development Prospects*, LAND LETTER, July 16, 2009, http:// www.eenews.net/public/Landletter/2009/07/16/1.

[268] *Member Proposals on Energy Tax Incentives: Hearing before the Subcomm. on Select Review Measures of the H. Comm. on Ways & Means*, 110th Cong. (Apr.24, 2007) (statement of Rep. Raul Grijalva (DAZ)).

[269] Tribal lands in Arizona account for approximately 24,753,480 acres. Rural Health Office, *Tribal Population Statistics*, UNIVERSITY OF ARIZONA, http://www.rho.arizona.edu/resources/dataline/Tribal_Health/default.aspx (last visited Nov. 3. 2010). The State of Arizona, meanwhile, occupies roughly 71,445,760 acres, according to recent census data. *See Arizona QuickFacts from the U.S. Census Bureau*, U.S. CENSUS, http:// quickfacts.census.gov/qfd/states/04000.html (last updated Aug. 16, 2010).

[270] A majority of the BLM applications are for land located in the eastern part of the state on the I-10 corridor connecting Phoenix to Los Angeles. The Colorado River Indian Reservation is especially close, geographically, to a number of these proposed sites. *See, e.g., Map of Solar Applications in Arizona*BUREAU OF LAND MGMT, http:// www.blm.gov/az/st/en/prog/energy/solar/propprojs.html (follow "Map of Solar Applications in Arizona") (last updated Sept. 18, 2009)

[271] Pub. L. No. 109-58, Tit V, § 503 (codified as 25 U.S.C. § 3501 (2006)).

[272] *Tribal Energy Self-Sufficiency Act and the Native American Development and Self-Determination Act: Hearing before the Comm. on Indian Affairs*, 108th Cong. (Mar. 19, 2003) (statement of Daniel K. Inouyte).

[273] *Id.* at 71 (statement of Theresa Rosier) (emphasis added). It is important to note that this statutory provision has yet to be implemented by the appropriate regulatory agencies (e.g. the DOE and the Office of Tribal Energy) but there is some evidence that this could happen soon. *See, e.g.*, NATIVE AMERICAN CONTRACTORS ASS'N 13, *Native American Economic Development Transition Recommendations for the Obama Administration* (Dec. 28, 2008), http://www.nativecontractors.org/media/pdf/NCAIED-NACA-NCAI-TransitionRecommendationsFINAL-12-23-08.pdf.

[274] As recent University of Arizona James E. Rogers College of Law graduate, Ryan Dreveskracht, has pointed out in his forthcoming work, Native Nation Economic Development via the Implementation of Solar Projects: How to Make it Work, "[t]he only time the federal government may interfere with the project is if it affects a federal trust resource (i.e. minerals, water, etc.), or if a lease or sale to a non-tribal entity for a period of more than seven years is involved." Thus, NEPA review may be triggered in relation to co-operative projects or right-of-way issues (as with transmission lines) but the extent of this review has yet to be fully determined. *See* Ryan D. Dreveskracht, *Native Nation Economic Development Via the Implementation of Solar Projects: How to Make it Work*, WASH. & LEE L. REV. (forthcoming), a*vailable at* SSRN: http://ssrn.com/abstract=1611403.

[275] T'SOU-KE NATION-SOOKE, BC, http://www.tsoukenation.com (last visited June 22, 2010).

[276] Honor the Earth, SUSTAINABLE TRIBAL ECONOMIES: A GUIDE TO RESTORING ENERGY AND FOOD SOVEREIGNTY IN NATIVE AMERICA, http://www.honorearth.org/ (last visited Nov. 3, 2010); Honor the Earth, NOW IS THE TIME TO ACT: A GREEN ECONOMY FOR THE SEVENTH GENERATION, http://www.honorearth.org/ (last visited Nov. 3, 2010).

[277] Phil Taylor, *supra* note 267.

[278] HONOR THE EARTH, 2008 ANNUAL REPORT 21 (2009).

[279] Mireya Navarro, *Navajos Hope to Shift From Coal to Wind and Sun*, N.Y. TIMES, Oct. 26, 2010, at A12.

[280] *Id.*

[281] *Id.*

[282] Winters v. United States, 207 U.S. 564, 574 (1908).

[283] *Id.* at 576.

[284] *Id.* at 577.

[285] *See*Arizona v. California, 547 U.S. 150, 157-58 (2006).

[286] "The foregoing reference to a quantity of water necessary to supply consumptive use required for irrigation ... shall constitute the means of determining quantity of adjudicated water rights *but shall not constitute a restriction of the usage of them to irrigation or other agricultural application*. If all or part of the adjudicated water rights of any of the five Indian reservations is used other than for irrigation or other agricultural application, the total consumptive use, as that term is defined in ... this decree, for said reservation shall not exceed the consumptive use that would have resulted if the diversions listed in ... this decree had been used for irrigation of the number of acres specified for that reservation in said paragraphs and for the satisfaction of related uses."
Id. at 168-69 (emphasis added).

[287] *See, e.g.*, Debra Gruszecki, *Augustine Band Takes Green Path*, THE DESERT SUN, Feb. 12, 2009, at B1.

[288] *Id.*

[289] OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEP'T. OF ENERGY, *Energy Efficiency and Conservation Block Grant Program*, http:// www1.eere.energy.gov/wip/eecbg.html (last updated Sep. 29, 2010).

[290] *See* American Recovery and Investment Act of 2009, Pub. L. No. 111-5, § 1102 (2009) (codified as amended at 26 U.S.C.A. § 48 (West 2010)).

[291] *Member Proposals on Energy Tax Incentives: Hearing before the Subcomm. on Select Review Measures of the H. Comm. on Ways & Means*, 110th Cong. (Apr. 24, 2007) (statement of Rep. Raul Grijalva (DAZ)).

[292] Fair Allocation of Internal Revenue Credit for Renewable Electricity Distribution by Indian Tribes Act of 2009, H.R. 2982, 111th Cong. (2009).

[293] *See*SUSAN BAKKER ET AL., CAL. ENERGY COMM'N, *2003 Integrated Energy Policy Report* (Dec. 2003), *available at* http://www.energy.ca.gov/reports/100-03-019F.PDF.

[294] *See* David Danelski, *Lauded Solar Plan in San Bernadino County Hits a Snag*, THE PRESS-ENTERPRISE, May 5, 2010.

[295] Marc Lifsher, *California's Clean Energy Future Threatened by Federal Delays, State Officials Say*, L.A. TIMES, July 28, 2010, http:// www.latimes.com/business/la-fi-solar-energy20100728,0,5792412.story.

[296] *But see* Lynh Bui, *supra* note 158; Press Release, Arizona Public Service, Starwood Solar I Agreement Terminated (Sept. 30, 2009), http:// www.aps.com/main/news/releases/release_553.html.

[297] Eric Weshoff, *$1.45 Billion Loan Guarantee for Abengoa CSP Plant*, GREENTECH MEDIA, July 5, 2010, http://www.greentechmedia.com/articles/read/abengoa/.