CHAPTER 11 | RECOMMENDATIONS

Our research and analysis reveals the many complexities, controversies, and uncertainties that exist within the issue of solar development in the California desert. Despite these challenges, state and federal administrations, solar developers, and renewable energy advocates are exerting pressure on regulatory agencies to finalize the processes necessary to move development forward. Given the unknown impacts of solar development, an adaptive management approach, which includes BMPs and mitigation requirements, should be carefully and thoughtfully developed. An adaptive management approach might require a slower pace of development with a high level of monitoring of constructed facilities in order to measure the true efficacy of BMPs and mitigation measures. If BMPs and mitigation measures are found to be ineffective, the management plan should then be adapted to address these deficiencies.

We have developed recommendations based on our findings, which can be used to establish a siting, development and implementation process that can proceed deliberately and adaptively. Our recommendations aim to improve the solar facility approval process, address potential ecological impacts, and support continued growth of the distributed generation market. We have also identified areas in need of future research.

RECOMMENDATIONS FOR THE BLM

Based on our analyses of the environmental and visual impacts (Chapters 5, 6, and 7), socioeconomic impacts (Chapter 8), and community attitudes (Chapter 9) regarding solar development, along with the analysis of the BLM ROW process for solar and wind development and the oil and gas leasing process (Chapter 10), we developed recommendations for improving the BLM process for evaluating solar development and siting individual solar facilities in the California desert (Table 11.1). These

Table 11.1 Recommendations for the BLM Process Based on Evaluation Criteria.

Efficiency
•Establish Authority to Reject Applications
Clarity of Process
•Define Environmental Mitigation Measures
•Establish a Rental Rate
•Establish Payments to Affected Communities
•Provide Guidance for SF-299 and POD
•Establish a Clear Process
Robust Set of Options
•Analyze Distributed Generation
Environmental Protection
•Establish a Land Use Efficency Standard
•Define Environmental Mitigation Measures
•Establish Alternative Mitigation Measures
•Ensure Effective Mitigation
•Evaluate and Establish BMPs
Spatial or Temporal Scale
•Designate Potentially Available and Closed Areas
Public Engagement
•Increase Public Involvement

recommendations are meant to address concerns of potential environmental impacts, predicted socioeconomic consequences, and deficiencies identified in our evaluation of the solar ROW process. Many of these recommendations are also based on the strengths of the wind ROW and oil and gas leasing processes. As the BLM evaluates solar development on its lands through the nationwide Solar PEIS, we recommend the following actions be taken and components be added to the evaluation of solar development and the permitting process.

1. Analyze Distributed Generation vs. Utility-Scale Generation

Determining how the nation will go about increasing production of energy from renewable sources is a major public policy decision. At the heart of this question is not simply the issue of siting utility-scale solar energy facilities, but also how the government should promote and incentivize solar energy production. While it may not be within the jurisdiction of the BLM, an agency of the federal government should conduct a comprehensive analysis comparing the energy production potential, land requirements, and environmental and socioeconomic impacts of distributed generation and utility-scale generation. In doing so, the government and the public will be better able to make critical decisions regarding how and if these types of solar generation facilities should be promoted. This recommendation does not apply to the BLM process for assessing individual facilities; however, it is important that this study be conducted before development begins.

2. Designate Closed and Potentially Available Areas

The BLM should designate areas as either “potentially available” or “closed” to solar development, so as to eliminate any ambiguity about which areas are appropriate for solar facilities. Legally delineating geographic units as closed for solar development would enable the BLM to automatically eliminate applications for projects in these areas. An area designated as “potentially available” could be developed for solar energy; however the right to develop that land would not be automatic. Proposed projects must still undergo a full process evaluation to ensure suitability at the proposed site. Designating potentially available solar energy zones would give developers more certainty about areas to be studied for facility location proposals, though all site conflicts would not be eliminated by these area designations. For example, our analysis shows that SESAs could be designated as areas potentially available for development as they appear to have lower ecological and visual impacts.

For consistency across field offices, potentially available solar energy zone and closed area designations should be coordinated across the CDCA and would require amendments to all affected RMPs. Any future changes to these designations would occur through the RMP amendment process.

In designating potentially available solar energy zones and closed areas, the BLM will likely have to justify each area's designation. Potentially available solar energy zones should include those places with the least amount of known conflict and that are nearby to existing or planned transmission and other necessary infrastructure, such as roads. Closed areas should include all areas that are legally incompatible with utility-scale solar development, areas where a high conflict with existing uses or management designations is present, and other areas that are otherwise inappropriate for solar energy development. These closed areas would include, but not be limited to: Wilderness areas, WSAs, Wild and Scenic Rivers, National Monuments, National Trails, ACECs, DWMAs, critical habitat areas, special management areas including Mojave Ground Squirrel Conservation Areas and Flat-tailed Horned Lizard Management Areas, and areas containing significant cultural or historical resources. Other areas that may be appropriate for closure include Class L lands, LTVAs, OHV open areas, and other areas of high-conflict as identified by the BLM field, district, or state office.

3. Establish Authority for BLM to Reject Applications

The BLM should be given the ability to reject applications that are inappropriate due to land use conflicts, regardless of whether or not the recommendation to create potentially available and closed areas is adopted. The BLM should also be able to reject applications that remain incomplete even after the applicant has been notified and given the opportunity to correct any discrepancies. To make this rejection process transparent, standard criteria for rejecting an application should be developed and published. Criteria for rejecting applications should include failing to meet land and water use efficiency standards (Recommendation 4), failing to adhere to all published deadlines for application materials, and proposing facilities on critical habitat, ACEC, DWMA, special management area, or other incompatible area. The BLM should still notify applicants of application deficiencies and allow them 60 days to make changes to the POD and resubmit. With clearer application criteria, developers would have a better understanding of what standards their applications must meet, while still being encouraged to consult with the BLM to ensure any conflicts or information gaps are resolved as best as possible.

4. Establish Efficiency Standards for Solar Technologies

The BLM should establish minimum land use and water use efficiency standards for all proposed solar projects in the Southwest U.S. Although environmental groups have concerns about inefficient technologies with large footprint sizes and water demand, the BLM has no authority to dictate types of solar technologies for proposed projects. By establishing these standards the BLM will have an additional criterion for rejecting applications. The DOE, familiar with solar technology development and research, should develop this standard. The standards should be suitably high to effectively deny solar applications with technologies that are grossly inefficient.

Furthermore, efficiency standards will incentivize solar developers to propose more efficient technologies, such as dish/engine or power tower, and solar companies to develop more efficient solar technologies. Solar developers are currently incentivized to use parabolic trough technology because it is proven and investors are comfortable with proven technologies. However, our land use analysis showed that parabolic trough is one of the least land-use-efficient technologies with an average efficiency of 372 MW produced per acre disturbed. Meanwhile, dish/engine systems have a high land use efficiency with 923 MW produced per acre disturbed. Additionally, our water use analysis also showed that parabolic trough is one of the least water-use-efficient technologies with an average efficiency of 1,071 gallons of water consumed per MWh. Dish/engine systems appear to be highly efficient with four gallons of water consumed per MWh. The tools we developed for calculating the land use and water use efficiencies of a proposed solar energy facility, or their equivalent, should be used to calculate the efficiencies of each new project proposal once standards have been set.

5. Define Effective Environmental Mitigation Measures

Mitigation is required for projects on public lands to offset development impacts to natural resources. Environmental, citizen, tribal, solar industry, and recreation groups have all raised concerns about yet to be determined mitigation standards for solar projects. It is necessary for the BLM to define these mitigation standards which guide whether a facility site can be suitably mitigated, how much private land must be acquired to compensate for impacts to particular species, and quality of mitigation land.

Solar facility applications consistently state that BMPs and mitigation measures will render all ecological impacts of the facility "less than significant." However, determining the amount of mitigation necessary to render impacts "less than significant" is difficult. The processes for determining the impact of the facility and the amount of land or money that would be necessary to reduce that impact is both subjective and expensive. The amount of land purchased or the amount of money set aside for mitigation is often negotiated among agency and developer representatives, and sometimes other interested stakeholders; as a result, these negotiations are often political in nature and not based on ecological knowledge.[1] In the California desert, developers must currently fulfill mitigation requirements for impacts to special-status species, which includes the desert tortoise, western burrowing owl, Mohave ground squirrel, and flat-tailed horned lizard. However, these ratios are not standardized and are different across regulating agencies such as the BLM, DFG, and FWS. Some examples from solar applications are:

- Desert tortoise mitigation ratios = 3:1, 1:1, and 0.5:1 (in acres).
- Western burrowing owl mitigation ratios = 6.5 to 19.5 : 1 (in acres) or 2:1 (in burrows).
- Mohave ground squirrel mitigation ratios = 2:1 and 0.5:1 (in acres)

Clear, standardized, and publicly available environmental mitigation ratios would allow developers to better predict future mitigation costs and allow BLM staff to establish a standard implementation and enforcement process for mitigation.

Additionally, while agency mitigation ratios can help guide land purchase decisions, they do not give adequate consideration of land quality. Whether it is even possible for mitigation measures to reduce the ecological impact of development to levels that are "less than significant" is addressed even less frequently. Therefore, the BLM should establish suitably high standards for the quality of mitigation land as well as define "less than significant" and evaluate whether each proposed facility site can successfully mitigate impacts to this level. Facility locations that can't meet this mitigation level should not be given approval for development.

6. Establish Alternatives to Acquisition-Based Mitigation

Given a likely shortage of suitable mitigation land, the BLM should establish alternatives as a complement to the traditional strategy of acquisition-based mitigation. Large solar facilities may require developers to acquire a substantial amount of mitigation land. One solar application determined that a total of about 215 acres would be needed to mitigate impacts to desert tortoise and Mohave ground squirrel. In another application, the developer determined that two-thirds of the mitigation requirement could be met by acquiring no less than 8,146 acres of land.

Considering that many utility-scale solar facilities could be sited in the California desert, and that many facilities will seek to acquire land for mitigation purposes, it is easy to imagine a shortage of suitable mitigation land. As Amy Fesnock, the Endangered and Threatened Species Lead for the California BLM, notes:

> "When we're the looking at the amount of projects currently proposed, there isn't that much land with willing sellers to be purchased, and I think we have to begin to assess whether it is possible for us to actually mitigate the impacts of those projects on the land that we already have."[2]

Suggested alternative mitigation strategies include funding research, restoration, agency staffing, and education. However, if a developer chooses to use one or more of these suggested alternative mitigation strategies, it is important that the specific use of funds must actually mitigate impacts by improving the status of sensitive species and habitats.

Research

In lieu of land acquisition, developers could give funds to be used for researching the California desert. In our interviews, desert scientists emphasized the high level of uncertainty in understanding impacts

of utility-scale solar development on the desert ecosystem. Says Debra Hughson, Science Advisor for the Mojave National Preserve, "Our understanding is vastly dwarfed by the things that we don't know, and even the things that we think we do know, sometimes the correlations are pretty poor, and the uncertainty is very broad."[3] Many scientists echoed this sentiment. Mitigation funding could go towards biological surveys of the desert and answering fundamental questions about presence/absence, abundance, and location of desert species.

Restoration

Mitigation funds could also go towards improving the quality of existing habitat. Suggestions include:

- Removal or control of invasive species;
- Reclamation or restoration of degraded habitat (e.g., abandoned agricultural areas, old grazing allotments, and illegal OHV areas) on BLM land;
- Mitigation of existing barriers to migration (e.g., highways).

Some solar facility applications include a statement about funding provided by the developer for restoration of the facility site upon the decommissioning of the facility and removal of infrastructure. We recommend that this be required of all facilities in the application process.

Staffing

With such a large area to manage and in an age of budget cuts, agencies are continually asked to take on more responsibility with fewer resources. Mitigation funding could fund individuals at the BLM and FWS who are specifically charged with protecting biological resources against illegal use in special designation areas. Areas that might benefit from increased enforcement include ACECs, DWMAs, WSAs, Wilderness Areas, and Critical Habitat.

Education

Mitigation funding could go towards educating California desert residents and visitors. Education efforts could help residents and visitors gain a better general understanding of the desert ecosystem and the benefits it provides to people. Such efforts might also reduce accidental or purposeful harm to desert flora or fauna.

7. Ensure Effective Mitigation

The BLM should ensure that any adopted alternative mitigation measures, including the above recommended measures or others, are effective. It is difficult to know how much research, restoration, additional staff, and education would be needed to adequately mitigate the impacts of a single solar facility, let alone the cumulative impacts of multiple solar facilities and associated infrastructure like roads and transmission lines. An independent economic analysis of the value of the resources at each individual facility is necessary to determine parameters for the proposed alternatives. If multiple

facilities are to be developed, the economic analysis should consider cumulative impacts to be mitigated as well, especially from associated disturbances like roads. In addition, funds set aside for alternative mitigation must be used effectively. An assessment team or task force, partnering with the BLM, should define desired results, and evaluate and monitor the implementation and impact of alternative mitigation. Evaluation and monitoring should occur on a regular basis so that the effectiveness of these measures can be improved upon and the financial contribution of developers can be adjusted accordingly.

8. Establish a Rental Rate Based on Installed Nameplate Capacity

Because solar energy is a natural resource that, similar to wind and oil and gas, will be extracted from federal lands, solar development should not use the standard ROW land rental fee. Instead, the BLM should assess an annual land rental fee based on total installed nameplate capacity. A rental fee should be assessed using the following formula:

Annual Rental Rate = (Anticipated total installed capacity in kilowatts on public land as identified in the approved POD) x (8760 hours per year) x (capacity factor) x (5.27 percent federal rate of return) x ($0.03 average price per kilowatt hour)

This rate is based on the current annual rental rate for wind development rights-of-way. The rental rate will be phased in with 25 percent of the total rental fee due the first year, 50 percent due the second year, 75 percent due the third year, and 100 percent due the fourth year and every year thereafter. The capacity factors that the calculation uses should be determined for each facility.

9. Establish Payments to Affected Local Communities

Generally, solar development will have few negative socioeconomic impacts. However, California desert residents living in proximity to development will bear the brunt of these negative impacts. For example, it may be necessary for construction vehicles to pass through downtown areas to get to project sites, thereby increasing local traffic and dust emissions in these urban centers. Facilities may also affect the community's viewshed, which may decrease the quality of life for nearby residents. Although communities near solar development will arguably be most affected, there is not currently a program for compensating these residents. The BLM should develop a funding program whereby a portion of facility rental payments is distributed among nearby communities to aid funding for public services.

10. Provide Guidance for SF-299 and POD Document Completion

One major cause of delay in the project application process is incomplete SF-299 or POD documentation, which requires BLM staff to request missing information and to review documentation. To alleviate this problem, the BLM should provide clear guidance on the content and level of information needed in an SF-299 and POD. The Wind PEIS, which created a set of policies and best management practices and mandated what information was necessary in an application, may be used as a model. Developers would then know the extent of information and level of detail required, thereby placing the burden on them to file complete applications. Additionally, BLM staff would be able to determine the seriousness of an application based on whether the developer has followed the guidance.

11. Increase Public Involvement

It is important to educate local residents regarding the proposed facilities. This provides the BLM and developer with feedback on local community concerns that should be incorporated into the project design or EIS. The stakeholder survey showed that desert residents are generally supportive of solar development, which is surprising given that many communities strongly oppose industrial development which would negatively impact their quality of life. This support may be the result of misconceptions regarding socioeconomic benefits, such as jobs and cheaper electricity, which are not likely to happen. Therefore, stakeholder outreach and involvement need to be better incorporated into the decision-making process.

However, based on the stakeholder survey, 74.5 percent of residents are unaware of opportunities to submit comments to the BLM on local concerns, 19 percent of residents are unable to attend a meeting due to inconvenient times, and 17 percent of residents are unable to attend meetings due to inconvenient locations. The BLM must increase public outreach and promote public involvement above and beyond the current minimum NEPA requirements. As the survey indicated, 85 percent of residents receive information from television and radio and 82 percent from newspapers. Therefore, the BLM should solicit public involvement through announcements in TV news media and local newspapers. Multiple public hearings should be held at different times of the day in communities within the vicinity of a proposed project, allowing residents with scheduling conflicts an opportunity to participate.

12. Establish a Clear Process

Whether through the Solar PEIS process or independently, the BLM should establish an open process that is well defined and easily understood by BLM staff, developers, and interested stakeholders. The updated or newly established process will likely be refined as it is applied multiple times to process all applications, as is currently occurring with the solar ROW process. Despite knowing that the new

process will likely not be perfect or please all stakeholders, standards can and should be developed to increase processing clarity and efficiency for both the BLM and developers.

13. Evaluate and Establish Best Management Practices

Once permitted, solar developers will need to abide by several federal, state, and local environmental laws, ordinances, regulations, and standards (LORS). These LORS include the ESA, Migratory Bird Treaty Act, Clean Water Act, and CEQA. Biological Resources Best Management Practices, or BMPs, are on-site impact avoidance and/or minimization measures that are intended to reduce impacts to sensitive biological resources and aid in compliance with LORS. Currently, there is no formal guidance provided by the BLM on BMPs for solar developers. Therefore, some developers are proposing BMPs designed with general construction and facility operation impacts in mind. The BMPs being proposed need to be evaluated for effectiveness and the BLM should establish a standardized set of BMPs to provide clarity to developers and ensure minimal impacts to biological resources.

As an example, we sampled six solar facility applications and evaluated 35 of the proposed BMPs for their effectiveness in the context of the California desert. Our objective was to focus on the types of BMPs that are being considered, not to highlight individual projects. BMPs were not attributed to specific facilities, though some language from the applications is used here for the purpose of description. BMPs were placed into one of three categories: green (●), yellow (▲), or red (■). If a BMP received a green rating, it was considered to be an effective BMP (i.e., have a high likelihood of reducing ecological or biological impacts from development), with a low likelihood of unanticipated impacts and which the BLM should adopt. A yellow rating was given to BMPs that had potential to be effective, but had a medium likelihood of unanticipated impacts; the BLM needs to improve such BMPs or needs more information or clarification to evaluate it. A red rating was given to BMPs with a high likelihood of unanticipated impacts and/or ineffective reduction of ecological or biological impacts. The BLM should not adopt BMPs which received a red rating and should require developers to use an alternative BMP.

BMPs and ratings are presented in Table 11.2. BMPs with yellow and red ratings have comments attached which explain why that rating was given as well as suggestions for alternatives. We also commented on BMPs that were given green ratings and could be useful to all solar facilities, but were only found in few applications. Overall, areas where proposed BMPs should be improved by the BLM include:

- Preventing or reducing the establishment and spread of invasive plants in disturbed areas.
- Preventing or reducing indirect mortality of desert tortoise and other wildlife.
- Monitoring the effectiveness of BMPs and allowing for adjustment if inadequate or ineffective.

Table 11.2 Best Management Practices.

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
01	Personnel	Worker Environmental Awareness Program/Training	●	5		
02	Personnel	On-site Designated Biologist(s), Authorized Biologist(s), and/or Biological Monitor(s)	●	6		
03	Pollution	Fueling of equipment will take place within existing paved roads and not within or adjacent to drainages or native desert habitats. Contractor equipment will be checked for leaks prior to operation and repaired as necessary.	●	3		(a) Pre-construction surveys for contaminants in drainages and off-site, "downstream" runoff areas. (b) Monitoring of drainages and off-site, downstream runoff areas during construction. (c) Adjust BMPs if BMPs are not adequately preventing/minimizing contamination.
04	Pollution	"All vehicles and equipment will be in proper working condition to ensure that there is no potential for fugitive emissions of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials…contaminated soil will be properly disposed of at a licensed facility."	●	5		
05	Pollution	Will use BMPs to minimize contamination of water or ephemeral drainages from construction site runoff.	▲	2	Need more information on what BMPs will be utilized.	
06	Pollution	Avoid use of toxic substances for road surfacing, road sealants, soil bonding and weighting agents.	●	1	Concern that only one project out of six mentions this BMP.	
07	Soil and Vegetation	"The anticipated impact zones...will be delineated with stakes and flagging prior to construction...Construction-related activities outside of the impact zone will be avoided."	●	4		

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
08	Soil and Vegetation	"Spoils should be stockpiled in disturbed areas presently lacking native vegetation."	▲	2	Concern about the establishment of invasive plants on stockpiled spoils.	(a) Cover the stockpile with tarp(s) or similar to prevent establishment and growth of invasive plants. (b) Monitoring and physical removal of invasive plants.
09	Soil and Vegetation	"New and existing roads that are planned for either construction or widening will not extend beyond the planned impact area."	●	3		
10	Soil and Vegetation	All vehicles will maneuver within the planned impact area.	●	2		
11	Soil and Hydrology	"BMPs will be employed to prevent loss of habitat due to erosion caused by project-related impacts." And/Or "Erosion and sedimentation control will be implemented during Project construction to retain sediment on-site and to prevent violations of water quality standards."	▲	4	Need more information on what BMPs will be utilized.	(a) Monitoring of soil/sediment runoff. (b) Adjust BMP if BMP is not adequately preventing/minimizing erosion and sedimentation.
12	Soil and Hydrology	"The solar fields shall be graded generally following the existing contours of the site to minimize the amount of ground disturbance."	●	1	Could also benefit site-level hydrology by minimizing alterations to water flow across the landscape.	

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
13	Vegetation	"…working around all shrubs and trees within the construction zone to the extent feasible" and/or "special-status plant impact avoidance and minimization."	▲	2	We are concerned about the extent to which this BMP can actually be applied to a solar facility. Contrast this BMP with a statement from another project: "Avoidance of some special-status plants may be feasible during construction of the proposed project, but over the long-term, avoidance is not practicable because of the need to reduce the standing vegetation to prevent fire hazards and to maintain clear access to wash the...mirror arrays and otherwise operate the facility." Developers have indicated that fire is a potential hazard and that vegetation underneath the solar arrays will need to be cleared. Vegetation may also need to be cleared for installation of solar arrays and potentially kept clear for maintenance.	Because vegetation has several important ecosystem functions, including reducing wind erosion, dust emission, water erosion, and loss of soil moisture, there is value in retaining as much existing native vegetation as possible. (a) Appropriate buffers around solar arrays to prevent fire hazards and allow for maintenance should be developed. (b) Site plans should indicate areas where vegetation can be left, such as areas along the perimeter of the facility.
14	Vegetation	"A Weed Management Plan shall be developed and implemented to minimize the introduction of exotic plant species."	●	3		Plan should include monitoring of invasive plants in and around facility site.
15	Vegetation	The disturbance area "shall be maintained free from nonnative invasive plant species. This can be accomplished through physical or chemical removal and prevention. If necessary, application of an approved herbicide (non toxic to wildlife) shall be" applied.	■	2	We are concerned with the residual chemicals that could runoff the facility site and into the surrounding native habitat. Exposure to herbicides has the potential to kill or alter the species composition of soil crusts.[4] Though non-toxic to wildlife species, runoff containing herbicides could negatively impact native plants and soil crusts off-site.	The control and removal of invasive plants is still necessary. (a) The BMP should rely primarily on physical removal of invasive plants. (b) If chemical means are necessary, conduct comparative testing of herbicides to determine if some are non-toxic or less toxic to native plants and soil crusts than others. (c) Monitoring of "downstream" native plants and soil crusts for impacts of chemical runoff.

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
16	Vegetation	"Preventing exotic plants from entering the site via vehicular sources shall include measures such as implementing Trackclean or other similarly effective methods of vehicle cleaning…Earth-moving equipment shall be cleansed prior to transport to the Project site."	●	3		
17	Vegetation	"Preventing exotic weeds from entering the site via materials sources shall require that weed-free rice straw or other certified weed-free straw be used for erosion control."	●	2	Concern that only two projects of six mention weed-free materials.	
18	Vegetation	Reclamation and restoration of temporary disturbance areas and/or reestablish vegetation quickly on disturbed sites.	▲	2	Need more information on methods for reclamation, restoration, and/or revegetation.	
19	Vegetation	"After Project completion, a seed mix of dominant plant species will be distributed within any extensive temporarily disturbed areas."	■	1	We are concerned that this will not aid in the establishment of native plant species. Considering that the estimated time for unassisted recovery of desert lands is hundreds of years, that complete ecosystem recovery is estimated to take over 3,000 years, and that invasive plants are better able to take advantage of habitat disturbances than native plants, we believe that it will likely take more than distributing seeds to ensure the recovery of native plants.[5,6] Resources might be wasted on a measure like BMP-19 when they could be better spent on more effective methods of habitat recovery.	(a) BMP should include a restoration plan for temporarily disturbed areas. (b) Plan should be implemented by a restoration ecologist. (c) Restoration efforts should use native and (if possible) local seeds to propagate plants. (d) Plants that have germinated (not seeds) should be used to increase the probability of successful plant re-establishment. (e) The restoration ecologist should monitor restoration efforts and employ adaptive management techniques to ensure successful restoration.

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
20	Fire	"Wildfires shall be prevented by all means possible by exercising care when driving and by not parking vehicles where catalytic converters could ignite dry vegetation. In times of high-fire hazard…trucks shall carry water and shovels or fire extinguishers in the field, and high-fire-risk installations (e.g., electric lines) shall be delayed. The use of shields, protective mats, or other fire-prevention equipment shall be used during grinding and welding to prevent or minimize the potential after fire. No smoking or disposal of cigarette butts shall take place within vegetated areas."	●	1	Concern that only one project out of six mentions a BMP to reduce fire hazards. This type of BMP should be adopted by other projects.	

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
21	Desert Tortoise	"Water will be applied to the construction right-of-way, dirt roads, trenches, soil piles, and other areas where ground disturbance has taken place to minimize dust emissions and topsoil erosion." "During the desert tortoise active season, a Biological Monitor will patrol these areas to ensure that water does not puddle for long periods of time and attract desert tortoise, common ravens, and other wildlife to the site."	■	4	This BMP raises two concerns. While dust emission and soil erosion are both serious problems for a desert ecosystem, we are concerned that the application of water will facilitate the proliferation of invasive plants. Invasive plants are able to take advantage of both disturbed areas and water runoff from impermeable surfaces, including paved and dirt roads. The application of water as a dust suppressant may create ideal conditions for invasive plant growth, though we recognize the importance of minimizing erosion and dust emission. The four projects that discuss the application of water to ground disturbances acknowledge that standing water could attract desert tortoise or non-native predators, like common ravens. To prevent tortoises, ravens, or other wildlife from being attracted to these water sources, BMP-21 states that a Biological Monitor will patrol these areas during the desert tortoise active season to ensure that water does not puddle for long periods of time. While this may reduce the likelihood that desert tortoises may become accustomed to this anthropogenic water source, we are concerned about the potential for these practices to attract a resident population of ravens. Ravens could be attracted to the water source at any time of year, become established around the water source, and then prey on tortoises during their active season.	If the only way to control dust emission from construction areas is to apply water, (a) an invasive plant control program should be implemented for areas where water is applied to minimize the establishment of invasive plants in disturbance areas. (b) A Biological Monitor should patrol the areas where water has been applied at all times (instead of just during the desert tortoise active season). However, developers will likely not be able to prevent common ravens from being attracted to and established around the site. This impact likely cannot be minimized.

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
22	Desert Tortoise	BMPs on desert tortoise site clearance surveys and relocation/translocation before construction.	■	5	While translocation can prevent direct mortality of desert tortoises from construction, it can sometimes be a cause of indirect mortality. Tortoise translocation in the California Desert has been characterized by a high-profile attempt by the Fort Irwin Army Base to translocate approximately 600 desert tortoises.[7, 8] In 2008, 27.2% of translocated tortoises died and in the following year 23.5% of translocated tortoises died, primarily from predation in both years.[9] Other reasons for translocation failures include extensive movement of translocated animals and homing behavior (i.e., attempts by animals to return to original habitats), inability of animals to locate food or water sources, and/or inability to find shelter in a new habitat.[10,11] Says Cameron Barrows, a researcher for the Desert Studies Initiative, "So what did we achieve? You feel better because we didn't let a bulldozer run over the tortoises, but all we did was move them someplace else where they often die anyway, and may spread disease to and disrupt the resident population." Under BMP-22, desert tortoise would be translocated (i.e., physically removed from the site) by a Designated Biologist to an off-site location. The number of individuals being translocated, the acreage of habitat being removed by the solar project, and the capacity of "new" habitats to support additional individuals are all important factors that influence the survival of translocated tortoises; these factors are not acknowledged by this BMP. Therefore, we are concerned that BMP-22 may not significantly reduce overall desert tortoise mortality from solar development.	There are no better alternatives. In some cases, translocated tortoises may survive, but at the population level, the only way to effectively reduce the impact of a solar facility on the desert tortoise is to not build the facility. If translocation is used as a BMP, desert tortoises should be monitored for survival post-translocation.

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
23	Desert Tortoise	Desert tortoise will be excluded from the project area via permanent tortoise-proof fencing and tortoise-proof gates at site entry points. Temporary fencing of utility corridors and tower locations during construction.	●	5		
24	Desert Tortoise	Personnel will utilize established roadways and existing tracks onsite. Cross-country vehicle and equipment use outside designated work areas will be prohibited. Personnel will follow established speed limits.	▲	5	Concern that speed limits vary between projects (15mph, 20mph, 25mph) to achieve the same objective. Which speed limit is most effective?	(a) Consult desert tortoise biologists and set an appropriate speed limit for all solar facilities across the desert.
25	Desert Tortoise	Vehicle and equipment parking and storage will occur within tortoise exclusion fence. If vehicle or equipment parking occurs outside of the tortoise exclusion fence, the ground under the vehicle will be inspected for the presence of desert tortoise before it is moved. BMPs provide rules for moving tortoises if found.	●	5		
26	Desert Tortoise	"Proposed channels that reroute the washes around the site shall be made as natural as feasible, with earthen bottoms that facilitate desert tortoise movement outside the site."	▲	1	Concern with type/material of channel bottom and whether it will obstruct groundwater recharge.	Construct artificial channels with permeable bottoms, using gravel and sand instead of packed earth.
27	Ravens and other predators	Raven management, monitoring, and control program or similar.	●	5		

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
28	Ravens and other predators	Trash Abatement Program. "Trash & food items will be contained in closed containers & removed daily to reduce the attractiveness to opportunistic predators such as common ravens, coyotes, & feral dogs."	●	5		
29	Ravens and other predators	"Standing water shall be minimized on site to the extent feasible to minimize the attractiveness to opportunistic predators…that may prey on sensitive species."	●	2	BMP-29 recognizes that opportunistic predators (e.g., the common raven) may be attracted to artificial water sources, and therefore seeks to minimize standing water on-site. We believe that BMP-29 is a very important BMP, but are concerned that it may have been overlooked by other applications. Contrast this BMP with statements from other projects about the need for/use of evaporation ponds.	
30	Ravens and other predators	"Road killed animals or other carcasses detected in the project area or on roads near the project area shall be picked up immediately upon detection and appropriately disposed of to avoid attracting common ravens and coyotes."	●	1	Concern that only 1 project out of 6 mentions a BMP to remove roadkill. This type of BMP should be adopted by other projects.	
31	Wildlife	"Underground pipeline construction shall involve nearly simultaneous trenching, laying of pipe, and backfilling so that no open trenches shall be left unattended during daylight hours. Any open trenches that cannot be backfilled shall be covered with steel plates at night."	●	3	Reduces potential for wildlife to become trapped in trenches or holes.	

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
32	Wildlife	Pre-construction clearance surveys and/or relocation for a variety of wildlife species, including western burrowing owl, American badger, desert kit fox, flat-tailed horned lizard, nesting migratory birds, gila monster.	■	6	As stated in BMP-22, relocation can prevent direct mortality from construction or other activities, but it can also be a cause of indirect mortality. In a 2000 study by Fischer and Lindenmayer, the authors found that translocations used to solve human-animal conflicts were often unsuccessful, resulting in high mortality of animals after translocation.[12] For more on why translocation can fail, see BMP-22. BMP-32 indicates that special-status wildlife, including western burrowing owl (*Athene cunicularia*), American badger (*Taxidea taxus*), and desert kit fox (*Vulpes macrotis arsipus*), would be passively relocated. These animals would be prevented from re-entering burrows, burrows would be destroyed, and individuals would be required to move off-site before the site is fenced. The distances that individuals would have to move in order to find suitable habitat may result in stress-induced mortality of those animals. The number of individuals being relocated, the acreage of habitat being removed by the solar facility, and the capacity of "new" habitats to support additional individuals are all important factors that influence the survival of relocated species; these factors are not acknowledged by this BMP. Therefore, we are concerned that BMP-32 may not significantly reduce overall wildlife mortality from solar development.	There are no better alternatives. In some cases, relocated wildlife may survive, but at the population level, the only way to effectively reduce the impact of a solar facility on the special status wildlife is to not build the facility. If relocation is used as a BMP, special status wildlife populations surrounding the project should be monitored to determine impacts from relocated individuals on the resident populations.
33	Wildlife	"If construction activities occur at night, all project lighting…shall be directed onto the roadway or construction site and away from sensitive habitat. Light glare shields shall be used, when necessary, to reduce the extent of illumination into adjoining areas."	▲	2	Concerns: potential for significant insect mortality and potential for lighting to affect nocturnal wildlife.	(a) Determine level of insect mortality and research impacts to nocturnal wildlife. (b) If necessary, restrict construction to daylight hours.

● - Effective ▲ - Potentially Effective ■ - Ineffective

ID #	Type of BMP	BMP	Rating	# of Facilities with BMP (of 6)	Comments or Concerns	Suggestions for Alternatives
34	Wildlife	"Prioritize and acquire land within the immediate vicinity of the Project that contributes to the preservation of adequate wildlife habitat connectivity." And/Or off-site mitigation for the permanent loss of special-status species' habitat.	▲	3	Concern about the availability and quality of habitat, especially if all permitted solar facilities attempt to acquire land as mitigation and the mitigation ratio is greater than 1:1.	See [the following chapter on mitigation]
35	Wildlife	Evaporation Pond Monitoring Program: monitoring bird populations and water quality at site evaporation ponds. "If significant adverse effects to birds are observed during the evaporation pond monitoring...additional monitoring may be needed to further assess impacts to bird species."	■	1	We are concerned that standing water in evaporation ponds could attract common ravens and other predators to the site. Two applications that we reviewed require on-site evaporation ponds for industrial wastewater, both of those applications indicate that they will monitor water quality, one of those applications (i.e., the source of BMP-35) acknowledges the need to monitor potential impacts to birds that might use the pond (e.g., waterfowl, shorebirds), but neither of those applications mentions that the evaporation ponds might also be attractive to common ravens. We are concerned that evaporation ponds could provide another resource that might attract opportunistic predators to a solar facility site. We are also concerned about the potential for minerals to bioaccumulate in birds that use the ponds. The health of birds that use the ponds might be negatively affected by minerals that could be in the water, including chloride, sodium, sulfate, selenium, chromium, and phosphate. Wording in the BMP also leads us to believe that birds might be at risk for salt toxicity.	(a) Prevent birds from using the ponds entirely, such as a physical barrier that still allows for evaporation. (b) Reduce the attractiveness of the pond(s) to ravens. This may involve covering up or disguising the pond(s).

● - Effective ▲ - Potentially Effective ■ - Ineffective

RECOMMENDATIONS FOR SUPPORTING CONTINUED GROWTH OF DISTRIBUTED GENERATION IN CALIFORNIA

California's renewable energy goals will require a mix of utility-scale and distributed generation capacity. Achieving a high level of distributed generation will contribute significantly to meeting RPS goals and reduce the need for utility-scale development. At a recent conference hosted by Greentech Media for the solar industry, panelists and speaker representing all aspects of the solar value chain spoke about the several key challenges for achieving growth in the residential PV market, the primary market for distributed generation. The following are recommendations for federal, state, and local governments, elected officials, and environmental organizations to address these challenges.

1. Streamline and Improve Incentive Programs

Federal, state, and local governments must streamline and improve incentive programs in order to reduce administration costs. Residential solar installations in many cities throughout the country achieve grid parity with market electricity rates but the time and expenses associated with processing incentive payments and securing financing is a significant barrier to both customers and installers. Although material and labor costs are coming down as a trained workforce develops, the cost of paperwork can account for about 40 percent of a business owner's installation costs. As a representative from Akina Solar noted, the downward stepping incentive payment structure of the California Solar Initiative may be a problem for solar installers because the buy down rate drops as total mega-watts installed increases. Installers will have a difficult time lowering installed costs to keep pace with the buy down rate once it reaches 35 cents per watt installed because of the high transaction costs of processing paperwork. This will leave homeowners with higher out-of-pocket costs and will lead to lower demand in the residential market.[13] In addition, PACE programs received some pushback from many industry representatives for the same reasons- they are too time consuming and complicated to scale statewide or nationwide. PACE programs have room for improvement and will likely see competition among alternative forms of financing from non-municipal sources.

2. Support the Expansion and Extension of Incentive Programs

Environmental organizations and elected officials should support expansion and extension of incentive programs such as utility rebates and tax-based incentives since they have the lowest administration costs to property owners and installers. Because the industry is subject to "stroke of pen" risks associated with expiring incentives, the best way to insure continued growth of the residential industry is to support policy continuity which prevents boom-bust cycles in residential customer's willingness to install solar. With certainty regarding federal and state level tax incentives, financing programs of all kinds will have an opportunity to mature and offer proven options in a growing market.

3. Educate the Public about Energy Management

A major challenge for distributed generation is behavioral preferences. Most utility customers are not consciously aware of the fact that every time they turn on a light or plug in an appliance, they are making a purchase. In addition, there is an even greater knowledge gap about how much utilities pay for electricity, which depends on time of day and overall demand, since residential customers pay a flat rate rather than the minute-by-minute wholesale prices paid by the utility. The simplicity of our current system is a significant barrier to behavioral change that can only be overcome with improved energy data visibility and management at the residential level. Advances in information technology are creating automated and affordable systems that provide homeowners with information that is both timely and actionable.

Environmental organizations should conduct community outreach to educate the public about new technologies for energy management and promote their adoption. This will contribute to making energy management signals ubiquitous and speed behavioral changes necessary for improving energy efficiency and adoption of renewable energy. The information generated by household-level energy management systems will not only help reduce overall energy consumption but will allow homeowners to more easily assess the costs and benefits of installing a PV system.

RECOMMENDATIONS FOR FUTURE RESEARCH

Through our research we identified gaps in knowledge areas related to ecological understanding, ecosystem services, and transmission. As solar development has the potential to have widespread impacts on the California desert, it is important to have as much information as possible regarding the natural ecosystem, impacts of facilities and related infrastructure, and the role that distributed solar generation may have. We identified the following areas as topics that would benefit from additional research.

1. Natural History of the California Desert

Interviews with scientists who study California desert ecology frequently revealed concerns about the great uncertainty associated with predicting the impacts of utility-scale solar development. Much of this uncertainty is due to incomplete information at the most basic level: what is out there, where is it, and how much is there? These questions regarding the location, structure, composition, and abundance of species and natural communities speak to a need for more natural history research on the California desert. Not only would this research help scientists predict the impacts of utility-scale solar development, but developers would also benefit, specifically from more complete maps of sensitive species. Since the presence of sensitive species, particularly those protected by federal

mandate, can complicate, prolong, or even prohibit project approval, this research could assist developers during site selection.

If utility-scale solar development occurs in the California desert, research should be conducted on the cumulative impacts facilities will have on ecological processes and species. To understand the cumulative impacts from development, baseline studies must be undertaken before more development occurs. While these studies could help inform future siting decisions within the study area, they might also be used to extrapolate potential impacts of other types of development within the ecosystem as well as potential impacts to similar ecosystems outside of the study area where similar development may occur.

Data on plant species in particular is lacking. While many flowering species are surveyed by wildflower enthusiasts, these surveys typically take place in areas that are both easily accessible to the public and during a time of year that is tolerable for being outside for prolonged periods of time. For this reason, much of the survey data for plants are for flowering species in National Parks and Preserves, at higher elevations, at times of full bloom, and in the cooler spring months. It is important to note that another reason for a proportionately low amount of data on desert plants is the sheer number of plant species in the CDCA. As noted by Dr. Jim Andre, plant expert and Director of UC Riverside's Sweeney Granite Mountains Desert Research Center, there are still many undescribed species throughout the desert, and a large number of rare plant species across the California desert.[14] In reference to a site survey he completed for a proposed solar facility, Andre notes, "The CNDDB showed no previous records of rare plants there - it'll say that for almost every site - and yet during project surveys 11 rare plant species were documented at the site. So if you get down and do the work, get out into the field and look…in a square mile…you are likely to find both rare or possibly new taxa there."[15]

2. Regional-Level Impacts

While our research focused on the California desert, it is important to recognize that utility-scale solar development is proposed for much of the Southwest. Solar development that occurs in bordering states such as Nevada and Arizona could affect the California desert. For example, if Nevada places fewer restrictions on water use and solar technology than California, developers who wish to utilize water intensive technologies may decide to site their facilities in Nevada instead of California. However, water use in Nevada could potentially affect aquifers and surface waters that plant and wildlife species in California depend upon. Because ecological impacts are not contained by state boundaries, research on the cumulative impacts of multiple utility-scale facilities across the Southwest is necessary.

3. Ecological Restoration Techniques

Ecological restoration can be very expensive and many traditional restoration techniques may be inappropriate for desert ecosystems. Hence, more research should be undertaken to identify the most effective and economical methods for restoration of disturbed desert ecosystems. Long-term landscape-level impacts may be more effectively mitigated if we have better techniques in place for restoring disturbed parts of the desert – both following construction-phase impacts as well as after a facility is decommissioned. Existing and new restoration techniques may be made more effective if developed specifically for the region to which they are applied.

4. Climate Change and the California Desert

Most land management and development decisions are made without regard for climate change. There is a great need to understand how and to what degree climate change will impact the California desert. A better understanding of the potential impacts on species and ecological processes could both inform public land management in the context of climate change, and inform an analysis of the tradeoffs between renewable energy development and habitat conservation in the CDCA.

5. Ecosystem Services and the Non-Market Value of the Desert

Although most stakeholders are in favor of solar power generation, many are concerned about how the BLM will make siting decisions and issue permits because these decisions will have an impact on the non-market value of the land. The stakeholder survey revealed concern about the negative impacts on ecosystem services and varying opinions about the net benefit of solar development. One respondent commented:

> "It is a perfect use for land that, except for the sunshine, has very little else going for it. However, to make such a project work it cannot put any further burden on existing facilities, waster use or emergency services. Water use is getting to be a very large deal breaker with the locals. They also need to hire local residents wherever possible. Also a big factor with the locals will be possible contamination of groundwater and dust control during construction."

The issues identified by this respondent reveal a disconnection between the desire to maintain ecosystem service value (dust control) and a perception that the landscape has no current value other than solar resources. Solar development in the California desert will clearly have an impact on the ecosystem. How can we use our increasing knowledge of the desert ecosystem and evaluate the impacts from an anthropocentric perspective? Ecosystem processes provide critical services that benefit human existence including regulation of biogeochemical cycles, preservation of genetic diversity, conversion of solar energy to plant material, and even opportunities for spiritual or cultural enrichment (Appendix F). A better understanding of ecosystem service values in the California desert

could greatly benefit the decision-making process for renewable energy siting dilemmas that must consider the tradeoffs from a human perspective. The lack of complete information about ecosystem services and functions, the presence of environmental externalities, and market interventions are all contributing to an economic market failure, which results in continued land conversion and negative impacts on ecosystem services.

The conflict surrounding development of utility-scale solar facilities in the California desert stems from the differing opinions about the inherent and instrumental resource values of the region. A tradeoff exists between the benefits of preserving the desert for conservation purposes, a non-use value, and developing the land for the purpose of providing an alternative source of energy, a use value. One respondent to our stakeholder survey expressed the need to evaluate the tradeoff: "Desert flora and fauna will be impacted. However the value to humans outweighs the loss to the amount of land used for the facility." In order to understand the value of services provided by the landscape in its present state, we need to pause and consider the tradeoffs that result from solar development, which will impact water resources, erosion control, recreational resources, landscape aesthetics, wildlife, and creation of sound and light pollution. It is also important to consider how investments and demands drive decision making and how accounting for environmental externalities is somewhat subjective but still critical for understanding the societal costs and benefits associated with energy resource development. Research in the field of environmental economics is needed in order to compare the values of various development scenarios to society as a whole.

6. Transmission

The current transmission system has also been identified as an area of concern for solar development for two primary reasons. First, the existing grid is aging and loaded down, making the addition of multiple new power plants difficult. According to the DOE, electricity demand in the U.S. has risen by nearly 25 percent since 1990, yet the construction of transmission lines has declined by approximately 30 percent.[16] This trend is manifested by congestion and bottlenecks, which can lead to electricity losses that reduce the overall efficiency of the system. Second, almost all solar proposals in California are located in the Mojave and Colorado deserts, which are within the CDCA. Because the CDCA has only modest pockets of development and a relatively small population, there are very few existing transmission towers and lines that could be connected to new solar energy power plants.

Given the relatively remote locations of many of these proposed projects and the limited amount of available capacity on the existing transmission grid, new utility-scale solar facilities will require new sections of transmission to be built. Additionally, the development of hundreds of miles of new transmission infrastructure is likely to have serious environmental implications. Potential effects on the

local ecology include habitat fragmentation, increased threat of wildfires, and species disturbances and fatalities that could occur during the construction process. Unfortunately, our attempts to gather and analyze information related to the development of new transmission infrastructure to accommodate the boom in solar development faced unanticipated obstacles. First and foremost, the highly sensitive and secure nature of transmission data made it difficult to obtain information unless formally working with a government agency. Second, information that was available was often incomplete, insufficiently labeled, or dated, and never included any information on the specifics of proposed transmission. However, we believe that the ecological impacts related to transmission are both unavoidable and significant, and thus should not be overlooked.

There are currently two professional models and assessments of transmission in development: the Renewable Energy Transmission Initiative (RETI) model and the Planning Alternative Corridors for Transmission (PACT) model. The RETI model is a joint effort by the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), the California Independent System Operator (CalISO), and various utilities working in the state.[17]. The goal of RETI is to identify the location and nature of upgrades needed to California's electric transmission system necessary to connect to competitive renewable energy zones (labeled as CREZs) to fulfill the state's energy demands. The RETI model also includes some analysis of the potential environmental impacts related to the build-out of transmission infrastructure. The PACT model is slightly less well-known and is being developed by the CEC to assist in identifying and developing the best routes for new transmission lines. As these models represent the most comprehensive and up-to-date information available as of this writing, we highly recommend that individuals and organizations working on renewable energy development make maximum use of these two models to inform their decisions.

Although the RETI model is one of the most comprehensive analyses to date, there are still areas of this issue that would benefit from additional research. One key concern is that Black & Veatch, the consulting firm working on the model, chose to exclude the costs of environmental mitigation as a factor in the economic analysis of transmission development. This is a relatively substantial omission. Due to the large amount of new transmission infrastructure that will need to be built, the mitigation requirements are also likely to be substantial. We believe this area in particular should be a prime consideration for future research.

CITATIONS

Chapter 11

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