National Ecosystem Services Partnership

FEDERAL RESOURCE MANAGEMENT AND ECOSYSTEM SERVICES GUIDEBOOK

Federal Agency Explorations and Applications: Case 12 (Bureau of Land Management)

Protecting Ecosystem Services While Developing Renewable Energy: Bureau of Land Management Solar Energy Program

Amanda Reed and Laura Crane

FEDERAL AGENCY EXPLORATIONS AND APPLICATIONS: CASE 12

Bureau of Land Management

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FEDERAL RESOURCE MANAGEMENT AND ECOSYSTEM SERVICES

Institutional Partners

National Oceanic and Atmospheric Administration
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About This Document

This case is part of the Federal Resource Management and Ecosystem Services (FRMES) Guidebook created by the National Ecosystem Services Partnership (NESP). NESP, housed at the Nicholas Institute for Environmental Policy Solutions, seeks to enhance collaboration within the ecosystem services community and to strengthen coordination of policy implementation and research at the national level. The FRMES Guidebook represents a collaborative effort by federal agencies and outside experts to develop a credible and feasible approach to incorporating ecosystem services into the decision-making processes of federal agencies.

Cases are written and approved by the author(s)' agency, but they have not been peer reviewed. They describe the decision-making context within which that agency is considering or testing an ecosystem services management framework, and they present approaches or innovations that the agency is using to incorporate ecosystem services into its planning and decision-making processes. Cases informed development of the FRMES Guidebook and could be of value to others embarking on ecosystem services planning and management efforts.

To read other federal agency explorations and applications of an ecosystem services management framework, visit www.nespguidebook.com.

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Protecting Ecosystem Services While Developing Renewable Energy: Bureau of Land Management Solar Energy Program

Introduction and Location

In 2012, the Department of Interior (DOI) established the Solar Energy Program, as approved through the Record of Decision (ROD) for the Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar PEIS). Geographically, the program covers approximately 100 million acres and 89 Bureau of Land Management (BLM) land-use planning units in Arizona, California, Colorado, Nevada, New Mexico, and Utah (see Figure 1.) As described in the Solar PEIS, the program defined how utility-scale solar energy would be considered and developed on public lands administered by the BLM.

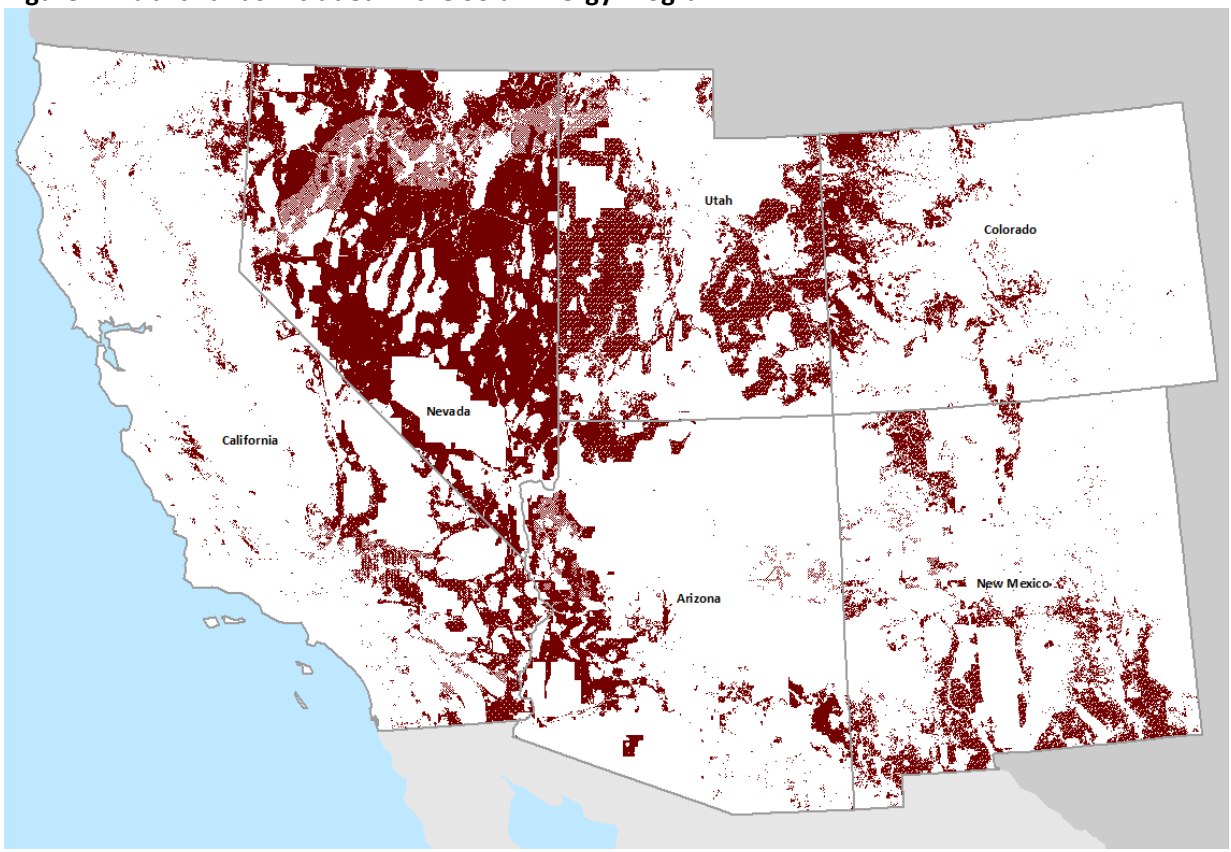
Further, the program established solar energy right-of-way authorization policies and required environmental impact minimization measures, or "design features," for industry use on public lands. In terms of public lands allocation, the program also defined three types of land use zones in relation to utility-scale solar energy: (1) *exclusion areas* or BLM lands where utility-scale solar energy is not allowed (79 million acres); (2) *variance areas* as well as a variance process defining where and how solar energy might be considered case by case on the basis of environmental concerns and a more localized, regional analysis (19 million acres); and (3) initial *solar energy zones* (SEZs), where solar energy development is the priority land use allocation (285,000 acres). At the time of the ROD, the initial SEZs would provide enough land, if developed, to power 7 million homes with clean energy.[1]

Utility-scale solar energy development often requires new infrastructure, including the solar installation plus associated infrastructure such as power lines and substations, to be built on large acreages (1–9 acres/MW). If not sited carefully, this infrastructure can pose serious threats to wildlife, habitats, and water resources. However, with smart planning, including intelligent siting and design features, it is possible to develop clean, renewable energy while also protecting ecosystem function and ecosystem services. In the locations covered by the Solar Energy Program, key ecosystem services and functions include protection of clean air, carbon sequestration from plants and microbiotic soils, and other regulating services; protection of clean water and recharge of groundwater aquifers through maintenance of soil stability and hydrologic function and other critical provisioning services; and sustained protection of wildlife, habitats and corridors to maintain biodiversity, and other supporting services. Additionally, the program considers recreation, open space, views, and tribal sacred space—all a fundamental component of cultural identity in the U.S. west.

The Solar Energy Program offers a framework for integrating these ecosystem services at both a larger, regional scale and at a more local or project-level scale. For example, decisions about where to prioritize the siting of utility-scale solar energy development as well as key areas that should be avoided due to ecosystem services-related conflicts (i.e., sustained biodiversity, recreational settings, or tribal sacred areas) occur at a regional level. Decisions about where to invest in nature to offset the unavoidable impacts of development also happen at a regional level, as do decisions about whether solar energy is appropriate in the variance lands. Finally, decisions about further minimizing impacts from development activities and ongoing operations occur at a local level.

[1] Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern State, Bureau of Land Management, October 2012 (ROD, October 2012).

Figure 1. Public Lands Included in the Solar Energy Program.



Source: The Nature Conservancy.

Motivation

The BLM and the U.S. Department of Energy (DOE), through its Energy Efficiency and Renewable Energy Program, initiated the Solar Energy Program in 2008. At the time, the BLM was overwhelmed with a large number of permit applications for utility-scale solar energy project proposals, particularly in Arizona, California, and Nevada. The Solar PEIS document notes that the BLM was answering the "need to respond in a more efficient and effective manner to the high interest in siting utility-scale solar energy development on public lands and to ensure consistent application of mitigation measures; avoidance, minimization, and compensation for the unavoidable impacts of such development."[2]

The BLM was also responding to multiple congressional and administrative mandates to increase renewable energy production on its lands, while meeting its Federal Land Policy and Management Act of 1976 (FLPMA) mandate: "the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people without permanent impairment of the productivity of the land and the quality of the environment."[3]

[2] ROD, October 2012
[3] The Federal Land Policy and Management Act of 1976 Public Law 94-579; http://www.blm.gov/flpma/FLPMA.pdf.

Related renewable energy mandates include the following:

- In Executive Order 13212, Actions to Expedite Energy-Related Projects, the President ordered that executive departments and agencies "…take appropriate actions to expedite projects that will increase the production, transmission, or conservation of energy." Moreover, "For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections."[4]
- In Secretarial Order No. 3285A1, the Secretary of the Interior announced a policy goal of identifying and prioritizing specific locations on public lands that are best suited for large-scale production of solar energy.[5]
- In Section 211 of the Energy Policy Act of 2005, Congress instructed the Secretary of the Interior, within 10 years of enactment of the act, to "…seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity."[6]
- The Energy Independence and Security Act of 2007 requires the DOE to facilitate integration of utility-scale solar energy into regional electricity transmission systems, and Executive Order 13514 requires federal agencies to help advance local efforts for renewable energy development.[7]

Finally, the BLM was responding to demands of state-level renewable energy portfolio standards, including the identification of development focus areas with high solar resource potential. Given these mandates and other market forces, the reasonably foreseeable development scenario (RFDS) developed for the Solar Energy Program estimated that the amount of solar energy generation on BLM lands in the study area over the 20-year study period would be about 24,000 MW; that generation necessitates the corresponding dedicated use of about 214,000 acres of BLM-administered lands.[8] Prior to the program, BLM solar policies guided resource managers to address environmental concerns for solar projects on a case-by-case basis; the program established policies and guidance that take a programmatic approach to assessing impacts and siting solar development to avoid, minimize, and offset impacts on a regional scale.

At the same time, multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, were also interested in developing a regional approach to siting solar energy development in the desert southwest given the expected demand. They viewed such an approach as part of their larger efforts to reduce the impacts of energy development, while promoting renewable energy sources.

Decision Context

The BLM's stated objectives for managing utility-scale solar development are as follows:

- Facilitate near-term utility-scale solar energy development on public lands,
- Minimize potential negative environmental impacts,

[4] Executive Order 13212, Actions to Expedite Energy-Related Projects, May 2001; http://www.gpo.gov/fdsys/pkg/FR-2001-05-22/pdf/01-13117.pdf.
[5] Secretarial Order No. 3285A1, Issued in March 2009 and amended February 2010; http://www.drecp.org/whatisdrecp/docs/DOI_Secretarial_Order_3285_A1.pdf.
[6] Section 211, of the Energy Policy Act of 2005 (P.L. 109-58); http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf.
[7] http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf; http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf.
[8] Final Solar PEIS, July 2012. See http://solareis.anl.gov/documents/fpeis/index.cfm.

- Minimize potential negative social and economic impacts,
- Provide flexibility to the solar industry to consider a variety of solar energy projects (e.g., location, facility size, and technology),
- Optimize existing transmission infrastructure and corridors,
- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands, and
- Meet projected demand for solar energy development (as estimated by the RFDS developed for the PEIS).[9]

The BLM can achieve these goals through landscape-scale planning and the application of the mitigation hierarchy, which is to avoid impacts associated with development of solar energy, to minimize those impacts, and, only then, to compensate for unavoidable impacts. The BLM applies the mitigation hierarchy through planning processes at (1) the programmatic level, which established Solar Energy Program and defined land use allocations; (2) a regional scale to determine whether additional avoidance areas are needed, where additional development is appropriate, and where the investment to compensate for the impacts of renewable energy development should occur; and (3) the local or project level, where additional decisions are made for minimizing impacts and measuring unavoidable impacts.

Avoidance is the least costly and most effective step in the mitigation hierarchy to meet goals related to the long-term viability of wildlife and ecosystem function, to achieve a balance of development and conservation, and to protect ecosystem services. Specifically, the avoidance step refers to identification of places that are too important for species, habitats, ecological function, and other ecosystem services values to allow development. Avoidance (or exclusion) areas are avoided entirely with respect to development activities. Through Solar Energy Program, the BLM proactively identified, at the programmatic level, exclusion areas. Some of these areas include lands designated by the BLM as areas of critical environmental concern (ACECs), habitat designated critical by the U.S. Fish and Wildlife Service for fauna and flora, and federally designated national conservation areas, national monuments, national trails, wilderness areas, and wilderness study areas.

The BLM also implemented an innovative approach to incorporating the avoidance principle: proactively identifying and promoting solar energy development in areas with the least conflict with environmental and other values. At the time of the ROD, the Solar Energy Program identified 17 solar energy zones (SEZs). By identifying where solar energy development is preferred, the BLM intends to help drive solar energy development in ways that avoid important ecological areas and concentrate development in areas of relatively low impact.

The Solar Energy Program also provided guidelines for a variance process to identify additional solar energy zones. The process involves landscape-scale analyses to evaluate the regional importance of locations and to select areas for solar energy development that protect ecological, cultural, and recreational values, while also meeting the needs of solar energy developers. The BLM retains the authority to determine if additional exclusion areas are necessary when a solar energy developer proposes a project in a variance area.

Minimization of solar energy development impacts, either for an entire solar energy zone or for a project, is achieved, in part, through required design features (e.g., identification of parcels that should not be released for lease due to local environmental values, reconfiguring of a project to avoid a desert wash, or requirements to use technologies that minimize water use). Avoidance of ecological features at the local or project level constitutes minimization of impacts. It is not characterized as the avoidance step in the

[9] ROD, October 2012.

mitigation hierarchy, because the larger ecosystem function is compromised in development areas, and indirect impacts from development generally affect adjoining lands.
Compensation measures are actions taken to offset residual impacts of development after applying appropriate avoidance and minimization measures. Through the Solar Energy Program and with the support of its Interim Policy on Regional Mitigation, the BLM is again taking a proactive, regional approach to identifying the most strategic places to invest in protection of wildlife and ecosystem services and the best actions to take at these places.[10] For each solar energy zone, the BLM is developing regional mitigation strategies and a regional mitigation plan. The latter allows for prioritization of mitigation investments on the basis of multiple conservation goals. As envisioned, regional mitigation plans will simplify and improve the mitigation process for future SEZ projects to promote coordination of mitigation actions to yield the greatest benefit. The plans include detailed data analysis about impacts, using finer-scale information than the analysis that established exclusion areas and solar energy zones. Additionally, when a solar developer requests a permit, a site-level environmental assessment will be undertaken to quantify impacts to resource values and connect those impacts to mitigation actions laid out in regional mitigation plans. The first pilot project to develop a regional mitigation strategy was undertaken for the Dry Lake solar energy zone in Nevada. It was released in March 2014.[11]

Near-term utility-scale solar energy development is facilitated through proactive identification of solar energy zones, allowing the BLM to minimize potential negative environmental, social, and economic impacts as well as to optimize existing transmission infrastructure and corridors to known locations for concentrated development. By focusing development in solar energy zones, the BLM can direct its limited capacity to processing those applications that have the highest probability of approval, given the analysis underlying SEZ identification. Solar PEIS standardizes and streamlines the authorization process for solar energy development within solar energy zones, and the variance process provides flexibility to the solar industry to develop a range of projects.

[10] Bureau of Land Management, Interim Policy on Regional Mitigation, IM 2013-142 (June 2013); http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.
[11] Bureau of Land Management, Solar Regional Mitigation Strategy for the Dry Lake Solar Energy Zone, Tech Note 444 (2014). Bureau of Land Management, Southern Nevada District Office, Las Vegas, NV.

Table 1. BLM Decision Context.

	Programmatic	Land use planning	Permit decision
Scale	West-wide	Regional or landscape level	Site specific
Process	Public process for programmatic Solar PEIS	Public process through resource management plan (RMP) development/ amendment or regional mitigation strategy development	Public process initiated externally through permit application or competitive bid
Evaluation	Programmatic environmental impact statement (EIS) to assess demand, resources, environment, alternatives	Regional environmental impact statement to assess demand, resources, environment, alternatives	Guided by RMP; solar energy development requires a site-specific environmental impact assessment
Function	Identifies avoidance areas and solar energy zones	Identifies variety of land uses and where they may or may not occur	Evaluates alternatives, including siting, construction, operations, and decommissioning
Requirements	Programmatic EIS	EIS	EIS of environmental assessment or EIS of project
Decisions	Exclusion areas, solar energy zones, variance process, design features, best management practices (BMPs)	Resource allocations	Decisions to deny or grant the permit or to grant it with stipulations such as BMPs and compensatory mitigation
Monitoring	Guidelines	Monitoring plan	Compliance monitoring

Source: Adapted from G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

In the interest of increasing effectiveness in the management of the nation's public lands, the BLM has identified several opportunities to improve the process described above by more explicitly integrating ecosystem services into land use planning and land-use allocation decisions:

- Integrate the assessment of impacts to ecological systems and the services they provide into the assessment of impacts in both the allocation of resources and the authorization of specific projects.
- Include guidance for decision-makers for considering tradeoffs between demands for products (i.e. water, energy) and impacts to ecological systems and the services they provide (e.g., water dynamics, nutrient cycling).
- Use information gained from implementation of the BLM Assessment, Inventory, and Monitoring System to

- Validate or revise the assumptions made to estimate potential environmental, social, and economic impacts, including addressing the identification, production, and valuation (monetary and non-monetary) of ecosystem services;
- Assess the relative effectiveness of resource allocation strategies, project siting criteria, and stipulations to achieve sustainable yield; and
- Use analysis of monitoring information to help guide future siting decisions and best management practices for operation.[12]

Key Players

The Energy Efficiency and Renewable Energy Program was initiated by the BLM and the DOE, and its development involved multiple stakeholders as well as specialists in solar energy, wildlife and special status species, vegetation, air quality, outdoor recreation, landscape architecture, archaeology, paleontology, hydrology, soils, sociology, and economics.[13]

The Solar PEIS was completed by the BLM Renewable Energy Coordination Office in conjunction with BLM renewable energy programs in Arizona, California, Colorado, New Mexico, Nevada, and Utah under an interagency assistance agreement with the DOE Argonne National Laboratories Environmental Services Division. In compliance with NEPA, the program's development included significant public involvement. The solar industry, utilities, and the environmental NGO community also played a significant role.

In addition to the BLM and DOE, 19 federal, state, and local cooperating agencies are involved in the Solar PEIS: U.S. Department of Defense; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service (FWS); U.S. National Park Service (NPS); U.S. Environmental Protection Agency, Region 9; U.S. Army Corps of Engineers, South Pacific Division; Arizona Game and Fish Department; California Energy Commission; California Public Utilities Commission; Nevada Department of Wildlife; N-4 Grazing Board, Nevada; Utah Public Lands Policy Coordinating Office; Clark County, Nevada, including Clark County Department of Aviation; Dona Ana County, New Mexico; Esmeralda County, Nevada; Eureka County, Nevada; Lincoln County, Nevada; Nye County, Nevada; and Saguache County, Colorado.

Funding

To develop all SEZ regional mitigation strategies and adaptive management pilot projects, the BLM is leveraging existing renewable energy program funds allocated by Congress.

Existing Resources

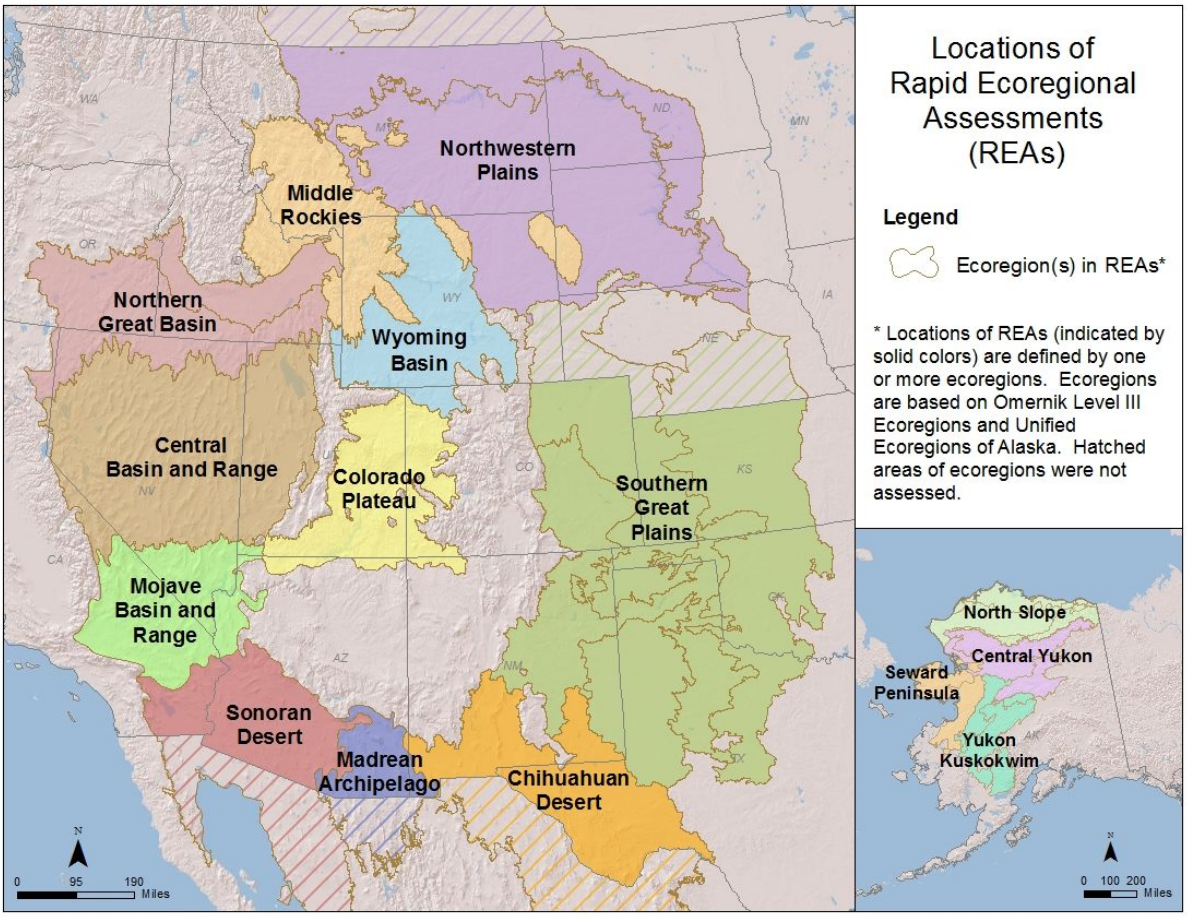
BLM Rapid Ecoregional Assessments

The Solar Energy Program uses analysis completed through BLM's rapid ecoregional assessments (REA) process. REAs provide regional baseline information regarding ecological values, conditions, and trends within ecoregions. REAs identify regionally important habitats for fish, wildlife, and species of concern and "the potential of these habitats to be affected by four overarching environmental *change agents:* climate change, wildfires, invasive species, and development (both energy development and urban

[12] G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).
[13] See http://energy.gov/eere/office-energy-efficiency-renewable-energy.

growth)."[14] The Solar Energy Program draws from numerous REAs completed in the six-state region (see Figure 2).

Figure 2. Locations of BLM Rapid Ecoregional Assessments



Source: http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/ecomap.html.

BLM Assessment, Inventory, and Monitoring (AIM) Strategy

The long-term solar monitoring and adaptive management plan identified in the Solar Energy Program will be based on BLM's AIM Strategy developed in 2011.[15] It will also incorporate the national landscape monitoring framework, Greater sage-grouse habitat analysis, and other local management-driven monitoring efforts.

Transmission Planning Efforts

The Solar Energy Program incorporates multiple transmission planning efforts, including the Western Governors' Association Renewable Energy Zone Project, the California Renewable Energy Transmission Initiative, and the *Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE/EIS-

[14] See http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html.

[15] http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2012.Par.53766.File.dat/IB2012-080_att1.pdf.

0386) PEIS in evaluating electricity transmission access issues associated with solar energy development in the six-state area.[16]

FWS and NPS Data

The FWS provided data for desert tortoise habitat and identified priority desert connectivity areas within the variance zones. The NPS provided data for natural, cultural, and visual resources and identified areas where there would be a high potential for resource conflicts. These data will be used during pre-application meetings to assess the impacts of potential solar energy development projects in the variance zones.

Desert Renewable Energy Conservation Plan

In 2011, the state of California called for development of the Desert Renewable Energy Conservation Plan (DRECP). Like the Solar Energy Program, the plan aims to facilitate renewable energy development while protecting desert ecosystems and species.[17] Unlike Solar Energy Program, which is limited to BLM-managed lands,, DRECP includes both private and public lands, and it must develop a reserve design that will lead to the recovery of covered species in addition to identifying zones for renewable energy development. The participating parties include the California Energy Commission, the California Department of Fish and Wildlife, the California Public Utilities Commission, California Independent System Operator, the BLM, the U.S. FWS, the NPS, the U.S. EPA, and the DOD. DRECP will be informed by and might refine the decisions in Solar PEIS for public lands in California deserts.

NGO Expertise

Multiple environmental NGOs, including Defenders of Wildlife, The Wilderness Society, and The Nature Conservancy, supported development of Solar PEIS through technical assistance as part of their larger efforts to reduce the impacts of energy development while promoting renewable energy development.

Options and Tradeoffs Considered

In addition to making regional land use decisions about where solar energy development may or may not occur, the Solar Energy Program provides a framework for evaluating options and tradeoffs at the local level to mitigate (avoid, minimize, offset) direct, indirect, and cumulative impacts.

The relevant ecosystem services at the larger scale might focus on habitat fragmentation, potential impacts on endangered species, water contamination and soil erosion, potential disruption of ecosystem functions and processes regulating biological communities, and climate change impacts. Ecosystem services at the local scale might focus on conflicting demands for products (e.g., water, energy) and on the impacts of disturbance of flora and fauna or of disruption of ecosystem processes (e.g., water dynamics, nutrient cycling).[18]

Tradeoffs at the programmatic scale were evaluated through identification of exclusion areas, where utility-scale solar development would not be allowed because of the high level of conflict with ecosystem services and cultural values, and solar economic zones, where solar energy development was prioritized in areas with the least conflict.

Exclusion areas were identified on the basis of the following criteria:

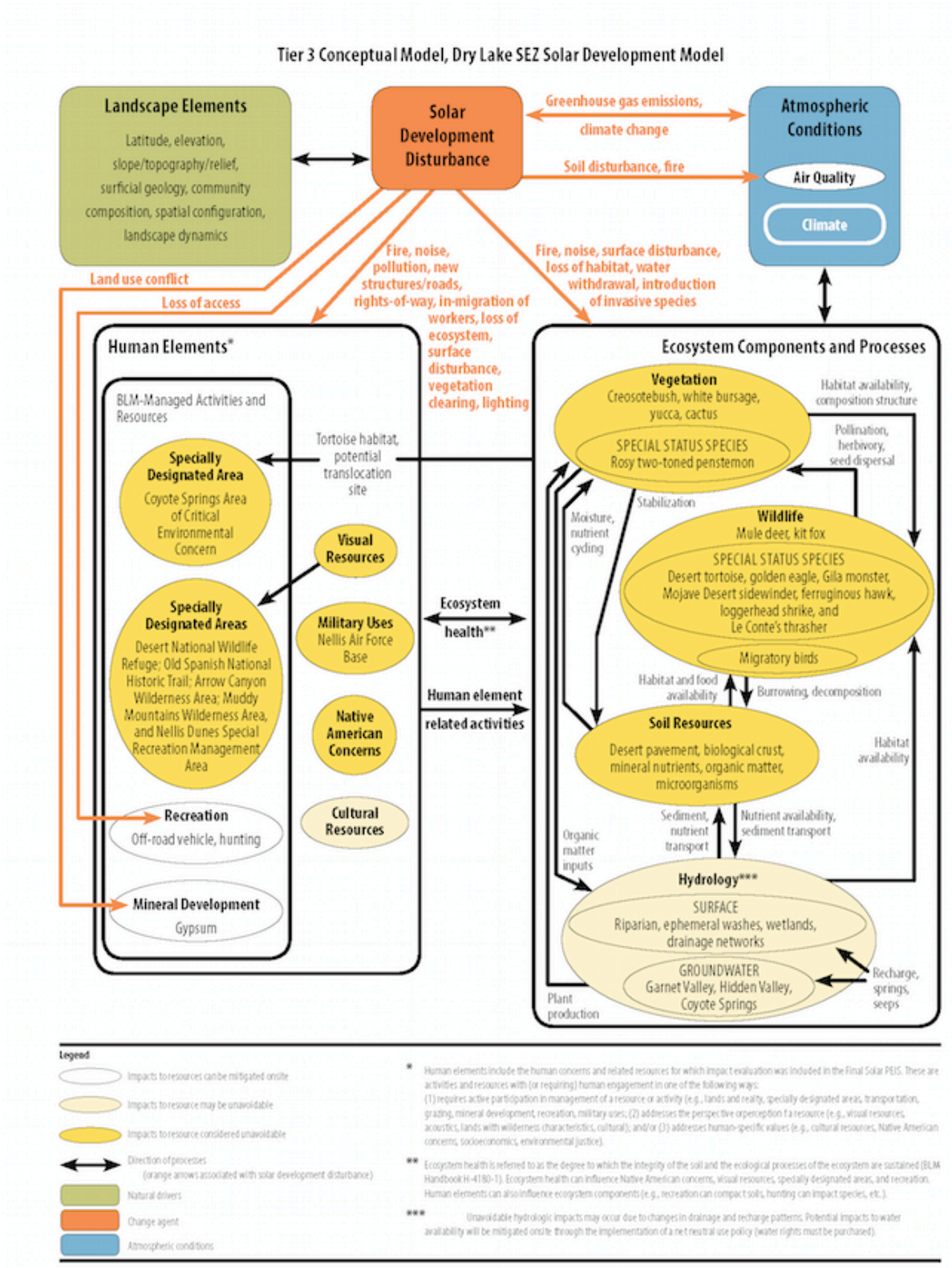
[16] See http://solareis.anl.gov/eis/how/index.cfm.
[17] See http://www.drecp.org/.
[18] G. Toevs and M. Dwyer, "Integrating Ecosystem Services and Adaptive Management" (2013).

- Areas of critical environmental concern;
- Desert wildlife management areas;
- Critical habitat areas for species protected under the Endangered Species Act;
- Protection for lands with wilderness characteristics;
- Special recreation management areas;
- Sensitive species habitat: (Sage-grouse core areas, nesting habitat, and winter habitat; Mohave ground squirrel habitat; flat-tailed horned lizard habitat; fringe-toed lizard habitat);
- California desert conservation area;
- Desert Tortoise connectivity corridors;
- Big game migratory corridors;
- Visual resource management;
- National recreation, water, or side and connecting trails and national back country byways;
- BLM National Landscape Conservation System and national scenic and historic trails;
- National historic and natural landmarks;
- Traditional cultural properties and Native American sacred sites;
- Wild, scenic, and recreational rivers;
- Old growth forest; and
- ROW exclusion and avoidance areas.[19]

Tradeoffs at the regional level will be analyzed through the development of regional mitigation strategies as established by the Solar Energy Program (see Figure 3). Tradeoffs at the local level will be analyzed through the project-level NEPA process. This process includes analysis of unavoidable direct, indirect, and cumulative impacts that contribute to loss of ecosystem services as well as strategies for off-site mitigation, monitoring, and adaptive management. Regional mitigation plans will establish a crediting methodology for assessing impacts and determining mitigation actions. Individual permits will be granted with stipulations reflecting these requirements.

[19] ROD, Table A-2 Exclusions under BLM's Solar Energy Program (October 2012).

Figure 3. Dry Lake Regional Mitigation Strategy Conceptual Model.



Source: Bureau of Land Management.

Analysis at the project level may incorporate impacts on

- Soils and nutrient cycles (erosion and carbon sequestration)
- Wildlife
- Special status species
- Vegetation
- Invasive/noxious weeds
- Hydrology
- Riparian function
- Visual resources
- Specially designated areas
- Military uses
- Cultural resources
- Native American concerns

Analysis

Solar PEIS provides a summary-level assessment of potential ecosystem service impacts, including impacts on rangeland resources, recreation lands, military and civilian aviation, soil resources, mineral resources, water resources, vegetation, wildlife and aquatic biota, special status species, air quality and climate, visual resources, acoustic environment, paleontological resources, cultural resources, native American concerns, and transportation.[20]

In addition, the BLM has developed action plans for each of the solar economic zones as part of the supplement to the draft Solar PEIS. These action plans described additional data that could be collected for individual zones and proposed data sources. These data will inform development of the regional mitigation strategies.

However, the BLM faces a number of challenges in evaluating impacts to ecosystem services. First, ecosystem functions vary significantly across the area covered by the program. Second, the long-term impacts of solar energy installations on certain functions such as soils are not yet well understood. Third, there is little qualitative research on the assessment of "tradeoffs" for ecosystem services—that is, whether greenhouse gas savings from solar electricity outweigh the lost carbon sequestration from disturbing soils. Fourth, there are questions about the appropriate scale at which ecosystem services and impacts to them should be evaluated.

An ecosystems services impact assessment can help value impacts that are hard to monetize (e.g., viewsheds, access to public lands, water and air quality), but it requires a high level of in-house expertise that the BLM and even many conservation NGOs do not have, and some of the valuation methods are immature. Therefore, the BLM contracted with outside scientists to evaluate cumulative impacts to ecosystems services, including a small contract to Colorado State University. BLM also drew from an ecosystems services analysis done for the San Pedro River Watershed in Arizona.[21]

Implications

The Solar Energy Program could significantly reduce the impacts to ecosystem services functions from solar energy development over a 20-year timeframe. It reduces landscape-scale impacts by centering development in solar economic zones where environmental, social, and cultural conflict is relatively low. At the same time, the program provides a framework for assessing and mitigating individual project-level

[20] Final Solar PEIS (July 2012). See http://solareis.anl.gov/documents/fpeis/index.cfm.

[21] K.J. Bagstad, D. Semmens, R. Winthrop, D. Jaworski, and J. Larson, *Ecosystem Services Valuation to Support Decisionmaking on Public Lands: A Case Study of the San Pedro River Watershed, Arizona,* USGS Scientific Investigations Report 2012-5251 (2012).

impacts. The program reflects a significant change in the BLM's land-use planning and permitting decision processes (e.g., from a case-by-case analysis to a programmatic analysis of ecosystem functions).

The ecosystem services framework facilitates impact assessments that could help avoid unintended consequences (e.g., cumulative impacts to water quantity or soil quality) and valuation of nonmarket benefits (e.g., access to public lands), which can help the BLM achieve its multiple use mandate.

Cover photo: Laura Crane, The Nature Conservancy.

About the Authors

Amanda Reed was, at the time of authorship, policy advisor for Energy and Transportation on The Nature Conservancy's U.S. Government Relations Team, where she focused on moving the Department of Interior and Department of Transportation to adopt programmatic and landscape-scale planning for infrastructure development and regional mitigation strategies. She is now executive director of Capitol Land Trust in Olympia, Washington.

Laura Crane is director of the Renewable Energy Initiative for The Nature Conservancy's California Chapter. She directs a team to provide scientific analyses and collaborates with government, industry, and NGOs to influence the development and mitigation of clean energy in order to preserve and protect the unique biodiversity and functioning of the Mojave and Sonoran desert ecosystems. She also oversees TNC's work in the California portion of the Mojave Desert, including the Amargosa River Project and science-based planning for TNC's involvement in issues such as energy development, invasive species, and water.

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About the National Ecosystem Services Partnership

The National Ecosystem Services Partnership (NESP) engages both public and private individuals and organizations to enhance collaboration within the ecosystem services community and to strengthen coordination of policy and market implementation and research at the national level. The partnership is an initiative of Duke University's Nicholas Institute for Environmental Policy Solutions and was developed with support from the U.S. Environmental Protection Agency and with donations of expertise and time from many public and private institutions. The partnership is led by Lydia Olander, director of the Ecosystem Services Program at the Nicholas Institute, and draws on the expertise of federal agency staff, academics, NGO leaders, and ecosystem services management practitioners.

About the Nicholas Institute for Environmental Policy Solutions

Established in 2005, the Nicholas Institute for Environmental Policy Solutions at Duke University improves environmental policymaking worldwide through objective, fact-based research in the areas of climate change, the economics of limiting carbon pollution, emerging environmental markets, oceans governance and coastal management, and freshwater management. The Nicholas Institute is part of Duke University and its wider community of world-class scholars. This unique resource allows the Nicholas Institute's team of economists, scientists, lawyers, and policy experts not only to deliver timely, credible analyses to a wide variety of decision makers, but also to convene decision makers to reach a shared understanding of this century's most pressing environmental problems.

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