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The Energy-Water Nexus: Socioeconomic Considerations and Suggested Legal Reforms in the Southwest

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ABSTRACT

Energy and water shortages amplify each other and require innovation. Increasingly, developers are proposing renewable energy projects to help meet future energy needs while reducing water demand. In the Southwest, such projects may be subject to state siting procedures as well as water transfer proceedings. Each type of proceeding provides a means to account for impacts to third parties and should ensure that socioeconomic impacts are given appropriate weight. Toward that end, new legislation should expressly provide for socioeconomic issues to be incorporated into the review process for a broader range of energy projects and should improve consistency among the states to reduce transaction costs and enable progress toward sustainability. In addition, energy and water proceedings should be better integrated and should be designed to promote collaboration at all levels of government. This article examines how economic modeling should be used as one tool in the decision-making process, demonstrating how information involving new projects should be carefully monitored, compiled, and made available. To the extent possible, third parties should be compensated for impacts from new energy projects.

INTRODUCTION

Energy is needed to pump, treat, and transport water. Water is needed to produce energy: to cool equipment, to mine and process fuels, to irrigate biomass and feedstocks for biofuels, and to turn turbines in

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hydroelectric generators and geothermal systems, among other things.[1] At the same time, significant energy and water shortages have occurred, and more are looming. This poses a fundamental problem: How can we simultaneously meet the growing demand for water and energy when each one constrains the other? To address this conundrum, decision-makers require an understanding of the tradeoffs for society.

The link between energy and water constraints is not a new problem. More than three decades ago, commentators predicted: "As energy development in the western states increases, the competition for water between energy and other uses will intensify."[2] However, concerns about this "energy-water nexus" have intensified due to climate change,[3] security issues,[4] continuing population growth, and development pressure.[5]

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1. TAMIM YOUNOS, RACHELLE HILL & HEATHER POOLE, WATER DEPENDENCY OF ENERGY PRODUCTION AND POWER GENERATION SYSTEMS, VIRGINIA WATER RESOURCES RESEARCH CENTER SPECIAL REPORT NO. SR46-2009 (2009), *available at* http://www.nirs.org/reactorwatch/water/sr46waterdependency.pdf [hereinafter YOUNOS ET AL.]; P. TORCELLINI, N. LONG & R. JUDKOFF, CONSUMPTIVE WATER USE FOR U.S. POWER PRODUCTION, NATIONAL RENEWABLE ENERGY LABORATORY TECHNICAL REPORT NO. NREL/TP-550-33905 (2003), *available at* http://www.nrel.gov/docs/fy04osti/33905.pdf; AMERICAN WIND ENERGY ASS'N, *How Much Water Do Wind Turbines Use Compared with Conventional Power Plants?*, http://www.awea.org/faq/water.html (last visited Oct. 14, 2010).

2. A. Bruce Bishop & Rangesan Narayanan, *Competition of Energy for Agricultural Water Use*, 105 J. IRRIGATION AND DRAINAGE DIV. 317, 317 (1979). *See also* David J. Hayes, *Energy, Again—But With a Kicker*, 16 NAT. RESOURCES & ENV'T 215, 215 (2002) (explaining the cyclical interest in energy issues, with environmental issues adding complexity).

3. *See, e.g.*, Ronnie Cohen, *The Water-Energy Nexus*, SOUTHWEST HYDROLOGY, Sept.–Oct. 2007, at 16, 19 ("Any evaluation of new water supplies or re-examination of existing supplies must factor in the predicted impacts of climate change."); *see also* LUX RESEARCH, GLOBAL ENERGY: UNSHACKLING CARBON FROM WATER (2009).

4. As two water scholars aptly predicted more than 25 years ago, "Because water is so crucial an element in energy, agriculture, and economic productivity, it may be that a crisis in any of those sectors would quickly put water on the national agenda. If our oil supplies were threatened again, more seriously than the Iranian oil embargo, as by a revolution in Saudi Arabia, unparalleled pressures would be brought to make the U.S. energy-independent." Gary Weatherford & Helen Ingram, *Legal-Institutional Limitations on Water Use*, *in* WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE 51, 69–70 (Ernest A. Engelbert & Ann Foley Scheuring eds., 1984). "[G]overnments . . . are now besieged by doubts about their energy security like at no time since the oil crises of the 1970s." David G. Victor & Linda Yueh, *The New Energy Order*, FOREIGN AFF., Jan./Feb. 2010, para. 1.

5. *See, e.g.*, ELECTRIC POWER RESEARCH INSTITUTE (EPRI), SUSTAINABLE WATER RESOURCES MANAGEMENT: EXECUTIVE SUMMARY, vol. 1 at v (2010) (highlighting "the strong interdependencies between electric power and water sustainability with respect to community social and economic vitality"); *see also* Alexey Voinov & Hal Cardwell, *The Energy-Water Nexus: Why Should We Care?*, J. CONTEMP. WATER RESEARCH & EDUC., Dec. 2009, at 17, 19–21 (discussing "Water Return on Energy Invested" and "Energy Return on Energy Invested"); ROBERT GLENNON, UNQUENCHABLE: AMERICA'S WATER CRISIS AND WHAT TO DO ABOUT IT 51–64 (2009) (discussing the connection between energy use and water); Benjamin

Energy project economics also are driving the increased awareness of the energy-water nexus. Historically, nonrenewable energy sources like coal and oil dominated the energy development landscape.[6] More recently, however, capital markets shifted their focus to renewable energy development in response to diminishing coal and oil supplies, more costly extraction due in part to less accessible sources, emerging environmental and utility regulatory actions, declining technology costs, and higher energy prices.[7] For most of the past century, hydropower was the renewable ticket, offering substantial peaking flexibility and the ancillary benefits of flood control, water storage for agriculture and municipal and industrial purposes, and recreational opportunities.[8] Today, hydropower has lost its luster despite its potential to meet water and energy needs simultaneously without emitting carbon; few feasible opportunities remain for new hydropower development, and existing

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K. Sovacool, *Running on Empty: The Electricity-Water Nexus and the U.S. Electric Utility Sector*, 30 ENERGY L.J. 11, 24 (2009) (identifying metropolitan areas susceptible to severe water shortages due to thermoelectric power generation); Michael E. Webber, *Catch-22: Water vs. Energy*, SCI. AM., Sept. 2008, at 34 (discussing the tension between water and energy needs); YOUNOS ET AL., *supra* note 1 (assembling information on water use for energy production). In 2005, Congress provided $500,000 in funding for research on the interdependence of energy and water, particularly potential threats to energy production from limited water supplies. Consolidated Appropriations Act of 2005, Pub. L. No. 108-447, 118 Stat. 2809 (2004) (H.R. 4818). That funding culminated in a 2006 report to Congress based on collaboration between a dozen national laboratories (the "Energy-Water Nexus Committee"). The report documented energy and water challenges and gaps. U.S. DEP'T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES (2006), *available at* http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf. Subsequently, the Energy-Water Nexus Committee undertook a "Road Map" process to assess existing federal programs and provide guidance on future planning, research, and investment. *See* SANDIA NATIONAL LABORATORIES: ENERGY-WATER NEXUS, *Roadmap Process Summary Overview Presentations*, http://www.sandia.gov/energy-water/roadmap_summary.htm (last visited Oct. 14, 2010).

6. *See* U.S. Energy Information Administration, Annual Energy Review 2009, 7 (Aug. 2010), *available at* http://www.eia.gov/emeu/aer/pdf/pages/sec1_7.pdf.

7. Terence Chea, *Rising Fossil Fuel Prices Boost Prospects for Renewable Energy*, SAN DIEGO UNION-TRIB., Oct. 14, 2004, *available at* http://legacy.signonsandiego.com/news/science/20041014-1354-wst-greenenergy.html; *see also* RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY, RENEWABLES 2010 GLOBAL STATUS REPORT (2010), *available at* http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR_2010_full_revised%20Sept2010.pdf; U.S. DEP'T OF ENERGY, 2008 RENEWABLE ENERGY DATA BOOK 17 (July 2009), *available at* http://www1.eere.energy.gov/geothermal/pdfs/data_book.pdf ("Since 2000, renewable electricity installations in the United States (excluding hydropower) have nearly tripled. . . .").

8. *See* U.S. Dep't of Energy, *Hydropower Basics*, ENERGY EFFICIENCY & RENEWABLE ENERGY, http://www1.eere.energy.gov/windandhydro/hydro_basics.html (last updated Jan. 2010); *see also* MARC REISNER, CADILLAC DESERT 167–68 (1993) (discussing the politics behind the "go-go years" of dam construction).

projects have left a legacy of environmental problems such as fishery and ecosystem damage.[9] As a result, in some situations, maintaining a dam has become more expensive than demolishing it.[10]

An array of government incentives and mandates have heightened awareness of the energy-water nexus and promoted new renewable energy projects. The American Recovery and Reinvestment Act of 2009[11] (Recovery Act) provided a boost for many projects, with some related industries posting a record year for growth in 2009.[12] The Recovery Act extended production tax credits and investment tax credits available for renewable energy development and also provided grants in lieu of credits for new projects.[13] The U.S. Bureau of Land Management, the nation's largest federal landowner, has placed several renewable energy projects eligible for Recovery Act funding on a fast track for approval.[14] In addition, many states, including Arizona, California, Nevada, and New Mex-

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9. *See* Hayes, *supra* note 2, at 216 ("There is . . . virtually no prospect for growing this energy source; it is difficult to find an undammed river of any consequence in the United States. And ongoing policy debates about hydropower regulation add to the complexity of the hydropower picture."); RONNIE COHEN, BARRY NELSON & GARY WOLFF, NAT. RESOURCES DEF. COUNCIL, ENERGY DOWN THE DRAIN: THE HIDDEN COSTS OF CALIFORNIA'S WATER SUPPLY 10 (2004) ("Careful analysis . . . reveals that . . . proposed dams might in fact be net consumers of energy."); Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX. L. REV. 1873, 1879 (2005) ("A few smaller dams are still being built, such as the controversial Animas La Plata in Colorado, but the movement in the United States is in the opposite direction. We have begun to decommission dams.") [hereinafter Glennon, *Water Scarcity*]. *But see* NAVIGANT CONSULTING, JOB CREATION OPPORTUNITIES IN HYDROPOWER: FINAL REPORT 3 (2009), *available at* http://www.hydro.org/Jobs%20Study/NHA_JobsStudy_Final%20Report_Final_Sept%2020.pdf (concluding that "[t]he U.S. hydropower industry could install 23,000 MW–60,000 MW of new capacity by 2025 . . . which will require nearly 230,000–700,000 jobs"); U.S. Dep't of Energy, Office of Energy Efficiency and Renewable Energy, *Hydropower Upgrades Yield Added Generation Without New Dams*, EERE NEWS (Nov. 4, 2009), http://apps1.eere.energy.gov/news/daily.cfm/hp_news_id=217 (discussing seven proposed hydropower projects that would increase generation at existing facilities).

10. *See* GLENNON, *supra* note 5, at 119.

11. The American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5 (codified in scattered sections). *See also* The Recovery Act, http://www.recovery.gov/About/Pages/The_Act.aspx.

12. *See, e.g.*, AMERICAN WIND ENERGY ASS'N, AWEA YEAR END 2009 MARKET REPORT 1 (2010), *available at* http://www.awea.org/publications/reports/4Q09.pdf ("The U.S. wind industry broke all previous records by installing close to 10,000 megawatts of new generating capacity in 2009 thanks to Recovery Act incentives. . . . In 2009, 38 manufacturing facilities were brought online, announced or expanded.").

13. *Renewable Electricity Production Tax Credit*, DSIREUSA.ORG, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F&re=1&ee=0 (last updated May 4, 2010).

14. *Fast-Track Renewable Energy Projects*, BLM.GOV, http://www.blm.gov/wo/st/en/prog/energy/renewable_energy/fast-track_renewable.html (last updated Oct. 13, 2010).

ico, have implemented renewable portfolio standards (RPS) requiring utilities to increase the proportion of their power supplies from renewable sources.[15]

While renewable energy project proposals have proliferated, project implementation is increasingly constrained by water scarcity in the Southwest.[16] In some cases, renewable energy project developers have been forced to forgo well-established technologies and pursue emerging, more water-efficient alternatives with higher upfront costs.[17] The unavailability of anticipated water supplies has delayed renewable energy project development.[18] Some relatively high water-use renewable energy project proposals have been scrapped entirely to make way for less water-consumptive projects.[19]

Competition for scarce water supplies is reaching new levels of intensity throughout the Southwest and, as renewable energy project developers scramble to fill the parallel growing demand for energy, third-party impacts—particularly socioeconomic impacts—must not be ignored. Although third-party impacts can be difficult and sometimes

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15. *See* U.S. Dep't of Energy, *States with Renewable Portfolio Standards*, ENERGY.GOV, http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm (last updated June 16, 2009). Utah has set voluntary goals for adopting renewable energy rather than impose binding RPS. *Id.*

16. *See* Comments of Southwest Gas Corp. at 8, Notice of Requested Comments for Ariz. Res. Planning, No. E-00000E-05-0431 (Ariz. Corp. Comm'n 2005), *available at* http://www.cc.state.az.us/divisions/utilities/electric/RP-Comments06.doc (quoting Chairman Hatch-Miller for the proposition that "[a] scarce water supply . . . may complicate the state's effort to add new power plants"). *See also* CLEAN AIR TASK FORCE AND THE LAND AND WATER FUND OF THE ROCKIES, THE LAST STRAW: WATER USE BY POWER PLANTS IN THE ARID WEST 6–7 (2003), *available at* http://www.catf.us/publications/reports/The_Last_Straw.pdf (discussing water-related constraints on traditional energy projects).

17. Todd Woody, *Alternative Energy Projects Stumble on a Need for Water*, N.Y. TIMES, Sept. 30, 2009, at B1; John Fleck, *Solar Plant Water Usage A Concern: Power Community Seeks Consumption Alternatives*, ALBUQUERQUE J., June 28, 2009, at A1.

18. *See* Transcript of Prehearing Conference at 43–51, Application for Certification for the Imperial Valley Solar Project, No. 08-AFC-5 (Cal. Energy Res. Conservation & Dev. Comm'n Mar. 25, 2010), *available at* http://www.energy.ca.gov/sitingcases/solartwo/documents/2010-03-25_Transcript.pdf (discussing solar project's water supply issues resulting from failure to complete wastewater treatment upgrades).

19. The Carrizo Energy Solar Farm was a proposed 177 MW concentrating solar power project that was two years into California's licensing process when it was abandoned in November 2009, resulting in the cancellation of a power purchase agreement with Pacific Gas and Electric, which expected to rely on the power to help meet RPS requirements. Todd Woody, *Ausra Sells Planned Plant to First Solar*, N.Y. TIMES GREEN BLOG (Nov. 5, 2009), http://green.blogs.nytimes.com/2009/11/05/ausra-sells-planned-plant-to-first-solar/. The project's abandonment is expected to help secure the necessary approvals of two other nearby solar projects, which are proposed to use less water-consumptive photovoltaic technology. *Id.*

impossible to quantify, they must be given appropriate weight in decisions to efficiently allocate water and energy resources. Moreover, assessing these impacts involves consideration of not only their magnitude but also their distribution.

This article explores the potential socioeconomic impacts from converting water use to new renewable energy projects in four different technologies: solar, wind, geothermal, and biomass. This article concentrates on the displacement of water used for agriculture, a displacement that may be inevitable given the agricultural sector's immense water and energy consumption and often relatively low profit margins.[20]

This article focuses geographically on the Southwest, where water supplies are severely constrained but vast renewable energy resource potential exists. In addition to abundant sunshine,[21] considerable geothermal[22] and wind[23] resources, and substantial agriculture (which provides

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20. *See, e.g.*, GLENNON, *supra* note 5, at 273 ("Let's be clear about one thing: the water for new demands . . . will mostly come from agriculture, because farmers use 70 to 80 percent of each state's water. Another driving factor is money. In many states, a high percentage of agricultural water is used to grow crops that return a relatively low value."); NAT'L RESEARCH COUNCIL, WATER IMPLICATIONS OF BIOFUELS PRODUCTION IN THE UNITED STATES 3 (2008), *available at* http://www.nap.edu/catalog/12039.html ("The primary concern with regard to water availability is how much irrigation will be required—either new or reallocated—that might compete with water used for other purposes."); Bishop & Narayanan, *supra* note 2 ("The major pressure for shifting water to energy uses is being felt by the agriculture sector."). *See also* Clay J. Landry, *A Solar-Powered Water Grab*, WATER RESOURCES IMPACT, Sept. 2009, at 23 ("Some solar companies are recognizing that water will be vital to their success. For example, Arizona Public Services, the state's largest electric utility, has focused solar development on farmland purchased with existing water rights previously used for growing alfalfa and cotton."); CAL. ENERGY COMM'N, SALTON SEA GEOTHERMAL UNIT #6 POWER PROJECT 32, 158 (2003), *available at* http://www.energy.ca.gov/sitingcases/saltonsea/documents/2003-12-19_COMISN_DECISION.PDF (approving 185 MW geothermal power plant proposed to use approximately 293 acre-feet of fresh water per year from the water delivery system of Imperial Irrigation District (IID), resulting in loss of approximately 173 acres of farmland).

21. *See* Nat'l Renewable Energy Lab, *Solar Maps*, NREL: DYNAMIC MAPS, GIS DATA, AND ANALYSIS TOOLS, http://www.nrel.gov/gis/solar.html (last updated June 15, 2010).

22. *See* BILLY ROBERTS, NATIONAL RENEWABLE ENERGY LAB, GEOTHERMAL RESOURCES OF THE UNITED STATES (2008), http://www.nrel.gov/gis/images/map_geothermal_national_lo-res.jpg.

23. *See* U.S. Dep't of Energy, Wind Powering America: 80-Meter Wind Maps and Wind Resource Potential, WINDPOWERINGAMERICA.GOV (last updated Oct. 6, 2010), http://www.windpoweringamerica.gov/wind_maps.asp. *See also* AMERICAN WIND ENERGY ASS'N, *supra* note 12, at 3 (reporting that, in 2009, California had the nation's third-largest amount of wind energy installations, Arizona became the site of its first utility-scale wind project, and Utah increased its wind energy capacity by an order of magnitude).

a potential feedstock for biomass energy[24] and can be relatively inexpensive[25]), this region's population-growth projections are among the highest in the country.[26] All of this makes the Southwest a logical focal point in the emerging dialogue about the energy-water nexus and the associated discussion of potential third-party impacts.

This article proceeds as follows: Part I provides a summary of the legal framework surrounding water and energy project planning in the Southwest. Part II discusses several socioeconomic impacts that should be considered in the planning process for energy and water projects. Part III presents a hypothetical case study of renewable energy development in Imperial County, California, one of many locations within the Southwest that is a primary target for such development. Part IV includes a brief discussion of actual water transfers that have occurred in connection with energy projects. Part V recommends strategies to enhance the consideration of socioeconomic impacts in water and energy project planning.

I. LEGAL FRAMEWORK

A. Energy Project Siting

To build a new generation project, a developer must find a site with ample energy resources and water supplies, proper land conditions (i.e., topography, space, price)[27] and access to transmission lines with sufficient capacity to transport new generation to energy demand (or "load") centers.[28] Then, the project developer must obtain financing and navigate through the permitting process, which may involve many resource agencies on the municipal,[29] county, state, and federal levels.

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24. *See* BILLY ROBERTS, NAT'L RENEWABLE ENERGY LAB, BIOMASS RESOURCES OF THE UNITED STATES: TOTAL RESOURCES BY COUNTY (2009), http://www.nrel.gov/gis/images/map_biomass_total_us.jpg.

25. *See* Nat'l Agric. Statistics Serv., *Charts and Maps: Land Values and Cash Rents*, NASS.USDA.GOV, http://www.nass.usda.gov/Charts_and_Maps/Land_Values_and_Cash_Rents/index.asp (last visited Jan. 29, 2010).

26. *See* U.S. CENSUS BUREAU, INTERIM PROJECTIONS: RANKING OF CENSUS 2000 AND PROJECTED 2030 STATE POPULATION AND CHANGE: 2000 TO 2030 (2005), http://www.census.gov/population/projections/PressTab1.xls.

27. JIM DYER, CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS, U.S. DEPARTMENT OF ENERGY TRANSMISSION BOTTLENECK PROJECT REPORT 89 (2003), *available at* http://www.oe.energy.gov/DocumentsandMedia/current_transmission_bottlenecks_report.pdf.

28. XIAOBO WANG, CALIFORNIA ISO, ECONOMIC PLANNING STUDY–CONGESTION EVALUATION 20 (2009), *available at* http://www.caiso.com/244e/244ef0f960680.pdf.

29. For example, water supply problems may arise in the context of local zoning. *See, e.g.*, Lee Ross, *Tank Halts Residential Solar Energy System*, ALBUQUERQUE J., Dec. 24, 2009, at

Proposed energy projects often require some form of state certification before breaking ground. Depending on the state, jurisdiction over siting may involve a single state agency, such as the California Energy Commission[30] (CEC); multiple state authorities, such as the Arizona Power Plant and Transmission Line Siting Committee and the Arizona Corporation Commission[31] (ACC); or several state, county, and local entities, such as in Utah.[32] Typically, the certification process requires a state determination that the proposed project is in the "public interest" based on a list of criteria prescribed by legislation.[33] In most cases, those criteria do not include the availability of water or socioeconomic impacts.[34] Smaller projects tend to be exempt from state certification processes, though the threshold size varies by state.[35] Some states also exempt certain renewable energy projects from state certification requirements, such as in California,[36] Nevada,[37] and Utah.[38]

A3 (discussing the need for a variance for a water storage tank for a small-scale renewable energy project).

30. CAL. PUB. RES. CODE § 25519 (West, Westlaw through 2010 legislation).

31. ARIZ. REV. STAT. ANN. § 40-360.07(A) (West, Westlaw through the Second Regular Session and Ninth Special Session of the Forty-Ninth Legislature (2010)).

32. *State of Utah Electric Generation Plant Siting Requirements*, UTAH DIVISION OF PUBLIC UTILITIES (Jan. 9, 2006), http://publicutilities.utah.gov/elect_siting.html.

33. *See, e.g.*, ARIZ. REV. STAT. ANN. §§ 40-360.06, 40-360.07(B) (West, Westlaw through 2010 legislation)); CAL. PUB. RES. CODE § 25509.5 (West, Westlaw through 2010 legislation); NEV. REV. STAT. § 704.890 (West, Westlaw through 2009 legislation); N.M. STAT. ANN. § 62-9-3(M) (West, Westlaw through 2010 legislation).

34. *But see* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-23, ENERGY-WATER NEXUS: IMPROVEMENTS TO FEDERAL WATER USE DATA WOULD INCREASE UNDERSTANDING OF TRENDS IN POWER PLANT WATER USE 60, 63–64 (2009), *available at* http://www.gao.gov/new.items/d1023.pdf (explaining integration of water issues into power-plant siting in Arizona and California under certain circumstances) [hereinafter GAO-10-23]; CAL. ENERGY COMM'N, ENERGY FACILITY LICENSING PROCESS: DEVELOPERS GUIDE OF PRACTICES & PROCEDURES 30 (2000), *available at* http://www.energy.ca.gov/siting/documents/2000-12-07_700-00-007.PDF (explaining comprehensive evaluation process for new power-project siting in California, including analysis of socioeconomic issues).

35. *See, e.g.*, ARIZ. REV. STAT. ANN. § 40-360 (West, Westlaw through 2010 legislation) (requiring certification for "thermal electric, nuclear or hydroelectric generating" units of 100 MW or more, as well as transmission lines); NEV. REV. STAT. § 704.860 (West, Westlaw through 2009 legislation) (requiring state review of proposed "utility facilities" including transmission, generation, and water projects); CAL. PUB. RES. CODE § 25120 (West, Westlaw through 2010 legislation) (requiring state certification for proposed electrical generating projects or "thermal power plants" with a capacity of 50 MW or greater).

36. CAL. PUB. RES. CODE § 25120. For any wind, hydroelectric, or solar photovoltaic electrical generating facility projects, the relevant permitting authority typically is the county government. *See* David Sneed, *Solar Power Company Drops Out of Plans for Carrizo Plain in Eastern San Luis Obispo County*, SAN LUIS OBISPO TRIB., Nov. 4, 2009, http://www.sanluisobispo.com/2009/11/04/909652/solar-power-company-drops-out.html.

Beyond state certification processes, a complex array of other federal, state, county, and local requirements may apply to proposed energy projects.[39] For example, if federal land ownership is involved or federal approval is required for some component of a project, the project may trigger review under the National Environmental Policy Act[40] (NEPA). NEPA provides for the disclosure of socioeconomic considerations[41] but does not provide any specific thresholds for project approval. Similarly, California's state-level analogue to NEPA, the California Environmental Quality Act (CEQA), requires state agencies to balance, on a regional and statewide basis, the risks and potential economic and social benefits of proposed projects when deciding whether to approve them.[42] While CEQA does not treat "[e]conomic and social changes resulting from a project [per se] as significant effects on the environment,"[43] CEQA deems a project to have significant effects if it involves the conversion of certain types of farmland to non-agricultural use, physical impacts to a community, such as by displacing housing units or requiring new housing con-

37. NEV. REV. STAT. § 704.860 (West, Westlaw through 2009 legislation) (providing statutory carve-out for renewable energy projects with a capacity of 70 MW and under). In an effort to promote renewable energy in Nevada, the state legislature modified the statute in 2009 to increase the carve-out from 35 MW to 70 MW. Act of June 8, 2009, ch. 480, sec. 4, § 704.860, 2009 Nev. Stat. 2753 (codified as amended at NEV. REV. STAT. § 704.860).

38. UTAH CODE ANN. § 54-2-1(7), (14)(a), (16)(d) (West, Westlaw through 2010 legislation).

39. For a summary of local requirements in western states, at least with respect to transmission projects, see JAMES A. HOLTKAMP & MARK A. DAVIDSON, TRANSMISSION SITING IN THE WESTERN UNITED STATES: OVERVIEW AND RECOMMENDATIONS PREPARED AS INFORMATION TO THE WESTERN INTERSTATE ENERGY BOARD (2009), *available at* http://www.hollandhart.com/articles/Transmission_Siting_White_Paper_Final.pdf.

40. National Environmental Policy Act of 1969, 42 U.S.C. § 4321 (2006).

41. An Environmental Impact Statement under NEPA must include analysis of the following types of impacts: "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. § 1508.8 (2009). The federal regulations acknowledge that certain impacts must be analyzed subjectively. *See* 40 C.F.R. § 1502.23 (2009) ("For purposes of complying with [NEPA], the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."). *See also* Metro. Edison Co. v. People Against Nuclear Energy, 460 U.S. 766, 771–75 (1983) (effects on the psychological health and community well-being of residents of an area surrounding a proposed project are cognizable under NEPA as long as they are not "too attenuated.").

42. Cal. Code Regs. tit. 14, § 15093 (2010).

43. *Id.* at § 15064.

struction, or by requiring changes to governmental facilities, such as schools, firehouses, and parks.[44]

B. Water Transfers

Construction of an energy project requires water to be available not only physically but also legally. Laws governing water rights are unique to each state and may differ for groundwater, surface water, Colorado River water, and effluent. Generally, in western states governed by the doctrine of prior appropriation, the right to use water is a property right that can be bought or sold. Appropriations generally are "first in time, first in right" and must be dedicated to "beneficial uses."[45] Where the demand for water rights exceeds the supply, some states have established a system in which certain water rights are given preference over others, with energy projects typically valued somewhere in the middle.[46]

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44. ASSOCIATION OF ENVIRONMENTAL PROFESSIONALS, 2010 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) STATUTE AND GUIDELINES 250 (2010), *available at* http://ceres.ca.gov/ceqa/docs/2010_CEQA_Statutes_and_Guidelines.pdf (App. G: Environmental Checklist Form).

45. State interpretations of "beneficial use" vary. In Arizona, beneficial uses may include use for domestic, municipal, recreation, fish and wildlife, agricultural, mining, stockwatering, and power purposes. ARIZ. REV. STAT. ANN. § 45-181 (West, Westlaw through 2010 legislation). In California, beneficial uses may include domestic, municipal, and industrial purposes, irrigation, power, frost protection, mining, fish and wildlife preservation, aquaculture, recreation, water quality, stockwatering, and heat control. Cal. Code Regs. tit. 23, §§ 659–672 (2010). Among the beneficial uses recognized in Nevada are irrigation, power purposes, municipal supply, domestic use, mining, and stockwatering. NEV. REV. STAT. §§ 533.030, 533.340 (West, Westlaw through 2009 legislation). In New Mexico, beneficial uses are not expressly listed in state statutes or regulations but are generally defined as "the basis, the measure and the limit of the right to the use of water." N.M. STAT. ANN. § 72-1-2 (West, Westlaw through 2010 legislation). In Erickson v. McLean, 308 P.2d 983, 988 (N.M. 1957), the Supreme Court of New Mexico defined beneficial use as "the use of such water as may be necessary for some useful and beneficial purpose in connection with the land from which it is taken." "[T]he State Engineer has broad authority in considering what constitutes beneficial use in New Mexico." *New Mexico Water Rights Fact Sheet*, WESTERN STATES WATER LAWS (Aug. 15, 2001), http://www.blm.gov/nstc/WaterLaws/newmexico.html. Utah regulations provide a list of examples of "beneficial uses," including irrigation, stockwatering, domestic, commercial, industrial, and municipal purposes. Utah Admin. Code r.655-16-5(1)(b) (2010). Although the Utah regulations expressly state that beneficial uses are not limited to the listed examples, "power generation" was affirmatively omitted from the list. 2010-5 Utah Bull. 58, 59 (Feb. 2, 2010).

46. In Arizona, for example, water rights applications for domestic, municipal, irrigation, and stockwatering uses are given preference over applications for power uses, which are given preference over recreation, fish and wildlife, and "non-recoverable" water storage. ARIZ. REV. STAT. ANN. § 45-157 (West, Westlaw through 2010 legislation). *See also* CAL. WATER CODE § 106 (West, Westlaw through 2010 legislation) ("It is hereby declared to be

Generally, water rights remain in effect until they are abandoned or forfeited.

Where appropriations have accounted for all of the available supply in an area—as is now the case in most of the Southwest—new demands frequently are met through voluntary transfers from existing water rights holders.[47] The theory behind water transfers is that capitalism can be harnessed to address limited supplies in which water should flow to the highest bidder so that its value can be maximized.[48] Water transfers also have been promoted as a means of conserving energy.[49] In some cases, however, water transfers face constraints relating to the use of water for energy production. In Arizona, for example: (1) legislative approval may be required for the use of water to generate electric energy in excess of 25,000 horsepower, equivalent to approximately 18.6 megawatts (MW);[50] (2) water rights for power production may expire after 40 years;[51] and (3) thermal generating plants may use no more than 34,000 acre-feet of Colorado River water annually.[52]

Parties seeking water transfers must participate in administrative or judicial proceedings and obtain approval from water courts, the state engineer, or another water official or agency.[53] Third parties that are not directly involved in water transfers, including "appropriators" (i.e., other holders of water rights) and "non-appropriators" (including the sur-

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the established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation.").

47. Other potential "new" supplies can be derived from desalination, conservation, effluent reuse, Glennon, *Water Scarcity*, *supra* note 9, at 1878–84, and "conjunctive use (i.e., using an alternative supply such as groundwater to replace use of surface water)." DONALD B. MOONEY & MARSHA A. BURCH, WATER ACQUISITION HANDBOOK: HOW TO ACQUIRE WATER FOR THE ENVIRONMENT IN CALIFORNIA 41–42 (2003).

48. *See* Christine A. Klein, *Water Transfers: The Case Against Transbasin Diversions in the Eastern States*, 25 UCLA J. ENVTL. L. & POL'Y 249, 254–57 (2006–2007) (providing citations to a large body of literature on the pros and cons of using free markets to facilitate water transfers).

49. *See* CAL. WATER CODE § 475 (West, Westlaw through 2010 legislation) ("The Legislature further finds and declares that transfers of surplus water on an intermittent basis can help alleviate water shortages, save capital outlay development costs, and conserve water and energy.").

50. ARIZ. REV. STAT. ANN. § 45-156 (West, Westlaw through 2010 legislation).

51. *Id.* at § 45-162.

52. *Id.* at § 45-166.

53. Charles W. Howe & Christopher Goemans, *Water Transfers and Their Impacts: Lessons from Three Colorado Water Markets*, 39 J. AM. WATER RESOURCES ASS'N 1055, 1056 (2003). The outcomes of these proceedings typically are subject to de novo judicial review. *See, e.g.*, Montgomery v. Lomos Altos, Inc., 2007-NMSC-002, ¶¶ 1, 3, 150 P.3d 971, 972–73; United States v. Alpine Land & Reservoir Co., 341 F.3d 1172, 1180 (9th Cir. 2003); Western Water, LLC v. Olds, 2008 UT 18, ¶ 17, 184 P.3d 578 (2008).

rounding community, the general public, and environmental advocates), may protest a water transfer. When a protest occurs, it typically becomes the proponent's burden to show that a proposed transfer will not unduly affect third parties.[54] The right to participate in water transfer proceedings may give third parties substantial leverage to influence water transactions despite their being "external" to those transactions and despite limits on their ability to appeal to the courts.[55] "When legally valid protests are filed, transfer approval is significantly delayed as the applicant and protestants argue over the magnitude of transfer impacts and the extent of mitigation or compensation. . . . [M]any approvals are conditioned on modifying the original transfer proposal to satisfy objectors."[56]

To address concerns about third-party impacts arising from water transfers, southwestern states have established various legal approaches, including "public interest" reviews and "area-of-origin" protections.[57] Like the "public interest" determinations involved in energy project siting, southwestern states generally have authorized regulators to consider non-appropriators' interests, or the "public interest" or "public welfare," in water transfer proceedings.[58] However, the states have not clearly defined what is encompassed by those terms. For example, in

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54. George A. Gould, *Water Rights Transfers and Third-Party Effects*, 23 LAND & WATER L. REV. 1, 20 (1988).

55. *See id.* "[T]hird party effects . . . represent a significant impediment to the development of water markets." *Id.* at 5. *See also* TERRY L. ANDERSON & DONALD R. LEAL, FREE MARKET ENVIRONMENTALISM 118 (1991) (arguing that the "public trust doctrine" is eroding the ability of water policymakers to "reap the advantages of the market"). *But see* Bonnie G. Colby, *Economic Impacts of Water Law-State Law and Water Market Development in the Southwest*, 28 NAT. RESOURCES J. 721, 722 (1988) ("It must be emphasized that policies which restrict market activities and make transactions more costly are not necessarily wasteful or inefficient. They are an expression of the concerns that members of society and policy makers have about reallocating water through market processes and they provide protection for third-parties who may be impacted by water transfers.").

56. Bonnie G. Colby, *Transaction Costs and Efficiency in Western Water Allocation*, 72 AM. J. AGRIC. ECON. 1184, 1186–89 (1990).

57. CAL. WATER CODE § 1215 (West, Westlaw through 2010 legislation) (see subsection (d) of the historical and statutory notes).

58. *See, e.g.*, CAL. WATER CODE § 386 (West, Westlaw through 2010 legislation); *id.* § 109 (establishing California policy "to facilitate the voluntary transfer of water and water rights where consistent with the public welfare of the place of export and the place of import"); N.M. STAT. ANN. § 72-12-7(A) (West, Westlaw through 2010 legislation); NEV. REV. STAT. §§ 533.345–533.372 (West, Westlaw through 2009 legislation)). *Cf.* ARIZ. REV. STAT. ANN. § 45-172 (West, Westlaw through 2010 legislation) (allowing water transfers "for use for irrigation of agricultural lands or for municipal, stock watering, power and mining purposes" provided that certain conditions are met, including that "[v]ested or existing rights to the use of water shall not be affected, infringed upon nor interfered with." While Arizona law requires any appropriation of water to be rejected if it "is against the interests and welfare of the public," third parties have relatively limited appeal rights with

2003, the Ninth Circuit determined that the task of defining "public interest" in Nevada falls upon the state engineer and, ultimately, the Nevada courts.[59] The Nevada Supreme Court has expressly held that economic considerations need not be part of the state engineer's public interest determination.[60] Similarly, the Utah Supreme Court has concluded that the state engineer can make final decisions regarding whether a water transfer ultimately may prove "detrimental to the public welfare," subject to judicial review and a "strict procedural approach" established by the state legislature "in order to 'maintain order and efficiency in the appropriation, distribution and conservation of water and to allow as much water to be beneficially used as possible.'"[61]

In addition to "public interest" reviews, southwestern states have implemented "area-of-origin" laws to protect third parties' rights related to water transfers.[62] The goal of these laws is to protect local interests in the area of origin of a water transfer, particularly when regional effects are considered beneficial.[63] States have adopted a variety of approaches to area-of-origin protection, including prohibitions on water exports from certain areas,[64] monetary compensation for redistribution effects,[65] and water set-asides in areas that otherwise would require water rights holders to use their rights or lose them.[66]

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respect to appropriations. *See* Ariz. Game & Fish Dep't v. Ariz. State Land Dep't, 535 P.2d 621, 622 (Ariz. Ct. App. 1975).

59. United States v. Alpine Land & Reservoir Co., 341 F.3d 1172, 1182 (9th Cir. 2003).

60. Pyramid Lake Paiute Tribe of Indians v. Washoe Cnty., 918 P.2d 697, 700 (Nev. 1996). *Cf.* Shokal v. Dunn, 707 P.2d 441, 449 (Idaho 1985) (citing Alaska law, ALASKA STAT. § 46.15.080, to interpret Idaho public interest requirements and concluding "common sense argues [that the economic effect of water use] ought to be considered part of the local public interest.").

61. Western Water, L.L.C. v. Olds, 2008 UT 18 at ¶ 8, 184 P.3d 578; *see also* United States v. Dist. Court of Fourth Jud. Dist., 238 P.2d 1132, 1134 (Utah 1951) ("Although the engineer is required, the same as courts, to exercise discretion, determine facts after a hearing and approve or reject applications accordingly, his duties are administrative in nature and purpose.").

62. CAL. WATER CODE § 1215 (see subsection (d) of the historical and statutory notes).

63. WESTERN STATES WATER COUNCIL, WATER LAWS AND POLICIES FOR A SUSTAINABLE FUTURE: A WESTERN STATES' PERSPECTIVE 120 (2008), *available at* http://www.westgov.org/wswc/laws%20&%20policies%20report%20(final%20with%20cover).pdf.

64. CAL. WATER CODE §§ 10505–10505.5 (West, Westlaw through 2010 legislation).

65. 2-14 WATERS AND WATER RIGHTS § 14.04 (Robert E. Beck & Amy L. Kelley, eds., 3d ed. LexisNexis/Matthew Bender 2010) (citing ARIZ. REV. STAT. ANN. §§ 9-431–9-432, 42-15251–42-15254, 45-545–45-551 (2010); CAL. WATER CODE §§ 1215–1222 (2009)).

66. N.M. OFFICE OF THE STATE ENG'R, MIDDLE RIO GRANDE REGIONAL WATER PLAN 2000–2050 app. 12.13.3 (2004) (citing N.M. STAT. ANN. §§ 72-1-9–72-12-8), *available at* http://www.ose.state.nm.us/isc_regional_plans12.html.

"Public interest reviews and area-of-origin protection statutes were developed at least partially in response to the concern over the short and long-term effects of transfers on rural and farming communities."[67] Therefore, to some extent, water transfer proceedings, like the proceedings for an energy project siting, provide a means to consider socioeconomic impacts. The nature of those impacts is discussed in the following Part.

II. SOCIOECONOMIC CONSIDERATIONS

A. Overview

The socioeconomic impacts of water transfers from agriculture to energy projects are complex. Such impacts may be direct, indirect, or induced; temporary or permanent; immediate or gradual; positive or negative.[68] Examples include impacts to employment, population, income, real estate values, taxes, business activity, gross domestic product (GDP), health and worker safety, and energy system reliability and security.[69] Direct impacts can further affect related industries, government services, political and social resources, and community demographics as local populations and income levels change.[70] Quantifying these impacts re-

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67. WESTERN STATES WATER COUNCIL, *supra* note 63, at 121 (quoting NAT'L RESEARCH COUNCIL, COMM'N ON GEOSCIENCES, ENV'T & RES., WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY, AND THE ENVIRONMENT 45 (1992)).

68. Indirect impacts are those impacts resulting from business spending on production inputs to meet the demand change generated by a direct spending impact. Induced impacts are those impacts resulting from spending of employee compensation and other income generated by a direct spending impact. *See generally* Alberta H. Charney & Gary C. Woodard, *Socioeconomic Impacts of Water Farming on Rural Areas of Origin in Arizona*, 72 AM. J. AGRIC. ECON. 1193, 1194 (1990); *see also* Charles W. Howe, Jeffrey K. Lazo, & Kenneth R. Weber, *The Economic Impacts of Agriculture-to-Urban Water Transfers on the Area of Origin: A Case Study of the Arkansas River Valley in Colorado*, 72 AM. J. AGRIC. ECON. 1200, 1201 (1990) ("[T]he severity of economic impacts in the area of origin will differ according to (*a*) whether or not the new use is inside or outside the economic area encompassing the area of origin, (*b*) the economic vitality of the area of origin, (*c*) whether or not the water sales proceeds are reinvested in the area of origin, and (*d*) the strength of the backward and forward linkages between irrigated agriculture and supplying and processing sectors.").

69. *See, e.g.*, Laura C. Makar, *Increased Urban Water Supply Reliability through Voluntary Transfers of Reclamation Water*, 24 NAT. RESOURCES & ENV'T 26, 28 (2010); ALYSSA KAGEL, GEOTHERMAL ENERGY ASS'N, A HANDBOOK ON THE EXTERNALITIES, EMPLOYMENT, AND ECONOMICS OF GEOTHERMAL ENERGY i (2006), *available at* http://www.geo-energy.org/reports/Socioeconomics%20Guide.pdf; BENT SØRENSEN, RENEWABLE ENERGY 778 (3d ed. 2004), Asit K. Biswas, *Socio-Economic Considerations in Water Resources Planning*, 9 WATER RESOURCES BULL. 746 (1973).

70. *See generally* Albert Schaffer & Ruth C. Schaffer, *Social Impacts on Rural Communities*, *in* WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE, *supra* note 4, at 309–30; *see also* Howe & Goemans, *supra* note 53, at 1062 ("When agricultural production falls, activities

quires assumptions regarding interest rates, planning horizons/depreciation periods, types of financing, and geographic study areas, among other considerations.[71] These assumptions may vary significantly, resulting in huge variances in analytical outcomes,[72] and reflect the choices, or prejudices, of the decision-maker. Analytical tools themselves "are not independent of social preferences" and cater to "different positions in the social debate."[73]

Adding to the complexity of socioeconomic impact analysis is the normative question of whether such analysis is appropriate in relation to water transfers out of agriculture.

> Scholars disagree on the significance and even the presence of adverse effects on rural communities. One reason, however, for the disagreement on this issue is because "no consensus exists within our society about the value of these communities."[74] Additionally, while impacts "may be small in relation to a state's entire economy, they are significant to area-of-origin residents."[75]

Furthermore, "[m]any rural communities have been in economic decline for some time, and attributing the reduced economic activity to the water transfer may be difficult."[76] As commentators have noted, some farms would fail anyway, even in the absence of water transfers out of agriculture.[77] Others have questioned whether third-party impacts deserve such

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linked to agriculture are negatively affected; suppliers of agricultural inputs lose business; processors of agricultural outputs lose supply sources; financial institutions lose the demand for loans, etc.").

71. *See* SØRENSEN, *supra* note 69, at 741–49.

72. Larry Leistritz & Nancy Hodur, *Local and Regional Economic Impacts of Biofuel Development*, *in* TRANSITION TO A BIO ECONOMY: ENVIRONMENTAL AND RURAL DEVELOPMENT IMPACTS PROC. 168 (Madhu Khanna ed. 2008) *available at* http://www.farmfoundation.org/news/articlefiles/401-Final_version_Farm_Foundation%20feb%2020%2009.pdf.

73. SØRENSEN, *supra* note 69, at 731.

74. WESTERN STATES WATER COUNCIL, *supra* note 63, at 121 (quoting NAT'L RESEARCH COUNCIL, COMM'N ON GEOSCIENCES, ENV'T & RES., WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY, AND THE ENVIRONMENT 45 (1992)).

75. *Id.* (quoting NAT'L RESEARCH COUNCIL, COMM'N ON GEOSCIENCES, ENV'T & RES., WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY, AND THE ENVIRONMENT 46 (1992)).

76. Noel R. Gollehon, *Water Markets: Implications for Rural Areas of the West*, 14(2) RURAL DEVELOPMENT PERSPECTIVES 57, 61 (1999), *available at* http://www.ers.usda.gov/publications/rdp/rdpsept99/rdpsept99.pdf.

77. Howe & Goemans, *supra* note 53, at 1062. *See also* Robert A. Young, *Local and Regional Economic Impacts*, *in* TRANSITION TO A BIO ECONOMY: ENVIRONMENTAL AND RURAL DEVELOPMENT IMPACTS PROC., *supra* note 72, at 262–64 (arguing that "changes between sectors are the natural consequence of an evolving economy" and "[t]hose who are forced out of farming are 'crying all the way to the bank'").

careful consideration as the competition for water intensifies because of the lack of such consideration in other contexts.[78] Meanwhile, some studies have predicted that "voluntary water marketing would have minimal impacts on rural communities because the transfers would primarily affect low-value crops."[79]

Cost-benefit analysis, which is frequently used to evaluate proposed energy and water projects, seeks to translate impacts into monetary terms and assumes in the abstract that the market will efficiently resolve conflicts over scarce resources.[80] In reality, however, "efficiency" is not one-dimensional. Third-party impacts involve multiple stakeholders with differing motivations, not all of whom have equal access to decision-making processes. Moreover, some socioeconomic impacts can only be evaluated subjectively, such as aesthetic, political, and psychological impacts.[81]

Understanding these limitations, decision-makers will confront the challenge of analyzing interrelated socioeconomic impacts of events—e.g., a power plant development or a water transfer—as efforts are made to meet future water and energy demands. Several tools are available. For example, "input-output models" such as that developed by the Minnesota IMPLAN Group, Inc.[82] (IMPLAN) estimate potential impacts within a defined economic region due to expected changes in the movement/spending of money (Model Input). This accounts for the dollar-flow relationships between different sectors of an economy and calculates both the estimated direct effects as well as the estimated secondary, or multiplier, effects of each dollar change in spending in particular economic sectors (like construction or hay farming) as these changes ripple through an economy to other sectors (Model Output). An-

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78. *See* Richard Howitt & Kristiana Hansen, *The Evolving Western Water Markets*, CHOICES, 1st Quarter 2005, at 60, *available at* http://www.choicesmagazine.org/2005-1/environment/2005-1-12.pdf ("Standard economic theory does not usually consider these third-party financial losses to be legitimate. However, many trades do provide some compensation to third parties, often to appease public opinion."); Robert A. Young, *Local and Regional Economic Impacts*, in TRANSITION TO A BIO ECONOMY: ENVIRONMENTAL AND RURAL DEVELOPMENT IMPACTS PROC. *supra* note 72, at 262–64 ("relatively few instances outside of irrigated agriculture can be identified where secondary impactees are the subject of formal public policy concern").

79. ARTHUR L. LITTLEWORTH & ERIC L. GARNER, CALIFORNIA WATER 254 (1995) (citing *Focus*, a publication of the Metropolitan Water District, Issue 3, 1993, at 3).

80. For a general critique of cost-benefit analysis, see LISA HEINZERLING & FRANK ACKERMAN, GEO. ENVTL. L. & POL'Y INST., PRICING THE PRICELESS: COST-BENEFIT ANALYSIS OF ENVIRONMENTAL PROTECTION (2002), *available at* http://ase.tufts.edu/gdae/publications/cb%20pamphlet%20final.pdf.

81. *See* Biswas, *supra* note 69, at 749.

82. *See* Howe & Goemans, *supra* note 53, at 1062.

other commonly used model, the U.S. Army's Economic Impact Forecast System (EIFS), is sometimes known as an "economic base model," which assumes that the ratio of economic activity between a local area and a "basic," or non-local, area is stable enough to allow changes in the local and regional economy to be predicted, based on data associated with a specific project, e.g., total cost, payroll, and jobs.[83] Econometric models provide another means of evaluating socioeconomic impacts, using time-series data to investigate patterns of behavior within a local economy and forecasting expected changes caused by an event.[84]

Each of these tools has strengths and limitations. Which model to use may depend on available data, time, and budgetary constraints and how adaptable or expandable the analysis needs to be.[85]

B. Comparison of Renewable Energy Projects

Decision-makers must consider the unique issues presented by different types of renewable energy projects. Renewable energy projects use drastically differing amounts of water. On one end of the spectrum are wind turbines, which require virtually no water for energy production.[86] Biofuels, on the other hand, can be extremely water-intensive to produce, depending on the type of feedstock crop, the type of refining or conversion process, and other local and region-specific factors.[87]

In addition, the amount of water used by renewable energy projects depends on whether water is used to convey captured heat and, if so, the type of cooling system installed. For example, "solar" projects generally may refer to photovoltaic systems or concentrating solar power

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83. *See Economic Impact Forecast System*, NEPA WORKBENCH (2006), http://nepaworkbench.com/common/about.asp.

84. *See* WILLIAM BRUNSEN ET AL., ECONOMIC IMPACTS STUDY 7 (1988) (submitted to Los Alamos Nat'l Lab.), *available at* http://www.osti.gov/bridge/servlets/purl/108147-iJbk9j/webviewable/108147.pdf.

85. *See id.*

86. RON PATE ET AL., SANDIA NAT'L LAB., SAND 2007-1349C, OVERVIEW OF ENERGY-WATER INTERDEPENDENCIES AND THE EMERGING ENERGY DEMANDS ON WATER RESOURCES 7 (2007); *see also* American Wind Energy Association, *How Much Water Do Wind Turbines Use Compared with Conventional Power Plants?*, www.awea.org, http://www.awea.org/faq/water.html (last visited Oct. 17, 2010). *But see* U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MGMT., FES 05-11, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT ch. 5 at 5-10 to 5-15 (2005), *available at* http://windeis.anl.gov/documents/fpeis/maintext/Vol1/Vol1Ch5.pdf (discussing impacts to water resources primarily during construction phase and decommissioning of wind projects).

87. *See generally* NAT'L RESEARCH COUNCIL, WATER IMPLICATIONS OF BIOFUELS PRODUCTION IN THE UNITED STATES 3 (2008), *available at* http://books.nap.edu/openbook.php?record_id=12039&page=R1.

(CSP) projects.[88] Water use for CSP projects ranges from 10 gallons per MW-hour-equivalent for systems with "dry cooling" to 750 gallons per MW-hour-equivalent for "closed-loop" systems.[89]

The number and distribution of jobs and related secondary or indirect impacts created by renewable energy projects also vary considerably. These depend on the project type, location, scale, and phase (i.e., manufacturing, construction, operating, and decommissioning).

During construction, positive impacts result primarily as wages inject new dollars into the local economy. Negative impacts result largely from labor force demands on a rural community's local housing, infrastructure, and superstructure, which may be insufficient to support utility-scale project construction needs. Such construction may result in "boom-bust" cycles reminiscent of the water projects developed in the past century. Quantifying these impacts can be difficult in the short term because of uncertainty as to the labor source for plant construction and the ultimate spending behavior of that labor. By contrast, the staff needed for a project's operation who move to an area tend to arrive with their families, become members of the local community, and ultimately demonstrate local spending patterns similar to the rest of the community. Accordingly, the direct economic impacts of the operation and maintenance phase may not only be the most relevant in evaluating the persistent impacts of the conversion of water for a project but also the most predictable.

Displacing agriculture for energy projects poses a significant risk that project owners will export profits. This is in contrast to local agriculture, which typically forms the foundation of an area's employment and way of life and whose profits more frequently stay local as an important source of capital.[90] Farmers who convert to energy crops could keep more benefits local by vertically integrating with bio-refineries or processors, but reducing competition for traditionally produced crops may have detrimental impacts on a larger scale.

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88. National Renewable Energy Laboratory, Solar Energy Basics, http://www.nrel.gov/learning/re_solar.html (last updated Oct. 7, 2009).

89. PATE ET AL., *supra* note 86.

90. *See* GLENNON, *supra* note 5, at 260 (discussing interests of "owners of farm-related businesses, such as the local John Deere dealer, the cotton gin operator, and feed, fertilizer, and pesticide suppliers."). *Cf.* Leistritz & Hodur, *supra* note 72, at 169 ("If the facility is owned by a corporation headquartered elsewhere, the profits leave the local area. In addition, some suggest that some other local expenditures are likely to be greater for a locally owned facility; accounting, administrative, and marketing functions are more likely to be performed locally for a locally owned plant whereas much of this activity might be centralized off site for a corporately owned facility. . . . Finally, financing for locally owned firms is more likely to involve local banks. . . . The extent of local ownership can have a substantial influence on impact estimates." (internal citation omitted)).

Depending on the technology adopted, biomass projects generally require more water than solar or geothermal projects. Therefore, landowners and water rights holders subject to "use-it-or-lose-it" provisions and "place-of-use," or appurtenance, requirements may be more inclined to engage in biomass development rather than transferring their rights away. In regions subject to "safe yield" requirements (such as Active Management Areas in Arizona, which also are energy load centers), development of more water-intensive types of renewable energy projects may be less feasible or may require the retirement of significant irrigated acreage. The availability of new energy sources in areas outside of those regulated areas may stimulate development and lead to redistribution and growth-related impacts, as discussed in Part II.C below.

At first blush, biomass projects seem to present an advantage over solar and geothermal projects because farmers, rather than fallowing their land and abandoning their lifestyle, may be able to grow crops that could serve as energy feedstocks. However, substantial economic barriers must be overcome:

> Farmers may . . . hesitate to switch from traditional row crops to next generation cellulosic crops because of potential problems with cash flow and lack of established markets. Specifically, it can take up to 3 years to establish a mature, economically productive crop of perennial grasses, and farmers would be hard-pressed to forgo income during this period. Moreover, farmers may not be willing to cultivate perennial grasses unless they are assured that a market exists for the crop and that they could earn a profit from its cultivation. Furthermore, efficient cultivation and harvest could require farmers to buy new equipment, which would be costly and would add to the price they would have to receive for perennial grasses in order to make a profit.[91]

Moreover, opportunities for positive local impacts are limited because key players in the bio-refinery business "generally have their own equipment and skilled workers that travel with them."[92]

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91. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-116, ENERGY-WATER NEXUS: MANY UNCERTAINTIES REMAIN ABOUT NATIONAL AND REGIONAL EFFECTS OF INCREASED BIOFUEL PRODUCTION ON WATER RESOURCES 28 (2009), *available at* http://www.gao.gov/new.items/d10116.pdf.

92. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-09-446, BIOFUELS: POTENTIAL EFFECTS AND CHALLENGES OF REQUIRED INCREASES IN PRODUCTION AND USE 41 (2009), *available at* http://www.gao.gov/new.items/d09446.pdf.

C. Transmission-Related Considerations

Decision-makers should consider potential distributive effects of proposed water transfers or energy projects. Some of these effects relate to energy transmission. While the total capacity of the transmission system in the United States far exceeds generation capacity,[93] regional or local transmission congestion remains a serious problem, costing hundreds of millions of dollars per year as "higher-cost generation is dispatched in favor of lower-cost generation that would otherwise be used (in the absence of the constraint)."[94] In transmission-constrained areas, renewable energy projects can provide an indigenous source of power, directly serving rural communities while lowering congestion costs on a larger scale.[95] The development of renewable energy resources in transmission-constrained areas can provide indirect benefits as well. First, the creation of new generation capacity in a transmission-constrained area increases competition for existing generating companies in those areas, creating an incentive for all generators to increase operating efficiencies, lowering costs, and producing public welfare gains.[96] Second, new renewable sources of power, coupled with sufficient storage to offset problems with intermittency and variability, can increase performance of the overall transmission system by reducing line losses and voltage drops.[97] Third, the development of new generation in transmission-constrained areas can stimulate investment in transmission, alleviating congestion problems, improving system reliability, and potentially even stimulating further energy resource development.[98]

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93. Seth Blumsack, *Measuring the Benefits and Costs of Regional Electric Grid Integration*, 28 ENERGY L.J. 147, 172 (2007).

94. BERNARD C. LESIEUTRE & JOSEPH H. ETO, ERNEST ORLANDO LAWRENCE BERKELEY NAT'L LAB., LBNL-5049, ELECTRICITY TRANSMISSION CONGESTION COSTS: A REVIEW OF RECENT REPORTS vi (2003), *available at* http://eetd.lbl.gov/ea/CERTS/pdf/54049.pdf. *See also* Xiaobo Wang, *Economic Planning Study–Congestion Evaluation* 20 (Oct. 2009), (presented at CAISO 2010 TRANSMISSION PLAN 2ND STAKEHOLDER MEETING, Oct. 26-27, 2009), *available at* http://www.caiso.com/244e/244ef0f960680.pdf (determining that transmission constraints are impeding new energy project development in California, particularly for renewables).

95. The current transmission grid does not pass through many of the remote areas where renewable energy resources are located. Center for American Progress, A National Clean-Energy Smart Grid 101 at 1 (Feb. 23, 2009), http://www.americanprogress.org/issues/2009/02/pdf/smart_grid101.pdf.

96. Blumsack, *supra* note 93, at 168–69.

97. MATTHEW H. BROWN & RICHARD P. SEDANO, ELECTRICITY TRANSMISSION: A PRIMER 35 (Nat'l Council on Electricity Policy ed., 2004), *available at* http://www.raponline.org/Pubs/ELECTRICITYTRANSMISSION.pdf.

98. *Id.* at 14.

Notwithstanding these benefits, some commentators have noted that "more prudent forms of growth, such as urban infill" may be preferable to rural development if the latter occurs merely because of constraints in distributing resources to urban areas.[99] In other words, decision-makers should consider whether transmission constraints should control whether development occurs in urban or rural areas.[100] Toward that end, in 2009, the Utah Legislature created an independent agency known as the Utah Generated Renewable Energy Electricity Network Authority and charged it with reviewing the location and availability of renewable energy resources serving electric loads in the state, determining whether there is adequate transmission capacity to bring those resources to market, prioritizing transmission projects on the basis of economic development and other factors, and facilitating the interconnection of renewable energy sources to transmission facilities.[101]

III. CASE STUDY: IMPERIAL COUNTY, CALIFORNIA

A. Overview

To illustrate the many decision-related issues raised by renewable power project development and water transfers in the Southwest, we examined the potential local impacts of converting water used for irrigation to renewable power generation in Imperial County, California. Specifically, we examined the hypothetical development of a solar thermal power facility, a geothermal power facility, and a biomass power facility, each with 50 MW of generation capacity.

Imperial County is home to the 450,000-plus-acre Imperial Irrigation District (IID).[102] IID's senior priority to more than 3 million acre-feet of Colorado River water[103] has long made it a key player in the hydropolitics of the Southwest. With respect to renewable energy, Imperial County is a particularly attractive location for development. The region's significant renewable energy resources and large-scale field crop production combine with a highly reliable water supply, modern transportation

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99. *See* WATER TRANSFER WORKGROUP, WATER TRANSFER ISSUES IN CALIFORNIA: FINAL REPORT TO THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD 7–8 (2002), *available at* http://www.waterrights.ca.gov/watertransfer/Final%20Report%20-%20Water%20Transfer%20Group.pdf.

100. *See id.*

101. UTAH CODE ANN. §§ 63H-2-101, 63H-2-301 (West, Westlaw through 2010 legislation).

102. *See* IMPERIAL IRRIGATION DIST., PROTECTING THE FLOW OF PROGRESS: 2006 ANNUAL REPORT 18 (2006), *available at* http://www.iid.com/Modules/ShowDocument.aspx?documentid=1267.

103. *Id.*

infrastructure, and close proximity to major manufacturing centers to create a superior location for solar power, geothermal, and biomass power generation facility development.[104] IID is also the region's primary electrical power provider. IID generates nearly 30 percent of its power locally from a combination of hydropower, steam, gas, and diesel generation facilities.[105] Renewable power developers in the area, therefore, also would have transmission access to the western power grid.[106]

A range of potential economic impacts on the Imperial County region may result from converting water from irrigation to renewable energy generation. The economic impacts of a water-consumptive energy project would be expected to come primarily from the following: (1) the sale or lease of property for the project site and associated necessary water rights (a one-time event); (2) reduction of irrigated agriculture as a result of using water for renewable power generation (ongoing impacts); (3) construction of a renewable power generation facility (short-term impacts); and (4) operation and maintenance of a renewable power generation facility (ongoing impacts).

Our analysis examines the second and fourth effects, that is, the ongoing, or long-term, impacts to the Imperial County economy from a reduction of agricultural activity due to the use of irrigation water for operating solar power, geothermal, and biomass power generation facilities.

We do not address the first effect because the potential property sale- or lease-related economic impacts on a local community are situation-specific and may fall in a wide range, though they are expected, at worst, to be neutral. For example, in some instances, power generation developers may lease property with attached water rights from federal and state land administrators such as the Bureau of Land Management.[107] As a result, there simply may be no real local economic impacts from land or water acquisition. In other instances, power developers may purchase or lease land and water from private owners. This typically results in an increase in the assessed value of the subject property for property tax purposes, which should have a positive economic impact on a local community by increasing government tax revenues. The

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104. *See* SUMMIT BLUE CONSULTING, RENEWABLE ENERGY FEASIBILITY STUDY FINAL REPORT 9–25 (Apr. 1, 2008), *available at* http://www.iid.com/Modules/ShowDocument.aspx?documentid=3896.

105. IMPERIAL IRRIGATION DIST., ABOUT IID ENERGY, http://www.iid.com/index.aspx?page=250 (last visited Oct. 20, 2010).

106. *See* IID, HOW ENERGY IS DELIVERED, http://www.iid.com/Energy/HowEnergyis Delivered.

107. U.S. BUREAU OF LAND MGMT., NEW ENERGY FOR AMERICA, http://www.blm.gov/wo/st/en/prog/energy.html (last updated Aug. 19, 2010).

purchase or leasing of private property also typically benefits local brokers and other professionals involved in the transaction. In addition, the equity appreciation or rental revenues realized by an owner from the sale or lease of land and water rights, respectively, may result in local economic impacts through increased seller/lessor local spending and investment. That said, many of the landowners in Imperial County, including many of those holding farmland within IID that may be idled due to the conversion of water use to power generation, do not live within Imperial County.[108] Accordingly, any equity gains or rental revenues may simply be exported out of the area without any localized economic impacts.

The third effect is not included in our hypothetical analysis because the local socioeconomic impacts of the construction phase of a power project, while potentially substantial, are relatively short-lived. While some of the workforce needed to build a renewable power project in Imperial County may be sourced locally, a majority of that workforce likely would be drawn from outside the area due to the special skills required. Renewable energy projects in the 50 MW range can require well over 100 workers on site at any one time during peak construction.[109] During the construction phase of a renewable energy project in a rural area such as Imperial County, labor creation would be the primary driver of local economic impacts because steel-manufactured components and other non-labor inputs would be imported to the region.

B. Methodology

To assess the impacts of converting water within IID from irrigation to renewable power generation, we first estimated the direct effects of the conversion on the dollar amount of spending that might occur within the county; i.e., the anticipated decline in local spending from the reduction in agricultural activity offset by the anticipated increase in local spending associated with the generation facility operation. We then

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108. *See* GLENNON, *supra* note 5, at 256 ("most Imperial Valley farmers are absentees who lease their land to locals"); David H. Getches, *Interbasin Water Transfers in the Western United States: Issues and Lessons*, *in* WATER CONSERVATION, REUSE, AND RECYCLING: PROCEEDINGS OF AN IRANIAN-AMERICAN WORKSHOP 233, 238 (Comm. on U.S.-Iranian Workshop on Water Conservation and Recycling ed., 2005), *available at* http://www.nap.edu/openbook.php?record_id=11241&page=238 ("A huge share of [Colorado River] water . . . goes to California's Imperial Valley near the Mexican border, mostly for large farms owned by wealthy families and corporations.").

109. *See* SUMMIT BLUE CONSULTING, *supra* note 104, at 92 (discussing the number of jobs generated by different renewable energy technologies).

estimated the potential local secondary output impacts,[110] direct and secondary employee compensation, and employment impacts resulting from the estimated direct spending changes.

The secondary output and its associated direct and secondary employee compensation and employment impacts were estimated using IMPLAN.[111] Our intent was to evaluate—on a relative and order-of-magnitude basis—the anticipated impacts of converting water use from agriculture to renewable power generation. We did, however, make some adjustments to the model in an effort to improve its accuracy. For most sectors within an economy (i.e., manufacturing, construction, etc.), the use of national level data is adequately accurate at the regional level because of the relative consistency of production practices within those sectors across regions. However, agricultural practices vary substantially from one region to the next. In Imperial County, for example, growers tend to hire custom service providers to a much greater degree to perform their on-farm cultural and harvest activities than is the case in many other parts of the Southwest.[112] The evolution of the farm sector in Imperial County to be heavily dependent on custom service providers may have been borne out of the sheer scale of the region's agricultural economy and thus efficiencies in outsourcing. As a result, in constructing the IMPLAN model for Imperial County, we adjusted two of the crop production functions[113] embedded within the model (for wheat and alfalfa hay) to better conform to the economic profile for producing those crops within Imperial County. We have assumed that the conversion of water from agriculture to renewable power generation would most

110. Secondary impacts are the combination of indirect and "induced" impacts. *See* Charney & Woodward, *supra* note 68. Output is defined as the total production value of agricultural and non-agricultural economic activity within a defined region (in this instance, Imperial County). Employee compensation is defined as the total value of wages and salaries paid for work performed within the county.

111. *See* Howe & Goemans, *supra* note 53.

112. *See, e.g.*, David Steffen, *IID to Audit Farm Service Providers for Fallowing-Related Funds*, IMPERIAL VALLEY PRESS (May 13, 2010) (discussing farm service providers that received funds from IID). *See also Water Transfer between the Imperial Irrigation District and the San Diego County Water Authority: Public Hearing Before the State Water Resources Control Board* (Sept. 2005) (comments submitted by Kimberly Collins, coordinator for the Imperial Valley Socioeconomic Improvement Committee (Local Entity)), *available at* http://www.swrcb.ca.gov/waterrights/water_issues/programs/hearings/iid_sdcwa/docs/comments/localentity.pdf (discussing the committee's charge to mitigate socioeconomic impacts related to fallowing of farmland in Imperial County occurring in order to conserve water for transfer to San Diego (the committee includes one member representing farm service providers)).

113. A crop production function is a mathematical expression of the "relationship between inputs and outputs of crop production." DIANA C. GIBBONS, THE ECONOMIC VALUE OF WATER 28 (1986).

likely result in the reduction of irrigation of these crops because, not only are they the primary crops under irrigation within IID, they also produce relatively lower returns (or have weaker economic profiles) than other crops under production, such as lettuce, broccoli, and onions.[114]

C. Agricultural Impacts

We adjusted the crop production functions within the IMPLAN model based on cost data contained in 2004 crop budgets—the most recent available—for Imperial County published by the University of California's Cooperative Extension Service.[115] To derive localized production function estimates, we combined this budget data with five-year averages of county-wide Imperial County crop yield and price data published by the California Agricultural Commissioner and averages of the most recent available five years of IID-wide crop acreages published by IID, for the period 2004 through 2008.[116] The price data was adjusted to 2009 dollar terms based on the prices paid index for U.S. farmers published by the USDA.[117]

As discussed above, solar thermal, geothermal, and biomass power generation projects employ technologies that differ with respect to their water consumption per MW of power produced. For this analysis, we derived estimates of the water that would be consumed to operate a 50 MW plant. These estimates are presented in Table 1 (below) and account for each plant's assumed capacity factors, i.e., the amount of power each can produce relative to its built capacity.[118] These assump-

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114. *See* Univ. of Cal. Davis Agric. & Resource Econ., *Archived Cost and Return Studies*, http://coststudies.ucdavis.edu/archived.php (last updated July 24, 2008) (select "Imperial County" and "2004" from the archived Cooperative Extension Service studies of cost and return on crops in California).

115. *Id.*

116. Agricultural Commissioners Office, *1907–2009 Agricultural Crop & Livestock Reports*, IMPERIAL COUNTY, http://imperialcounty.net/ag/Crop%20&%20Livestock%20Reports/archives_1907-2009.htm (last visited Nov. 3, 2010) ("Crop & Livestock Report 2004" through "Crop & Livestock Report 2008"); IID, *Agriculture and Crop Reports*, http://www.iid.com/index.aspx?page=119 (last visited Nov. 3, 2010) ("2004 Crop Rank and Acreage" through "2008 Crop Rank and Acreage").

117. *See* U.S. Dep't of Agric., *National Agricultural Statistics Service*, http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1002 (last visited Oct. 21, 2010) (providing past and current price indexes for farmers' crops in the United States).

118. For example, solar thermal plants typically demonstrate efficiencies in the range of 20 to 40 percent. *See, e.g.*, Pascal De Laquil, David Kearney, Michael Geyer & Richard Diver, *Solar-Thermal Electric Technology*, *in* RENEWABLE ENERGY: SOURCES FOR FUELS AND ELECTRICITY (Thomas B. Johanssen et al. eds., 1993) 280 ("typical solar-only capacity factors are between 20 and 30 percent"); U.S. Energy Information Administration, *Assumptions to the Annual Energy Outlook 2010* (Apr. 9, 2010), http://www.eia.doe.gov/oiaf/aeo/

tions were derived from trade press and publicly available information on renewable power generation.[119]

TABLE 1. Average annual water consumption and capacity factors by renewable technology (assuming 50 MW capacity)

Renewable Technology	Solar Thermal	Geothermal	Biomass
Average Annual Water Consumption (acre-feet)	309	1,694	548
Assumed Average Capacity Factor	30%	90%	80%

We assumed that the estimated amount of water consumed for each hypothetical power plant would be converted directly from irrigation. Therefore, our analysis does not consider the potential for finding alternative supplies or implementing conservation methods to make water available for energy development without reducing local irrigation water supplies. Accordingly, we divided the amount of water consumed annually by each hypothetical power plant by the estimated weighted average consumptive use (evapotranspiration, or ET) per acre of water for the irrigation of wheat and alfalfa hay within Imperial County.[120] Again, wheat and alfalfa hay are assumed to be representative of the

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assumption/renewable.html (assuming average solar thermal annual capacity factor for California of 40 percent). Biomass-powered electricity generation is assumed to be in the form of combined heat and power, which "typically achieve[s] total system efficiencies of 60 to 80 percent for producing electricity and thermal energy." U.S. Envtl. Prot. Agency Combined Heat & Power P'ship, *Biomass Combined Heat and Power Catalog of Technologies* 1 (Sept. 2007), http://www.epa.gov/chp/documents/biomass_chp_catalog.pdf. For geothermal systems, the typical capacity factor is 90 percent. MASASHI SHIBAKI, GEOTHERMAL ENERGY FOR ELECTRIC POWER: A REPP ISSUE BRIEF 9 (Dec. 2003), http://www.repp.org/articles/static/1/binaries/Geothermal_Issue_Brief.pdf. *See also* NAT'L. RENEWABLE ENERGY LAB., POWER TECHNOLOGIES ENERGY DATA BOOK 9, 17, 22 (4th ed. 2006), *available at* http://www.nrel.gov/analysis/power_databook/docs/pdf/39728_complete.pdf (projecting 2010 capacity factors of 24–73 percent for solar thermal, 80–85 percent for biomass, and 83–95 percent for geothermal); NATIONAL GRID, THE WEST'S RENEWABLE ENERGY FUTURE: A CONTRIBUTION BY NATIONAL GRID 37 (July 2008) (citing BLACK & VEATCH, RENEWABLE ENERGY TRANSMISSION INITIATIVE: PHASE 1A FINAL REPORT Table 1-1 (April 2008)), *available at* http://www.nationalgridus.com/non_html/transmission-WestRenewableFuture.pdf (presenting capacity factors of 26–29 percent for solar thermal, 80–85 percent for biomass, and 70–90 percent for geothermal).

119. Lux Research, *supra* note 3, at 11 (providing the amount of water consumed based on electricity source); U.S. DEP'T OF ENERGY, ENERGY DEMAND ON WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER 38 (2006), *available at* http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf (providing the water intensity for various power-generation technologies).

120. ET estimates for Imperial County were obtained from Natural Resources Consulting Engineers, Inc., Fort Collins, Colo. (1999) (on file with authors).

crops within IID whose production would likely decline due to the conversion of agricultural water to energy generation. We weighted the ET values for each crop by the respective acreages of wheat and alfalfa hay reported by IID for 2009 to estimate the amount of acreage of the crops that would be fallowed due to the energy-generation-associated consumptive use of water. Table 2 (below) presents our estimates of crop acreage reductions as a result of each hypothetical renewable power project. We then estimated the dollar amount reduction in revenues (output) from the sale of these crops as a result of the water conversion by multiplying the estimated crop acreage reductions by the estimated average prices and yields for the crops as derived previously from 2004 through 2008 yield and price data published by the IID.[121] The projected revenue reductions, shown in Table 2, were input into the IMPLAN model to estimate the projected resulting overall county level economic impacts.

TABLE 2: Estimate crop acreage reduction by renewable technology

Renewable Technology	Solar Thermal (50 MW)	Geothermal (50 MW)	Biomass (50 MW)
Average Annual Water Consumption (acre-feet)	309	1,694	548
Weighted Average Crop ET (acre-feet)	3.75	3.75	3.75
Total Irrigated Acreage Reduction	82	452	146
Alfalfa Hay Acreage Reduction	41	223	72
Wheat Acreage	42	228	74
Loss of Alfalfa Revenues (2008$)	$51,000	$279,500	$90,400
Loss of Wheat Revenues (2008$)	$46,000	$252,200	$81,600

D. Power Generation Impacts

As noted previously, the primary source of economic impacts from a power generation facility's operations within a rural area would be expected to come from wages paid to project labor and subsequent local spending by those workers. Table 3 (below) summarizes the estimated number of full-time operation and maintenance (O&M) jobs associated with solar thermal, geothermal, and biomass technologies, with a capacity of 50 MW, based on publicly available sources on staffing re-

121. IMPERIAL IRRIGATION DIST., ANNUAL REPORTS (2004–2008), *available at* http://iid.com/index.aspx?page=73 (referencing multiple reports, one for each year between 2004–2008).

quirements per MW of capacity.[122] We assumed that the salaries paid to this staff average $36,500 per year,[123] and that 70 percent of annual salaries (an average of $25,550) would be spent in the local community, with the remaining 30 percent of the wages going to taxes and savings.

TABLE 3: Estimated O&M jobs and direct spending impacts by renewable technology

Renewable Technology	Solar Thermal (50 MW)	Geothermal (50 MW)	Biomass (50 MW)
O&M Jobs	10	85	20
Average Estimated Annual Salary	$36,500	$36,500	$36,500
Estimated Annual Direct Local Spending Impact	$255,500	$2,171,750	$511,000

E. Impacts

Table 4 (below) summarizes the estimated impacts of each hypothetical plant on overall output, employee compensation, and jobs within Imperial County. The table shows that the net positive impacts of solar power are quite low; that is, although positive, converting water from irrigation to solar power has a relatively small anticipated impact on the local economy. This would also be true of wind power, which generally has very low operational labor requirements—even lower than solar.[124] On the other hand, the ongoing anticipated impacts of geothermal and biomass production are much larger because of the larger direct job creation needed for operation. In each case, the decline of agricultural output and the associated employee compensation and jobs is quite low. Thus, separate from any distributional effects, renewable power generation in all three instances appears to be a more productive use of water that is otherwise used to irrigate lower-valued crops when evaluated in terms of standard economic impact metrics—output, employee compensation, and jobs.

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122. DANIEL JENNEJOHN, LESLIE BLODGETT & KARL GAWELL, GEA ISSUE BRIEF: GEOTHERMAL ENERGY AND JOBS 5 (Aug. 7, 2009) (citing DELOITTE CONSULTING, MARKET ANALYSIS-GEOTHERMAL (Sept. 19, 2008)), *available at* http://www.geo-nergy.org/pdf/Geothermal_Energy_and_Jobs_Issue_Brief.pdf; U.S. Envtl. Prot. Agency Combined Heat & Power P'ship, *supra* note 118, at 83.

123. SUMMIT BLUE CONSULTING, *supra* note 104, at 95.

124. *See* VIRINDER SINGH & JEFFREY FEHRS, THE WORK THAT GOES INTO RENEWABLE ENERGY 20 (Renewable Energy Policy Project, Rep. No. 13, Nov. 2001), *available at* http://www.repp.org/articles/static/1/binaries/LABOR_FINAL_REV.pdf.

TABLE 4: Estimated impacts of hypothetical 50 MW project on overall output, employee compensation, and jobs within Imperial County

Renewable Technology	Solar Thermal (50 MW)	Geothermal (50 MW)	Biomass (50 MW)
Output Impacts Due to Plant Operations (2008$)	$819,334	$6,964,339	$1,638,668
Output Impacts Due to Reduction in Irrigation (2008$)	($125,760)	($689,346)	($222,997)
Employee Compensation Impacts Due to Plant Operations (2008$)	$432,100	$3,672,850	$864,200
Employee Compensation Impacts Due to Reduction in Irrigation (2008$)	($17,403)	($95,394)	($30,859)
Employment (# of Jobs) Impacts Due to Plant Operations	13	107	25
Employment (# of Jobs) Impacts Due to Reduction in Irrigation	(1.3)	(7.1)	(2.3)

IV. ACTUAL WATER TRANSFERS FOR ENERGY

Because of the constraints of predictive models, it would be beneficial to examine actual, documented impacts of agriculture-to-energy water transfers in the Southwest. At this point, however, there is a dearth of empirical information. In the last 25 years, few agriculture-to-energy water transfers have been reported in southwestern states.

One well-documented agriculture-to-energy water transfer involved the sale of approximately 45,000 acre-feet per year of water by local irrigators for development of the Intermountain Power Project (IPP), a 3,000 MW coal-fired power plant in Utah that broke ground in the early 1970s.[125] The water transfer was heralded for protecting local interests because not all units of the IPP were immediately constructed and "water use remained in the area of origin and was leased to farmers, thus preventing sudden reductions in irrigated acreage."[126] However, by the time the final unit of the IPP was proposed, the city of Los Angeles,

125. COMM. ON WESTERN WATER MGMT., WATER SCI. & TECH. BD., & COMM. ON ENG'G, & TECHNICAL SYS., WATER TRANSFERS IN THE WEST: EFFICIENCY, EQUITY, AND THE ENVIRONMENT 66 (1992), *available at* http://www.nap.edu/openbook.php?isbn=0309045282&page=66.

126. *Id.*

one of the IPP's biggest customers, had vowed to become "coal-free."[127] The change in social values, away from coal and toward renewable sources, was not predictable at the project's outset decades earlier. This illustrates one of the key shortcomings of socioeconomic analysis of energy projects: the wide variance in impacts caused by changes over different planning horizons.

The Water Transfer Level Dataset[128] provided a source of other actual agriculture-to-energy water transfers. As Table 5 (below) shows, approximately 34 water transfers to apparent energy interests have occurred nationwide since 1987, totaling approximately 1 million acre-feet annually. Those transfers represent a small fraction of the 4,177 transfers recorded in the Water Transfer Level Dataset. As Table 5 indicates, the vast majority of the water sold, leased, or exchanged in those cases has been in the Pacific Northwest, with only some of the transfers occurring out of agriculture.

127. Robin Bravendar, *Los Angeles*' '*Coal Free*' *Vow Scuttles Utah Power-Plant Expansion*, N.Y. TIMES, July 9, 2009, *available at* http://www.nytimes.com/gwire/2009/07/09/09greenwire-los-angeles-coal-free-vow-scuttles-utah-power-29532.html.

128. The Water Transfer Level Dataset is a compilation of information on water rights transactions in the western United States since 1987, drawn from monthly reports in the trade journal WATER STRATEGIST (formerly known as the WATER INTELLIGENCE MONTHLY). WATER STRATEGIST (Rodney T. Smith & Roger Vaughn, eds., Stratecon Inc.) [hereinafter WATER STRATEGIST]. "Although the *Water Strategist* may not record all the trades in western water, it is the only comprehensive source of water trade information." Richard Howitt & Kristiana Hansen, *The Evolving Western Water Markets*, 20(1) CHOICES 59, 61 (1st Qtr., 2005), *available at* http://www.choicesmagazine.org/2005-1/environment/2005-1-12.pdf. The Water Transfer Level Dataset includes the following information: "the year of a water transfer; the acquirer of the water; the supplier; the amount of water transferred; the proposed use of the water; the price of the trade; and the terms of the contract." ZACH DONOHEW & GARY LIBECAP, WATER TRANSFER LEVEL DATASET 1, *available at* http://www.bren.ucsb.edu/news/documents/water_trans_07_intro.doc (last visited Oct. 21, 2010).

TABLE 5: Water transfers to energy interests, 1987–2009

Year	State	Quantity of Water Transferred (Minimum Annual Acre-Feet)	Price (Inflation Adjusted Price per Committed Acre-Foot)	Form of Contract	Seller	Buyer	*WS* Issue[129]
2001	AZ	6,479	$44.90	sale	Vidler Water Co., Inc.	Allegheny Energy Inc.	5/01
1989	CA	255	$131.20	lease	Chevron Corp.	Mobil Oil Co.	7/89–8/89
1989	CA	0	$123.68	lease	Allied Signal, Inc.	Mobil Oil Co.	6/89
1997	CA	1,200	N/A	lease	Bureau of Reclamation	(i) Southern Calif. Gas & Electric (ii) Pacific Gas & Electric	Spr. '97
2002	CA	7,179	N/A	sale	Inland Empire Utilities Agency	Reliant Energy Inc.	10/02
2003	CA	1,020	N/A	sale	Southern Calif. Edison, developers, and individuals/ irrigation districts	Baldy Mesa W.D., Victor Valley W.D., Reliant Energy, and individuals/ irrigation districts	1/04
2008	CA	9,000	N/A	lease	Tesoro Refining and Mktg.	Shell Oil Co.	1/09
1989	CO	70	N/A	sale	Upper Yampa WCD	Colo. Ute Electric Ass'n.	7/87
1992	CO	56	N/A	sale	farmers	Rocky Mt. Fuel Corp.	4/92
1992	CO	19	$26.12	sale	farmer	Rocky Mt. Fuel Corp.	3/92
1999	CO	28	$189.49	sale	irrigator	Martin Oil Mktg.	7/99
1999	CO	2	$213.09	sale	irrigator	Martin Oil Mktg.	10/99
2000	CO	0	N/A	sale	irrigator	Martin Oil Mktg.	2/00
2008	CO	50,000	N/A	sale	Colorado Division of Wildlife	Shell Frontier Oil & Gas Inc.	2/08
1988	ID	100,000	$2.40	lease	irrigators	Idaho Power Co.	9/88
1989	ID	50,000	$2.29	lease	irrigators	Idaho Power Co.	10/89
1990	ID	13,000	$2.39	lease	irrigators	Idaho Power Co.	3/91

(continued)

129. WATER STRATEGIST, *supra* note 128.

(continued from preceding page)

Year	State	Quantity of Water Transferred (Minimum Annual Acre-Feet)	Price (Inflation Adjusted Price per Committed Acre-Foot)	Form of Contract	Seller	Buyer	*WS* Issue
1990	ID	99,000	$2.39	lease	irrigators	Idaho Power Co.	9/90
1991	ID	103,968	$2.29	lease	contractors	Idaho Power Co.	12/91
1993	ID	53,235	$2.36	lease	contractors	power companies and irrigators	7/93–8/93
2000	ID	100,000	$6.93	lease	irrigators	Idaho Power Co.	10/00
2004	ID	1,153	$24.06	lease	Idaho Power	Bonneville Power Admin.	9/04
2007	ID	5,000	$1.75	lease	Payette River Basin W.D. #65	power producer	6/08
2007	ID	950	$7.63	lease	various entities	power producer	5/07
2007	ID	2,803	$1.74	lease	various entities	power producer	5/07
2002	NM	1,000	N/A	lease	City of Clovis	Duke Energy Curry, LLC.	3/02
1987	NV	7,000	$233.11	lease	private owner	Nevada Power Co.	8/87
1994	NV	1,400	N/A	lease	BuRec, Washoe County C.D., Pyramid Lake Indian Tribe	Sierra Pacific Power Co.	6/94
2001	NV	16,000	N/A	lease	Las Vegas Valley W.D.	Duke Energy Corp. and Mirant Americas Dev.	5/01
1994	OR	400,000	$49.82	lease	Skyline Farms	Bonneville Power Admin.	1/95
2001	OR	644	$211.68		701 irrigators	Bonneville Power Admin.	5/01
1996	TX	6,782	$30.41	lease	Lavaca-Navidad River Auth.	City of Point Comfort, Central Power & Light, Calhoun County Navigation Dist.	Winter '97
2002	TX	3,037	N/A	lease	City of Longview	Entergy Power Ventures, L.P.	5/02
1993	WY	6,479	N/A	exchange	Cannon Land and Livestock Limited P'ship	PacifiCorp Electric Operations	3/93
TOTAL:		**1,046,759**					

The 2001 sale from Vidler Water Company (Vidler) to Allegheny Energy (Allegheny), shown in Table 5, involved an agriculture-to-energy water transfer in Arizona.[130] The sale transferred 6,496.5 acre-feet of water rights and 2,589 acres of land in the Harquahala Valley, approximately 75 miles west of Phoenix, for roughly $9.4 million.[131] "The water, previously used for irrigation, [was intended to] be used in the cooling towers at an electricity generating facility that is planned for construction on [land that was sold along with the water rights.]"[132] Because construction of the facility, known as the La Paz Generating Facility, has not yet occurred, this water transfer does not provide a basis for empirical analysis of socioeconomic impacts. However, it does illustrate how regulators have addressed the energy-water nexus and considered socioeconomic issues and highlights several points discussed above.

In its Certificate of Environmental Compatibility for the La Paz Generating Facility, the Arizona Power Plant and Transmission Line Siting Committee imposed 40 conditions, including a groundwater use limit of approximately 6,500 acre-feet, pursuant to a formula prescribed by state law.[133] The Arizona Corporation Commission (ACC), in a two-to-one vote, subsequently affirmed the Certificate of Environmental Compatibility, finding that construction of the $540 million, 1,080 MW natural gas–fired facility was in the public interest "because it aids the state in meeting the need for an adequate, economical and reliable supply of electric power."[134] In its decision, the ACC modified certain conditions to require that the facility (1) recharge 100,000 acre-feet of water through nearby projects or (2) purchase and permanently retire the irrigation rights of existing agricultural lands, and that Allegheny, then

130. WATER STRATEGIST (May 2001), *supra* note 128, at 2.

131. PICO HOLDINGS, INC., ANNUAL REPORT FILED WITH THE SECURITIES & EXCHANGE COMM'N FOR THE FISCAL YEAR ENDED DEC. 31, 2001, at 5, 14, 29 (filed Mar. 18, 2002), *available at* http://google.brand.edgar-online.com/DisplayFilingInfo.aspx?Type=HTML&text=%2526lt%253bNEAR%252f4%2526gt%253b(%22CHARLES+E.%22%2C%22BANCROFT%22)&FilingID=1794986&ppu=%2FPeopleFilingResults.aspx%3FPersonID%3D2150997%26PersonName%3DCHARLES%2520E.%2520BANCROFT. The $9.4 million figure includes $300,000 reportedly paid as a nonrefundable option fee. *Id.* at 29; WATER STRATEGIST (May 2001), *supra* note 128, at 2.

132. WATER STRATEGIST (May 2001), *supra* note 128, at 2.

133. Press Release, Ariz. Corp. Comm'n, Commission Approves La Paz Generating Facility (Apr. 10, 2002), http://www.azcc.gov/divisions/utilities/news/pr04-10-02.htm.

134. Allegheny Energy Supply Co., No. L-00000-AA-01-0116, 2 (Ariz. Corp. Comm'n. Apr. 16, 2002), *available at* http://images.edocket.azcc.gov/docketpdf/0000034899.pdf [hereinafter *Allegheny Energy Supply Co. Case*] (Decision No. 64718) (determination on application).

headquartered in Hagerstown, Maryland,[135] "encourage the hiring of qualified local employees in connection with construction and operation of the Project."[136] Then-ACC Chairman William Mundell voted against the facility after unsuccessfully proposing to require dry-cooling technology to reduce the facility's water consumption.[137]

With its 2001 application for a Certificate of Environmental Compatibility, Allegheny submitted an Arizona State University (ASU) study that used IMPLAN to estimate economic impacts.[138] According to the ASU study, construction of the facility would require 365 construction workers over a 30-month construction period, with an average annual wage of $42,000, assuming:

> (i) use of county suppliers during the plant's construction would follow the patterns typical of new utility construction in the county (relationships already captured in the IMPLAN model); (ii) one-quarter of the on-site construction crew would live in La Paz County; and (iii) none of the specialized mechanical or electrical equipment would be purchased from suppliers in the county.[139]

Significantly absent from the ASU study is any discussion of the "boom-bust" nature of construction; that is, how the sparsely populated area—La Paz County averaged 4.4 persons per square mile[140]—would accommodate a 30-month influx of 270 construction workers. In addition, the ASU study concluded:

> The direct impact of Allegheny operations on jobs and incomes in Arizona will be modest—employment of 40 workers and earnings of some $3 million per year. However, the plant will use a large amount of natural gas that is taxable under the state's sales tax. Also, because the plant is so highly capital

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135. *Id.* at 1. On February 11, 2010, Allegheny (now headquartered in Greensburg, Pennsylvania) announced that it would merge with FirstEnergy, an Akron, Ohio–based energy company with $13 billion in annual revenue, and that the combined company would "retain the FirstEnergy name and be headquartered in Akron, Ohio." Press Release, Allegheny Energy, FirstEnergy and Allegheny Energy to Combine in $8.5 Billion Stock-For-Stock Transaction (Feb. 11, 2010), *available at* http://www.businesswire.com/portal/site/alleghenyenergy/permalink/?ndmViewId=news_view&newsId=20100211005656&newsLang=en.

136. *Allegheny Energy Supply Co. Case* at 2.

137. Press Release, Ariz. Corp. Comm'n., *supra* note 133.

138. Application to the Ariz. Power Plant & Transmission Line Siting Comm. at J-1-4 to J-1-9, *Allegheny Energy Supply Co. Case*, *available at* http://images.edocket.azcc.gov/docketpdf/0000060508.pdf.

139. *Id.* at J-1-4.

140. *Id.* at J-1-2.

> intensive, it will generate state income and local property tax revenues far out of proportion to its employment. For the average Arizona business, tax collections from sales, property, and income taxes amount to about $1,500 per worker. Taxes associated with the operations of Allegheny's La Paz facility are on the order of $400,000 per worker. When these tax monies are spent by governments, or used to reduce existing taxes and then spent by households, a significant number of new jobs are indirectly created. It is estimated that each job at the Allegheny plant will induce an additional 19 jobs somewhere in the state. All totaled, operations at the La Paz facility will generate 800 new jobs and earnings of $31 million for the state of Arizona.[141]

The ASU study modeled the gross benefits of the proposed facility but did not discuss the socioeconomic costs of displacing agricultural use of the land. In fact, Allegheny represented that no such displacement would occur:

> The properties purchased are either currently irrigated by [Colorado River] water through the Harquahala Valley Irrigation District or are grazing properties. Allegheny plans to maintain the leases for the farm properties so that the agriculture economy of the Harquahala Valley is not adversely impacted and plans to maintain the grazing access associated with the other properties.[142]

It is not clear that the farm properties would maintain production if their water is moved to power generation. This is emblematic of many socioeconomic studies that present positive impacts, such as gross jobs and tax revenues created, rather than focusing on the difference between existing and proposed conditions, i.e., net jobs and tax revenues created. Positive impacts cannot be considered in a vacuum. As they sometimes occur at the cost of agricultural jobs and related impacts, the result is often not a "zero-sum game."[143]

On the other side of the coin, PICO, Vidler's holding company, headquartered in California, reportedly earned $5 million on the water sale after having paid $4.4 million in cash to acquire the assets it sold to Allegheny.[144] In other words, more than half the value of the assets was

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141. *Id.* at J-1-8.

142. Testimony of Kevin Geraghty at 10, *Allegheny Energy Supply Co. Case*, *available at* http://images.edocket.azcc.gov/docketpdf/0000060528.pdf.

143. Charney & Woodard, *supra* note 68, at 1197.

144. PICO HOLDINGS, INC., *supra* note 131, at 14 ("Most of the difference between the $2.3 million pre-tax income on an accounting basis and the $5 million cash surplus was

exported out of the area of origin. These distributional effects are not mentioned in the ASU study nor would they be captured by IMPLAN modeling.

With respect to government services, the La Paz Generating Facility presented a notable social impact. Rather than viewing the proposed La Paz Generating Facility as a strain, nearby towns battled for the right to provide services. A local newspaper reported:

> One local group which may benefit from this new $540 million construction project is the Quartzsite Fire District, which is looking to expand its service area to include this new power plant. Company officials present at the Quartzsite meeting thought that the Wenden Fire District could handle the safety and rescue, but the Quartzsite Fire Chief, John Will, told him [sic] that his district would be a better choice.[145]

As the IIP and La Paz Generating Facility illustrate, an examination of actual water transfers will provide a valuable check on predicted outcomes. For now, few actual agriculture-to-energy transfers are available for study in the Southwest. However, as we approach the limits of water and energy supplies, more agriculture-to-energy water transfers are inevitable. Those transfers will improve empirical information regarding socioeconomic and other third-party impacts that can help decision-makers going forward.

V. RECOMMENDATIONS

Decision-makers need to strike the right balance between over-regulation and under-regulation of water and energy so that these resources can be efficiently and equitably allocated.[146] Toward that end, this Part offers the following eight recommendations.[147]

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recorded as an increase in book value of the assets when PICO acquired Vidler's ultimate parent company, Global Equity Corporation, in 1998.").

145. Leland Weeks, *Quartzsite Hopes to Cash in on New Plant*, QUARTZSITE TIMES, July 4, 2001, at 1, *available at* http://news.google.com/newspapers?nid=944&dat=20010704&id=5NEwAAAAIBAJ&sjid=Ft0FAAAAIBAJ&pg=6042,2146331.

146. *See* Colby, *supra* note 56, at 1188.

147. There is no shortage of further ideas. *See, e.g.*, Sovacool, *supra* note 5 (offering strategies to avoid water and power shortages, including research and development on alternative cooling cycles, banning new thermoelectric power generation and constructing utility-scale wind and solar projects, promoting energy efficiency and demand-side management, and changing electricity pricing); Webber, *supra* note 5 (proposing wastewater reuse, implementation of solar water heating, and changes to water pricing); Lon W. House, *Will Water Cause the Next Electricity Crisis?*, 9 WATER RESOURCES IMPACT, Jan. 2007, at 12, *available at* http://www.waterandenergyconsulting.com/Jan07Impact.pdf (suggesting self-generation, demand reduction, and demand response); U.S. DEP'T OF ENERGY, ENERGY DEMANDS ON

A. Statutory Definitions of "Public Interest" Should Be Amended to Include Socioeconomic Concerns

Energy project siting and water transfer proceedings provide varying degrees of protection for the "public interest" or the "public welfare." A lack of statutory specificity as to what those terms encompass impedes decision-makers' ability to efficiently and equitably resolve trade-offs that arise from the energy-water nexus. "Public interest" statutes throughout the Southwest should be amended to ensure that they contain sufficient specificity and comprehensiveness, including a mandate that socioeconomic impacts be considered.[148]

The definition of "public interest" should not be tasked, ultimately, to the courts. Rather, legislatures, consisting of elected representatives who can hold hearings, can better assess the social consequences of new rules regarding public interest determinations.[149] Moreover, the courts historically have been unable to keep pace with evolving paradigms in the water and energy contexts.[150] The courts also lack the administrative continuity to assure predictable and consistent results.[151]

The discussion in Part I of this article demonstrates that states in the Southwest have not uniformly or systematically incorporated socioeconomic concerns into public interest determinations. Even when the law requires consideration of the "public interest," the term is not defined with enough specificity to ensure that socioeconomic impacts are given proper weight. For example, although Arizona's siting certification process requires consideration of the "total environment of the area" and the "public interest," the Vidler-Allegheny water transfer illustrates that public-interest determinations in Arizona may, in practice, distill simply to whether an energy project "aids the state in meeting the need for an

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WATER RESOURCES: REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER (Dec. 2006), *available at* http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf (promoting development of science and system-based natural resource policies and regulations and coordinated infrastructure development).

148. *See* Lawrence J. MacDonnell & Teresa A. Rice, *Moving Agricultural Water to Cities: The Search for Smarter Approaches*, 14 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 105, 153 (2008). *See also* Howe & Goemans, *supra* note 53, at 1064 ("The set of criteria to be considered by the transfer agencies in approving, modifying, or disapproving water transfers should be expanded to include consideration of secondary economic and social costs imposed on the basin of origin. . . .").

149. *See* JOSEPH SINGER, PROPERTY LAW 372 (Richard A. Epstein et al. eds., 2d ed. 1997).

150. *See, e.g.*, Robert Jerome Glennon & Thomas Maddock III, *In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water*, 36 ARIZ. L. REV. 567, 591 (1994) (discussing Arizona Supreme Court's application of obsolete principles of hydrogeology and failure to acknowledge scientific developments).

151. WILLIAM GOLDFARB, WATER LAW 25 (2d ed. 1988).

adequate, economical and reliable supply of electric power"[152] irrespective of impacts on third parties. Socioeconomic impacts should be added to the list of factors to be considered in the issuance of a Certificate of Environmental Compatibility.

In addition, other legislative responses in the states would help improve the consideration of socioeconomic impacts in energy-project siting and water-transfer proceedings. In Arizona, the law governing water transfers should be amended to require, at a minimum, consideration of the "public interest" or "public welfare" as is the case for water transfers in other states and for water appropriations in Arizona.[153]

In California, the California Energy Commission's (CEC) process for project siting is relatively comprehensive compared to other states in the Southwest and consolidates siting authority to simplify energy project permitting.[154] However, California has given certain renewable energy projects a pass. The exemption from CEC jurisdiction for wind, hydroelectric, and solar photovoltaic energy projects is intended to help such projects speed along the regulatory process. However, the socioeconomic impacts of such projects should not be ignored, particularly as they become a larger part of the state's energy portfolio and are concentrated in rural areas.

California's State Water Resources Control Board must consider the "overall economy of the area" affected by water transfers, which provides at least some protection for parties external to water transfers. A fuller description of what those considerations should encompass, including direct, indirect, and induced impacts, would help the State Water Resources Control Board better handle conflicts among competing interests in water-transfer proceedings.

In New Mexico, the existing siting statute should be amended so that the state's Public Regulation Commission is required to consider third-party interests for generation projects, not just for transmission

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152. *See Allegheny Energy Supply Co. Case*, *supra* note 134.

153. *See* ARIZ. REV. STAT. ANN. §§ 45-172, 45-153(A) (West, Westlaw through 2010 legislation). Arizona courts have held that the Arizona Department of Water Resources has discretion to reject an application to appropriate water when a third party challenges the application based on the public interest, even if the third party is not a prior appropriator. However, such a third party may not have the right to appeal an approved application to the superior court. Ariz. Game & Fish Dep't v. Ariz. State Land Dep't, 535 P.2d 621, 622 (Ariz. Ct. App. 1975). The Arizona State Land Department was "the predecessor to the Arizona Department of Water Resources which reviewed water appropriation applications." D. Craig Bell & Norman K. Johnson, *State Water Laws and Federal Water Uses: The History of Conflict, The Prospects for Accommodation*, 21 ENVTL. L. 1, 10 (1991).

154. Certification by the CEC is "in lieu of any permit, certificate, or similar document required by any state, local or regional agency, or federal agency." CAL. PUBLIC RESOURCES CODE § 25500 (West, Westlaw through 2010 legislation).

projects. The list of third-party interests in both cases should expressly include socioeconomic considerations.

B. Jurisdiction Over Siting Processes Should Be Expanded to Include Smaller Projects

Siting statutes should be expanded to authorize state oversight of smaller projects and not just projects greater than 50 MW as in California, 70 MW as in Nevada for renewable energy, 100 MW as in Arizona, or 300 MW as in New Mexico. Siting authorities have specialized knowledge that should be brought to bear on a larger universe of power projects as the competition for water increases, particularly in light of the potential for smaller projects to alleviate water scarcity problems.[155] This would help standardize the assessment of socioeconomic impacts, improve equity, and reduce uncertainty for project developers.

C. Energy Project and Water Transfer Approval Processes Should Provide for Compensation for Socioeconomic Impacts

As agriculture is displaced to make way for energy projects, compensation for socioeconomic impacts should be required when possible. Indeed, some states already have authorized fees to protect local interests. For example, California's area-of-origin laws give local parties "the right to purchase, for adequate compensation, water made available by the construction of any works" by an exporter.[156] In Arizona, the Groundwater Transportation Act authorized certain water transfers subject to payment of damages based on a list of considerations that includes whether the transfer will result in "[r]etirement of land from irrigation."[157] In addition, Arizona law prohibits water transfers from remote areas of origin to municipalities unless the municipalities make payments to the state "in lieu of taxes that would otherwise have been levied by the area of origin."[158] With the approval of the state engineer, counties in Nevada may impose fees to compensate for water transfers, and the collected fees must be used by the county "only for the purposes of economic development, health care and education."[159] Alternatively, if a county of origin does not impose a fee, it may cooperate with the trans-

155. *See* Voinov & Cardwell, *supra* note 5, at 27 ("Small hydro, wind, solar, and biogas installations can help produce additional energy at the point of service, reducing conversion losses. They will also help lower water demands and will provide essential stability for the whole system.").

156. CAL. WATER CODE § 1217(a) (West, Westlaw through 2010 legislation).

157. ARIZ. REV. STAT. ANN. §§ 45-545, 45-551 (West, Westlaw through 2010 legislation).

158. WATERS AND WATER RIGHTS, *supra* note 65.

159. NEV. REV. STAT. ANN. § 533.438 (West, Westlaw through 2009 legislation).

fer applicant to develop a plan to mitigate the adverse economic effects of the proposed transfer.[160] Such mitigation plans may include compensation for the foreseeable effects of the transfer.[161]

Of course, monetizing and internalizing socioeconomic impacts that are not captured in market transactions remains the subject of much academic debate.[162] But, provided that compensation for such impacts is required in a consistent and equitable manner,[163] the idea may not prove so controversial in practice, and the actual magnitude of such compensation may prove lower than expected.[164] Compensation structures could be designed to include certain benchmarks to increase their predictability. For example, fees could be placed in escrow and returned to transferees if tangible local adverse impacts—such as a specified drop in employment rates or physical impacts to the community along the lines set forth in the CEQA guidelines—do not occur as predicted over a specific timeframe.

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160. NEV. REV. STAT. ANN. § 533.4385(1) (West, Westlaw through 2009 legislation).

161. *Id.* at § 533.4385 (2).

162. *See* Howitt & Hansen, *supra* note 78 and accompanying text; *see also* JOHN M. HARTWICK & NANCY D. OLEWILER, THE ECONOMICS OF NATURAL RESOURCE USE 385 (John Greenman & Mary G. Ward eds., 1986) ("The solution advocated by many economists is to use the powers of government to impose a price on an external effect, so that agents are forced to include the external effect in their calculations of what goods to produce and consume."); WATER TRANSFER WORKGROUP, *supra* note 99, at 7. ("[M]arket forces can fail to achieve the highest social welfare because of interests that are not considered within private bargaining. In these circumstances, focused regulation and government intervention are necessary to protect social interests that are not price responsive.").

163. *See* SØRENSEN, *supra* note 69, at 797. ("[M]oneti[z]ing should be used only if it does not significantly increase uncertainty, which means that the decision-makers should not be exposed to the monetizing simplification unless it preserves their possibility of making a fair assessment.").

164. *See* Robert Glennon, *America's Water Crisis and What to Do About It*, 26 ENVTL. F. 50 (2009) ("What will happen to American farmers if cities and developers go around buying up their water rights? Nothing, as it turns out. Over the last 25 years, water transfers have moved roughly twice the annual flow of the Colorado River out of farming . . . Yet, aggregate farm income has not declined."); Howe & Goemans, *supra* note 53, at 1062 ("If the economic region is economically diversified and buoyant, alternative employment opportunities are close at hand and the selling farmer can find local investment opportunities for his or her money. The 'secondary impacts' in such a setting are likely to be short lived. If the new use of water supports more profitable activities in the same economic region, the region as a whole will be better off economically from the water sale."); GARREY E. CARRUTHERS, THOMAS G. BAHR, HERBERT H. FULLERTON & NORMAN H. STARLER, *Federal Water Policies and Irrigated Agriculture*, *in* WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE, *supra* note 4, at 449 ("Given an initial 85/15 agriculture/nonagricultural water distribution, a twofold expansion of nonagricultural use would reduce this ratio to 70/30. Numerous studies have demonstrated that adjustments in this range would not seriously affect agricultural viability, i.e., a total economy on a state or regional basis.").

D. Statutory Definitions of "Beneficial Use" Should Be Expanded to Include Low-Water-Use Renewable Energy Production

Not all states in the Southwest have legislatively defined "beneficial use." In many cases, the term has been defined by the courts, creating a lack of uniformity. An emerging understanding of the energy-water nexus in the Southwest has highlighted the critical need for renewable energy projects with lower water requirements than conventional power plants. Indeed, some states have mandated water-use efficiency for new energy projects. "California and Arizona have established formal policies or requirements to encourage power plant developers to consider alternative cooling methods and reduce the amount of freshwater used in a proposed power plant."[165]

The need for water-efficient renewable energy projects should be reflected—and related uncertainty should be eliminated—by legislation establishing that water use for such projects will be deemed "beneficial use." Such projects could be defined based on a specific threshold of water intensity, or gallons-per-MW produced. Additionally, water use for water-efficient renewable energy projects should be given priority over water-intensive power production and for nonrenewable power production. Such a priority system would create an added incentive for renewable energy production using water-efficient technology, which currently faces financial challenges.[166]

E. Decision-Makers Should Recognize That Conservation Is Not Without Limits

As an alternative to water transfers, water conservation is commonly proposed as a means to create new supplies for energy use.[167] Of

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165. GAO-10-23 *supra* note 34, at 37.

166. In New Mexico, for example, a 2003 bill that would have required water efficiency measures (including techniques such as "dry cooling") for new power projects, died after the Public Service Company of New Mexico—the state's largest electricity provider—testified about the potential for dry-cooling technology to add 5 to 10 percent to the construction cost of a new facility and to decrease operating efficiency by 10 percent. *See* Fiscal Impact Report, H.B. 292, 46th Leg., 1st Reg. Sess. (N.M. 2003) ("Water Conservation Plans for Electric Plants"), *available at* http://www.nmlegis.gov/lcs/_session.aspx?chamber=H&legtype=B&legno=292&year=03. The bill also would have expanded the Public Regulation Commission's jurisdiction to include authority over siting decisions for electric generating plants of 50 MW or more. *Id.*

167. *See, e.g.*, Voinov & Cardwell, *supra* note 5, at 17 ("[W]e will likely have to meet many of our future water and energy needs via increased efficiency and conservation."); Nancy Stoner, *America's Water Future: There's a Better Way*, 26 ENVTL. F. 52 (2009) ("we can no longer afford the luxury of wasting water"); House, *supra* note 147, at 12–13 (promoting conservation).

course, water conservation needs to be part of any strategy to meet energy and water demands in the future. However, the benefits of water conservation are not unbounded.

Water conservation may lead to significant, adverse third-party impacts. Some communities rely upon inefficiency in water supply systems. For example, a proposal by the U.S. Bureau of Reclamation, in the name of water conservation, to line the earthen All-American Canal that delivers water from the Colorado River to the IID was opposed by farmers and other residents of the Mexicali Valley who depend on aquifer recharge by the water that seeps from the canal.[168] In 2005, those parties sued the Bureau of Reclamation, claiming, among other things, that the proposed project would cause a "loss of farm-worker jobs [and] revenue to U.S. and Mexican farmers."[169] In 2006, Congress passed legislation promoting the canal-lining project and rendering moot socioeconomic review under NEPA with respect to the project.[170] As a result, the courts sided with the Bureau of Reclamation and allowed the project to proceed, after also finding that the 2006 legislation passed constitutional muster despite the equal protection issues that were raised.[171]

Because water demand has increased to the point that some users rely on system inefficiencies, water conservation may not always provide an equitable solution to shortages. However, as decision-makers consider the socioeconomic impacts of water transfers, the limits of water conservation as an alternative should be taken into account.

F. Economic Models Should Be Used with Recognition of Their Limits

Economic models such as IMPLAN, EIFS, and econometric models may be useful as one part of a larger tool kit for assessing the broad range of potential local impacts. For example, IMPLAN has been criticized because (1) the model does not address the full range of potential community impacts of a proposed development, policy change, or "event," and (2) the model results have inherent inaccuracies because many of the dollar-flow relationships internal to the model are based on

168. *See* GLENNON, *supra* note 5, at 295–99.

169. Nicole Ries, *The (Almost) All-American Canal:* Consejo de Desarrollo Economico de Mexicali v. United States *and the Pursuit of Environmental Justice in Transboundary Resource Management*, 35 ECOLOGY L.Q. 491, 509 (2008) (quoting plaintiff's brief).

170. Consejo De Desarrollo Economico De Mexicali, A.C. v. United States, 482 F.3d 1157, 1168–70 (9th Cir. 2007) (discussing the Tax Relief and Health Care Act of 2006, Pub. Law No. 109-432, 120 Stat. 2922).

171. *Id*. at 1172.

national economic data, which fails to adequately account for heterogeneous region-specific economic conditions.[172] However, with respect to the first criticism, IMPLAN is simply a tool for assessing standard quantifiable economic metrics such as output, employee compensation, and employment. Other potential impacts—including distributional effects and non-economic metrics such as demographic (population), infrastructure, superstructure, and environmental/visual impacts—should not be ignored but should be considered separately and weighed by decision-makers to achieve the best outcome.[173] As a practical matter, IMPLAN's results can provide a good starting point to evaluate the potential demographic impacts of an event as job creation or loss frequently is a primary driver of community population change. Estimates of population impacts can then be used to evaluate the potential impacts of an event on local infrastructure, such as roads, and superstructure, including public safety services.

Criticism of IMPLAN's potential inaccuracies must be viewed with perspective on how the model output is to be used. If a decision-maker seeks absolute estimates of employment, income, and other impacts of an event, concerns about inaccuracies are warranted; IMPLAN may not be an appropriate tool. However, to evaluate the relative impacts of different project alternatives and to estimate the order of magnitude of these impacts to facilitate decision-making, IMPLAN is effective, evidenced by its wide adoption and acceptance.[174]

Economic models facilitate decision-making but may be limited by the "real time demands of active decision-makers."[175] Despite their shortcomings, socioeconomic analysis should not be ignored. Because some impacts cannot be quantified, decision-makers' biases will always influence the outcome of socioeconomic analyses. Yet, that is exactly

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172. *See, e.g.*, Wilbur Maki, Richard Lichty & Scott Loveridge, Reducing System Bias and Specification Error in Micro-IMPLAN (June 1994), *available at* http://ageconsearch.umn.edu/bitstream/13317/1/p94-12.pdf (Univ. of Minnesota, Staff Paper P94-12); T.Y. Hall & R.K. Skaggs, Economic Impact of Southern New Mexico Vegetable Production and Processing (2003), *available at* http://aces.nmsu.edu/pubs/research/horticulture/CTF9.pdf (N.M. State Univ. Coop. Extension Serv., N.M. Chile Task Force Rep. 9).

173. *See* SØRENSEN, *supra* note 69, at 779; *see also* Thomas A. Campbell, *Economic Valuation of Injury to Natural Resources*, 6 NAT. RESOURCES & ENV'T 29 (1992). (arguing that "[t]hose who cry that [certain impacts] cannot be valued in crass economic terms may very well be left holding the proverbial bag, since judges and juries are not likely to award damages based on an undefined or unsubstantiated claim").

174. The courts have accepted IMPLAN results as credible evidence of potential project impacts. *See, e.g.*, High Sierra Hikers Ass'n v. Moore, 561 F. Supp. 2d 1107, 1113 (N.D. Cal. 2008).

175. *See* BRUNSEN ET AL., *supra* note 84, at 3 (discussing the importance of timeliness in economic impact analysis).

why we elect and appoint them. "If this were not the case, there would be no need for decision-makers, as the calculated total impact values would directly point to the best alternative."[176]

G. Efforts Should Be Undertaken to Improve Information Available to Decision-Makers

Information on energy and water projects should be centralized to ensure that knowledge gaps are filled and the energy-water nexus is appropriately addressed.[177] As more agriculture-to-energy water transfers occur, it will be helpful to monitor actual socioeconomic impacts and compile the results to better understand their magnitude and distribution and to improve predictive models. This information must be widely accessible.[178] A bill to help facilitate this, the American Clean Energy Leadership Act of 2009,[179] did not survive the legislative process; interested parties should ensure that sufficient political will exists to enact such legislation. Better information will equip decision-makers to more efficiently and equitably allocate resources.[180]

H. Energy and Water Policy Should Be Integrated

If the geographic jurisdictions of various agencies with authority over energy and water resources were placed on a single map, a striking lack of uniformity would be seen.[181] At the same time, states' political

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176. SØRENSEN, *supra* note 69, at 779. *But see* Getches, *supra* note 108, at 245 ("If the elements constituting the public interest were comprehensively articulated, government employees could use them to guide state policy in resolving conflicts among competing interests and to understand better the tradeoffs inherent in any water decision.").

177. GAO-10-23, *supra* note 34, at 51 (recommending that resource agencies "establish a process for regularly coordinating with each other, water and electricity industry experts, environmental groups, [and] academics . . . to identify and implement steps to improve data collection and dissemination.").

178. *See* Colby, *supra* note 56, at 1191 ("[D]ata developed for previous transfers . . . should be publicly available and used to build up a cumulative information base for evaluating transfer impacts, with the goal of reducing information costs.").

179. S. 1462, 111th Cong.(2009), *available at* http://www.govtrack.us/congress/bill.xpd?bill=S111-1462.

180. *See* Mark Limbaugh, *Minimizing and Resolving Conflict Is the Key*, 26 ENVTL. F. 51 (2009) ("Water managers . . . need information in real time to better control and manage the resource. A 'smart' water grid could apply today's powerful computer and sensor technology, informing water managers through the mining of different data sources . . . and connecting real-time monitoring equipment with automated or supervisory controlled water management infrastructure.").

181. *See* DALE PONTIUS, COLORADO RIVER BASIN STUDY: REPORT TO THE WESTERN WATER POLICY REVIEW ADVISORY COMMISSION, app. A, at A-2 to A-11 (1997) (graphically depicting jurisdictional areas of the Bureau of Reclamation, Bureau of Indian Affairs, Bureau of Land

boundaries have little to no relationship with watershed boundaries or electricity transmission systems. Yet, the mission statements of different resource agencies suggest significant areas of overlap.[182] To ensure that energy and water resources are properly valued, and that related trade-offs are best understood, a more integrated approach is necessary.

At the state level, the CEC's exclusive authority over energy project siting provides a good example of how one agency can coordinate decisions.[183] By exempting certain renewable energy projects with low water use from the CEC's jurisdiction, the California legislature has integrated water-consumption concerns directly into energy project planning. For other energy projects, the CEC considers the availability of water in its review process. By contrast, California's State Water Resources Control Board has no express obligation to consider the availability of energy in its water transfer proceedings, an inconsistency that should be addressed by legislative action.

In other states, decisions regarding water transfers and energy project siting are overseen by an array of agencies without integrated approaches. As articulated above, legislatures may be best equipped to improve the extent to which water transfer proceedings account for energy-related impacts and state energy project certification processes account for water-related impacts. Some commentators have proposed that regional natural resources planning groups[184] or local cooperation organizations[185] may be the most efficient means of promoting integration of energy and water planning.[186] Others have suggested the creation of a

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Management, Army Corps of Engineers, Environmental Protection Agency, National Park Service, Fish and Wildlife Service, Forest Service, Natural Resource Conservation Service, and Western Area Power Administration); *see also* Gerald Sehlke, *What Is "The Energy-Water Nexus?,"* 143 J. CONTEMP. WATER RESEARCH & EDUC., 1, 2 (2009) ("The federal government has more than 20 agencies responsible for understanding and managing water and energy resources. Every state and many tribes have one or more agencies that are responsible for managing energy and water resources within their areas of jurisdiction.").

182. *See* PONTIUS, *supra* note 181.

183. *See* CAL. PUBLIC RESOURCES CODE §§ 25120, 25500 (West, Westlaw through 2010 legislation).

184. U.S. DEP'T OF ENERGY, *supra* note 5, at 49.

185. Erik K. Webb & Joshua Johnson, *Federal Engagement in Water Resource Technology Development: Current Programs and the Future*, 143 J. CONTEMP. WATER RESEARCH & EDUC. 3, 8 (2009) (describing one such group).

186. *See* PATE ET AL., *supra* note 86, at 16. ("Energy planning will become increasingly dependent on interactions [between] regional water, wastewater, and agricultural water managers and planners because regional energy and water concerns may become common."). WATER TRANSFER WORKGROUP, *supra* note 99, at 5. ("[L]ocal government is often concerned about how water transfers affect third parties and the social and economic conditions . . . Partnerships with local government are one way to better address these issues.").

National Electricity Water Policy Program Office[187] or, alternatively, a Department of Water[188] to act as a counterpart to the Department of Energy, as ways to improve coordination and better account for tradeoffs inherent in the energy-water nexus.

Whether collaboration occurs in a federal, regional, or local context, a planning process that integrates energy and water development is essential to create a comprehensive approach to socioeconomic impact analysis, avoid serious regulatory uncertainty, keep transaction costs down, and enable progress toward sustainability. "[O]nly water policy designs that engage, involve, and empower those affected in water decisions are likely to result in equitable and democratic water politics."[189] This is equally applicable to energy policy designs.

CONCLUSION

Given the array of interests at stake, addressing problems associated with the energy-water nexus will require a multidimensional approach. Political, technological, and legal innovations must be implemented. From a socioeconomic standpoint, the best path forward will depend on the goals to be accomplished. For example, should projects be developed when a community or region can afford them, regardless of whether they make economic sense?[190] Is the goal to respond to increasing pressure on scarce resources by ratcheting back our standard of living?[191] Do we want to maintain our standard of living?[192] Do

187. Sovacool, *supra* note 5, at 49 (proposing that such a program office be established by legislation or executive order, to "coordinate and harmonize federal laws to stimulate the expedited implementation, permitting and siting of clean power facilities" particularly in designated crisis areas). A similar idea was proposed in 1984 to help mitigate adverse socioeconomic impacts associated with out-of-agriculture water transfers. Estevan T. Flores, *Social Impacts on Rural Communities*, *in* WATER SCARCITY: IMPACTS ON WESTERN AGRICULTURE, *supra* note 4, at 327 (arguing that "federal relief zones patterned after existing disaster areas" could be created to provide federal assistance to rural communities and small farms in decline due to water resource reallocation).

188. *See* Webber, *supra* note 5, at 39 (arguing "no federal agency ensures the effective use of water [and] Congress should create a single overseer[.]").

189. Helen Ingram, *Reason and Rationality in Water Politics*, 116 J. CONTEMP. WATER RESEARCH & EDUC. 50, 51 (2000), *available at* http://www.ucowr.siu.edu/updates/pdf/V116_A12.pdf. *But see* Biswas, *supra* note 69, at 751 ("Increased public participation in the planning process does not mean that the public will more readily accept agency plans—but it does suggest that the plans may be more acceptable to the population as a whole.").

190. *See* REISNER, *supra* note 8, at 487.

191. *Compare* Klein, *supra* note 48, at 275 ("The new presumption should be that we can and must 'live within our means,' rejecting the view that never-ending growth is desirable or inevitable.") *with* Press Briefing with Ari Fleischer, White House Office of the Press Sec'y (May 7, 2001) (transcript *available at* http://web.archive.org/web/20010605170000/http://www.whitehouse.gov/news/briefings/20010507.html) ("Q: Is one of the problems

we want to improve it? At what level: nationally, regionally, or locally? Do we want to sustain historical practices[193] or move toward a more modern economy?[194] Opposing perspectives will persist, even if we accept the credo that "[w]here conflicting interests must be reconciled, the question shall always be answered from the standpoint of the greatest good of the greatest number in the long run."[195]

Decision-makers faced with conflicting interests arising from the energy-water nexus will better understand socioeconomic impacts and will be better equipped reach resolution if: (1) the legislative changes suggested in this article are pursued; (2) decision-makers proceed with an understanding of the limits of water conservation and economic modeling; (3) available information is improved; and (4) energy and water policy are integrated.

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with . . . the entire energy field, American lifestyles? Does the President believe that, given the amount of energy Americans consume per capita, how much it exceeds any other citizen in any other country in the world, does the President believe we need to correct our lifestyles to address the energy problem? MR. FLEISCHER: That's a big no. The President believes that it's an American way of life, and that it should be the goal of policy makers to protect the American way of life. The American way of life is a blessed one.").

192. *See* Voinov & Cardwell, *supra* note 5, at 25 ("There is a clear correlation between energy consumption and economic development. However, there is no obvious correlation between gross domestic product and such 'quality of life' indicators as 'life satisfaction,' or life expectancy. With no sacrifice to life quality we can at least halve the per capita gross domestic product and therefore reduce energy consumption accordingly.").

193. *See* GLENNON, *supra* note 5, at 278 ("Protecting existing farmland is critical for the nation's economy and food supply, our national security, the fiscal stability of local governments and even the environment because farmland provides open space, food and cover for wildlife, flood control, and wetlands protection."); WATER TRANSFER WOKRGROUP, *supra* note 99, at 6 ("[T]he basic provision of water for agricultural purposes at subsidized rates is a reflection of the high social value placed on agriculture in our society. The purpose of these dedications may be compromised if the water does not stay with the intended use.").

194. *See, e.g.*, J. CAVE, ET AL., TRENDS IN CONNECTIVITY TECHNOLOGIES AND THEIR SOCIO-ECONOMIC IMPACTS, 9 n.14 (2009), *available at* http://www.ifap.ru/library/book455.pdf (proposing progress toward "'immateriali[z]ation'—substituting communications for travel and information goods for physical goods").

195. SARAH BAKER MUNRO, TIMBERLINE LODGE: THE HISTORY, ART, AND CRAFT OF AN AMERICAN ICON 21 (2009) (attributing this credo to Gifford Pinchot).