6 ANALYSIS OF BLM'S SOLAR ENERGY DEVELOPMENT ALTERNATIVES

Through this programmatic environmental impact statement (PEIS), the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) is evaluating three alternatives for managing utility-scale solar energy development on BLM-administered lands in the six-state study area. These alternatives, which are described in Section 2.2, include two action alternatives—a solar energy development program alternative and a solar energy zone (SEZ) program alternative—and a no action alternative.

Under the action alternatives, the BLM would establish a new Solar Energy Program to replace certain elements of its existing Solar Energy Policies (BLM 2007, 2010a,b; see Appendix A, Section A.1).[1] The action alternatives identify lands that would be excluded from utility-scale solar energy development and, on the basis of those exclusions, the lands that would be available for solar right-of-way (ROW) application.[2] Both action alternatives also identify SEZs where the agency would prioritize solar energy and associated transmission infrastructure development. Final SEZs would be identified in the Record of Decision (ROD) for the Solar Programmatic Environmental Impact Statement (PEIS). Under the solar energy development program alternative, the SEZs would constitute a subset of the total lands available (i.e., applications would be accepted within the SEZs and on specific lands outside the SEZs). Under the SEZ program alternative, applications would only be accepted within the SEZs, and no additional lands would be available outside the SEZs.

In addition to establishing lands available for solar ROW authorizations, the action alternatives would establish a suite of program administration and authorization policies and design features that would apply to utility-scale solar energy projects on BLM-administered lands (see Section 2.2.2 and Appendix A, Section A.2).[3] These design features represent the most widely accepted methods to avoid and/or minimize potential impacts from the types of activities associated with solar energy development and to successfully administer solar energy development on public lands and therefore are proposed as standard features of both action alternatives.

Under both action alternatives, the elements of the BLM's new program would be implemented through amendment of almost all of the land use plans within the six-state study

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[1] It is anticipated that elements of the existing policies addressing rental fees, terms of authorizations, due diligence, bonding requirements, and BLM access to records would remain in effect.

[2] The exclusions proposed under the action alternatives would apply only to the siting of utility-scale solar energy generation facilities and not to any required supporting linear infrastructure, such as roads, transmission lines, and natural gas or water pipelines. Management decisions for supporting linear infrastructure, including available lands, are defined in existing applicable land use plans. Siting of supporting infrastructure would be analyzed in project-specific environmental reviews.

[3] As discussed in Section 2.2.2, design features are mitigation measures that have been incorporated into the proposed action or alternatives to avoid or reduce adverse impacts. The proposed programmatic design features of the Solar Energy Program would apply to all utility-scale solar energy ROWs on BLM-administered lands under both action alternatives. Additional design features have been proposed for individual SEZs.

area (see Appendix C). Similar programs have been established and have proven useful for other types of renewable energy development, specifically for wind and geothermal energy development (more information about these and other BLM energy programs is available at http://www.blm.gov/wo/st/en/prog/energy.html).

Under the no action alternative, the BLM would continue to develop solar energy resources under its existing policies (BLM 2007; 2010a,b). The agency would not take further steps to programmatically or comprehensively identify lands excluded and lands available for solar energy development or establish a program of policies or required mitigation measures.

Table 6.1-1 lists the approximate amount of land that would be available for utility-scale solar ROW applications in each state under the three alternatives. Maps showing the distribution of these lands are included at the end of Chapter 2 (see Figures 2.2-1 through 2.2-6).

This chapter presents an analysis of the BLM's three management alternatives in terms of their effectiveness in meeting the objectives outlined as part of BLM's purpose and need for action (see Section 1.3.1). These objectives include the following:

- Facilitating near-term utility-scale solar energy development on public lands;

- Minimizing potential negative environmental, social, and economic impacts;

TABLE 6.1-1 Summary of Potentially Developable BLM-Administered Land under the No Action Alternative, the Solar Energy Development Program Alternative, and the SEZ Program Alternative[a]

State	Total State Acreage[b]	BLM-Administered Lands Constituting No Action Alternative (acres)	BLM-Administered Lands Constituting Solar Energy Development Program Alternative (acres)[c]	BLM-Administered Lands Constituting SEZ Program Alternative (acres)
Arizona	72,700,000	9,218,009	4,485,944	13,735
California	100,200,000	11,067,366	1,766,543	339,090
Colorado	66,500,000	7,282,061	148,072	21,050
Nevada	70,300,000	40,794,055	9,084,050	171,265
New Mexico	77,800,000	12,188,361	4,068,324	113,052
Utah	52,700,000	18,182,368	2,028,222	19,192
Total	440,200,000	98,732,220	21,581,154	677,384

a To convert acres to km^2, multiply by 0.004047.

b From Table 4.2-1.

c The acreage estimates were calculated on the basis of the best available geographic information system (GIS) data. GIS data were not available for the entire set of exclusions, so the exact acreage could not be calculated. Exclusions that could not be mapped would be identified during the ROW application process.

- Providing flexibility to consider a variety of solar energy projects (e.g., location, facility size, and technology);

- Optimizing existing transmission infrastructure and corridors; and

- Standardizing and streamlining the authorization process for solar energy development on BLM-administered lands.

The analysis in this chapter also evaluates the extent to which each management alternative would assist the BLM in meeting the projected demand for utility-scale solar energy development, as estimated by the reasonably foreseeable development scenario (RFDS) developed for this PEIS (see Section 2.4). The extent to which each option would assist the BLM in meeting the mandates of the Energy Policy Act of 2005 (Public Law [P.L.] 109-58) and Order 3285A1, issued by the Secretary of the Interior (2010) (see Section 1.1), including but not limited to the mandate to identify and prioritize specific locations best-suited for utility-scale solar energy development on public lands, is also assessed.

This chapter provides summary-level information on the potential impacts to resources and resource uses from solar energy development in the context of how such impacts would vary as a function of the alternatives. The level of detail presented for individual alternatives is commensurate with the programmatic decisions to be made, which are primarily planning-level decisions (i.e., allocation and exclusion decisions). This chapter provides a summary of the key adverse impacts of solar energy development for each SEZ (based on the detailed analysis of SEZs included in Chapters 8 through 13) that will inform possible decisions regarding the size, configuration, and/or management of the SEZs. This chapter also assesses the cumulative impacts of utility-scale solar development expected in the six-state study area over the next 20 years based on the RFDS.

Table 6.1-2 provides a summary of the environmental impacts of the alternatives. Because of the programmatic focus of the PEIS, the impact summaries are primarily qualitative; however, some impacts have been quantified. Chapter 5 provides a detailed discussion of the impacts summarized here; Appendix J provides a comparison of species affected by alternative. The impacts of solar development itself are largely similar across the alternatives. However, because the alternatives represent planning decisions (i.e., allocations and exclusions for solar ROWs), differences between the alternatives are found in the location, pace, and concentration of this development. Table 6.1-3 includes a summary of the potential resource conflicts identified for individual SEZs and the extent to which these conflicts would potentially limit the amount of land available for development within each SEZ.

Sections 6.1 through 6.3 discuss the potential effectiveness of each of the management alternatives at meeting the described objectives and their potential environmental impacts. Section 6.4 compares the alternatives and identifies the BLM's preferred alternative. Section 6.5 discusses the potential cumulative impacts of developing utility-scale solar energy on BLM-administered lands in the six-state study area over the next 20 years. Section 6.6 discusses the other National Environmental Policy Act of 1969 (NEPA) considerations related to the preferred alternative, including unavoidable adverse impacts, short-term uses of the environment and

TABLE 6.1-2 Summary-Level Assessment of Potential Environmental Impacts by Alternative[a]

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Lands and Realty	Utility-scale solar energy development would preclude other land uses within the project footprint and could alter the character of largely rural areas. Development of supporting infrastructure (e.g., new transmission lines, roads) would also locally impact land use. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., stakeholder coordination/consultation, consolidation of infrastructure) could effectively avoid or minimize many of these impacts.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Specially Designated Lands and Lands with Wilderness Characteristics	Specially designated lands and lands with wilderness characteristics could be significantly impacted through direct and indirect impacts (e.g., visual impacts, reduced access, noise impacts, fugitive dust) during both the construction and operations phases. Impacts potentially could be dispersed across the 22 million acres. All NLCS lands (4,714,372 acres) would be excluded, along with SRMAs (3,213,151 acres); ACECs (3,474,696 acres); Desert Wildlife Management Areas (DWMAs); National Recreation Trails and National Back Country Byways; Wild, Scenic, and Recreational Rivers, and segments of rivers determined to be eligible or suitable for Wild and Scenic River status (not quantified).[b] All areas where there is an applicable land use plan decision to protect lands with wilderness characteristics would be excluded (not quantified)	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect a smaller number of areas.	Same impacts as solar energy development program alternative except that only NLCS lands currently off-limits to solar energy development would be excluded. Impacts could be potentially more widespread and greater to specially designated lands and lands with wilderness characteristics excluded under the action alternatives.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Rangeland Resources	Some livestock grazing allotments may be affected by solar energy development ROW authorizations through reductions in acreage and/or loss of animal unit months (AUMs). Wild horses and burros also could be affected with animals displaced from the development area; the number of wild horse and burro herd management areas (HMAs) overlapping with or in the vicinity of lands available for ROW application would be less than under the no action alternative. Impacts potentially could be dispersed across the 22 million acres.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller geographic area with a known set of grazing allotments.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread and there is less certainty about which grazing allotments and HMAs potentially could be affected.
Recreation	Recreational uses would be precluded within lands used for solar energy development. Recreational experiences could be adversely impacted in areas proximate to solar energy projects and related transmission. Impacts potentially could be dispersed across the 22 million acres. All SRMAs excluded from solar energy development (3,213,151 acres), along with developed recreational facilities, and special-use permit recreation sites (not quantified)	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer recreational resources.	Same impacts as solar energy development program alternative except SRMAs, recreational facilities, and special-use permit recreation sites not excluded. Impacts could be potentially more widespread and greater to those recreational areas excluded under the action alternatives.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Military and Civilian Aviation	Military and civilian aviation impacts would be identified and adequately mitigated prior to BLM's issuance of a ROW authorization.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Geologic Setting and Soil Resources	Development of large blocks of land for solar energy facilities and related infrastructure would result in impacts to geologic and soil resources in terms of soil compaction and erosion, although these impacts could be effectively mitigated. Impacts to biological soil crusts would be long term and possibly irreversible. Impacts potentially could be dispersed across the 22 million acres.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Mineral Resources	Mineral development within the project footprint for utility-scale solar energy development would generally be an incompatible use; however, some resources underlying the project area might be developable (e.g., directional drilling for oil and gas or geothermal resources, underground mining). Impacts potentially could be dispersed across the 22 million acres. Lands within SEZs could be withdrawn from location and entry under the mining laws.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread. No SEZs would be identified or withdrawn.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Water Resources	Solar thermal energy technologies with wet-cooling systems require large volumes of water, with potentially significant environmental impacts; however, such projects would be limited primarily to locations with ample groundwater supplies where water rights and the approval of water authorities could be obtained. Solar thermal projects with dry-cooling systems require less than one-tenth of the amount of water required for wet-cooling systems. All solar energy facilities require smaller volumes of water for mirror or panel washing and potable water uses, which would result in relatively minor impacts on water supplies. Other potential impacts, including modification of surface and groundwater flow systems, water contamination resulting from chemical leaks or spills, and water quality degradation by runoff or excessive withdrawals, can be effectively mitigated.	Same impacts solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer water resources.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Vegetation	Development likely to require total removal of vegetation at most facilities, which could result in significant direct impacts in terms of increased risk of invasive species introduction, changes in species composition and distribution, habitat loss (e.g., dune or riparian areas), and damage to biological soil crusts. Indirect impacts also likely in terms of dust deposition, altered drainage patterns, runoff, and sedimentation. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., invasive species control programs, fugitive dust control, minimizing size of disturbed areas) could significantly reduce many of these impacts. Multiple exclusions would avoid such impacts, including exclusion of ACECs, Research Natural Areas, and Old Growth Forest (not quantified).	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect a smaller number of areas. About 48% of the SEZ lands are located within the Sonoran Basin and Range	Same impacts as solar energy development program alternative except there would be no explicit exclusions to avoid known sensitive vegetation resources. Impacts could be potentially more widespread and greater to those vegetation resources excluded under the action alternatives.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Vegetation *(Cont.)*	About 46% of the lands available for ROW application are located within the Central Basin and Range Ecoregion. About 14% each of the Central Basin and Range and Chihuahuan Deserts Ecoregions, 11% of the Sonoran Basin and Range Ecoregion, and 5% of the Madrean Archipelago Ecoregion are located within the lands that would be available for application. Other ecoregions coincide with these lands at levels below 5%. The land cover types for the following example species overlap with lands that would be available for ROW application by the percentage shown: Joshua tree – 7% Saguaro – 10%	Ecoregion. Of the five ecoregions that coincide with SEZs, 1% or less of each ecoregion would be available for ROW application. Less than 1% of the land cover type for Joshua tree and saguaro species are located within the SEZs.	Lands available for ROW application span 22 ecoregions. About 44% of the available lands are located within the Central Basin and Range Ecoregion. Over 50% of 2 ecoregions (Central Basin and Range, Northern Basin and Range) would be available for application. The land cover types for the following species overlap with the lands that would be available for ROW application by the percentage shown: Joshua tree – 32% Saguaro – 26%

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Wildlife and Aquatic Biota	Numerous wildlife species would be adversely impacted by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, habitat fragmentation, and changes in water availability. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., limiting land disturbance, conducting pre-disturbance surveys, controlling surface water runoff) could reduce many of these impacts. Multiple exclusions would avoid such impacts, including exclusion of ACECs, big game migratory corridors and winter ranges, Research Natural Areas, and lands with seasonal restrictions (not quantified). The following example species' habitats overlap with lands that would be available for ROW application by the percentage shown: Western rattlesnake – 6% Golden eagle – 5% Black-tailed jackrabbit – 6% Pronghorn – 5% Mule deer – 6% Mountain lion – 5%	Same impacts as solar energy development program alternative except the potential area of impact would be limited to a smaller, known geographic area. Less than 1% of the habitats for western rattlesnake, golden eagle, black-tailed jackrabbit, pronghorn, mule deer, and mountain lion are located within the SEZs.	Same impacts solar energy development program alternative except there would be no explicit exclusions to avoid known sensitive wildlife resources. Impacts could be potentially more widespread and greater to those wildlife resources excluded under the action alternatives. The following species' habitats overlap with the lands that would be available for ROW application by the percentage shown: Western rattlesnake – 27% Golden eagle – 23% Black-tailed jack rabbit – 24% Pronghorn – 22% Mule deer – 22% Mountain lion – 21%

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Special Status Species	Special status species and critical habitats would be protected in accordance with ESA requirements either through avoidance, translocation (plants), or acquisition and protection of compensatory habitat. Impacts potentially could be dispersed across the 22 million acres. Critical habitat designated or proposed by USFWS would be excluded (over 5,954,000 acres). All ACECs designated for habitat would be excluded along with identified Desert Tortoise translocation sites and other areas where BLM has made a commitment to protect sensitive species (not quantified). Lands available for ROW application include areas of potentially suitable habitat for special status species (see Appendix J). For example, the following species' habitats overlap by the percentage shown: Plants: Nevada dune beardtongue – 61% White-margined beardtongue – 8% Munz's cholla – 16% Animals: Desert tortoise – 12% Western burrowing owl – 8% Greater sage-grouse – 8% Gunnison prairie dog – 3% Gunnison sage-grouse – 1% Northern aplomado falcon – 11% Southwestern willow flycatcher -- <1% Townsend's big-eared bat – 7% Utah prairie dog – 12%	Special status species and critical habitats would be protected as under solar energy development program alternative. Same exclusions as under solar energy development program alternative, except, in some states, habitat identified by state fish and game agencies would also be excluded (not quantified). Lands available for ROW application include areas of potentially suitable habitat for special status species (see Appendix J). For example, about 1% or less of the habitat for two plant species (Nevada dune beard tongue, white-margined beard tongue) and nine animal species (desert tortoise, western burrowing owl, greater sage-grouse, Gunnison prairie dog, Gunnison sage-grouse, northern aplomado falcon,	Special status species and critical habitats would be protected as under solar energy development program alternative. Critical habitat, ACECs designated for habitat value, and other areas where BLM has made a commitment to protect sensitive species would not be excluded. Lands available for ROW application include areas of potentially suitable habitat for special status species (see Appendix J). For example, the following species' habitats overlap by the percentage shown: Plants: Nevada dune beardtongue – 66% White-margined beardtongue – 34% Munz's cholla – 45%

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Special Status Species *(Cont.)*		southwestern willow flycatcher, Townsend's big-eared bat, and Utah prairie dog) is located within the SEZs; about 4% of the plant Munz's cholla habitats is located with the SEZs.	Animals: Desert tortoise – 29% Western burrowing owl – 27% Greater sage-grouse – 54% Gunnison prairie dog – 15% Gunnison sage-grouse – 24% Northern aplomado falcon – 26% Southwestern willow flycatcher -- 7% Townsend's big-eared bat – 23% Utah prairie dog – 36%
Air Quality and Climate	Air quality would be adversely affected locally and temporarily during construction by fugitive dust and vehicle emissions, although impacts would be relatively minor and could be mitigated (e.g., dust control measures, emissions control devices, vehicle maintenance). Impacts potentially could be dispersed across the 22 million acres. Operations would result in few air quality impacts. Relatively minor CO_2 emissions would be generated by the use of heavy equipment, vehicles, and backup generators. Overall, CO_2 emissions would be reduced if solar energy production offsets fossil fuel energy production.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread and of smaller magnitude locally. Carbon dioxide emission reductions would occur more slowly if the pace of development is slower.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Visual Resources	Solar energy projects and associated infrastructure introduce strong contrasts in forms, line, colors, and textures of the existing landscape which may be perceived as negative visual impacts. Suitable development sites typically located in basin flats surrounded by elevated lands where sensitive viewing locations exist. Impacts potentially would be dispersed across the 22 million acres. Design features could reduce impacts but some large impacts cannot be avoided. All NLCS lands (4,714,372 acres) would be excluded, ACECs, (3,474,696 acres), SRMAs (3,213,151 acres), along with developed recreational facilities, special-use permit recreation sites, National Recreation Trails, and National Back Country Byways (not quantified). 902 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi (40 km) of the lands available for ROW viewsheds.	Same impacts as solar energy development program alternative except the impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas. SEZs are visible from 149 potentially sensitive visual resource areas (not including ACECs) within 25 mi.	Same impacts as solar energy development program alternative except that only NLCS lands currently off-limits to solar energy development would be excluded. Impacts could be potentially more widespread and greater to those areas excluded under the action alternatives. 1,510 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi (40 km) of the lands available for ROW application and could be affected by solar development within their viewsheds.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Acoustic Environment	Construction related noise could adversely affect nearby residents and/or wildlife, and would be greatest for CSP projects requiring power block construction. Operations related noise impacts would generally be less significant than construction related noise impacts but could still be significant for some receptors located near power block or dish engine facilities. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., siting, engineering controls) would significantly reduce impacts in some circumstances.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Paleonto-logical Resources	Paleontological resources subject to loss during construction but impacts also possible during operations. Impacts potentially could be dispersed across the 22 million acres. Design features would significantly reduce impacts.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.
Cultural Resources and Native American Concerns	Cultural resources subject to loss during construction but impacts also possible during operations. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., minimizing land disturbance, consultation and records searches, training and education programs) would significantly reduce some impacts.	Same impacts as development program except impacts would be concentrated into a smaller, known geographic area.	Same impacts as solar energy development program alternative except there would be no explicit exclusions to avoid known sensitive cultural resources.

TABLE 6.1-2 (Cont.)

Resource	Solar Energy Development Program Alternative (Approximately 22 million acres available for application)	SEZ Program Alternative (Approximately 677,000 acres available for application)	No Action Alternative (Approximately 99 million acres available for application)
Cultural Resources and Native American Concerns *(Cont.)*	ACECs designated for cultural or historic resource values, National Historic and Scenic Trails, National Historic and Natural Landmarks, properties designated or eligible for the National Register of Historic Places, and areas with important cultural and archaeological resources excluded.		Impacts could be potentially more widespread and greater to those cultural resources excluded under the action alternatives.
Transportation	Local road systems and traffic flow could be adversely impacted during construction. Impacts during operations would be minor. Impacts potentially could be dispersed across the 22 million acres. Design features (e.g., road improvements, ride-sharing programs, staggered work schedules, traffic control measures) would significantly reduce impacts.	Same impacts as solar energy development program alternative except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as solar energy development program alternative except impacts could be potentially more widespread.

[a] To convert acres to km^2, multiply by 0.004047.

[b] The acreage estimates were calculated on the basis of the best available GIS data. GIS data were not available for the entire set of exclusions and, therefore, the acreages cannot be quantified at this time.

TABLE 6.1-3 Potential Effects of Environmental Impact Considerations on Acres Available for Solar Energy Development in the Proposed SEZs[a,b]

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Arizona			
Brenda	3,878	Possible restrictions to development on east side of SEZ to reduce impacts to Plomosa SRMA.	Restricted areas to be identified; extent unknown.
		Military aviation concerns related to structures >250 ft.	
		Because of water availability limits, wet-cooling options would not be feasible.	
		Need to avoid Bouse Wash, Tyson Wash, other dry washes, dry wash woodland, chenopod scrub habitat, sand dunes, sand transport systems, sand flats, agricultural and riparian habitats, and saguaro cactus communities. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		Potential for prehistoric sites, especially in eastern portion of SEZ, that if present should be avoided.	
Bullard Wash	7,239	Military aviation concerns related to structures >250 ft.	Restricted areas to be identified; extent unknown.
		Restricting development of solar facilities within 5 mi (8 km) of the Tres Alamos WA, as well as restricting solar development to lower-profile facilities, should be considered.	
		Because of water availability limits, wet-cooling options would not be feasible.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Arizona (Cont.)			
		Facilities should avoid the wetland, dry washes, dry wash woodland, mesquite bosque, and riparian habitat; and Joshua tree and saguaro cactus communities Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		No cultural or historic resource surveys have been conducted.	
Gillespie	2,618	Power tower development should be prohibited to avoid visual impacts.	Restricted areas to be identified; extent unknown.
		Military aviation concerns related to structures >250 ft.	
		Wet-cooling options would not be feasible if groundwater was the chosen water source for a solar project.	
		Need to avoid wetland, dry wash, dry wash woodland, mesquite bosque, riparian habitat, and saguaro cactus communities and to minimize impacts on tributaries of Centennial Wash. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on nine special status species.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
California			
Imperial East	5,722	Development on portions of the SEZ may be incompatible with existing military or civilian aviation use. Because of water availability limits, wet-cooling options would not be feasible. Need to avoid wetland and riparian habitats (within the western and southern portions of the SEZ), sand dune habitat, and sand transport areas within the SEZ. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided. Additional cultural and historic resource surveys are needed. Development could affect Native American burials and prehistoric and historic resources.	Restricted areas to be identified; extent unknown.
Iron Mountain	106,522	*Minerals*: The presence of the KSLA must be addressed to evaluate the compatibility of solar development in the KSLA with continuation of sodium mineral leasing (the KSLA is assumed to be restricted from development). Development in 2,101 acres in the northwest portion of the SEZ should be consistent with VRM Class II to mitigate impacts on the Old Woman Mountains WA; an additional 9,311 acres should be consistent with VRM Class III. Development in 5,725 acres south of State Route 62 should be consistent with VRM Class III to mitigate impacts within the Palen-McCoy WA. Development in 21,219 acres of the eastern portion of the SEZ should be consistent with VRM Class II objectives to mitigate impacts on the Turtle Mountains WA; an additional 13,301 acres should be consistent with VRM Class III. There is some overlap of areas affected by visual restrictions. Development on portions of the SEZ may be incompatible with existing military use.	69% (total of 73,984 acres; 50,984 acres [accounting for overlapping restricted areas] could be restricted due to visual impacts; an additional 23,000 acres of the Danby Lake KSLA should not be developed due to multiple resource conflicts). Note that a small portion of the excluded area may be overestimated because the area of visual restrictions for Old Woman Mountain WA on the northwest side of the SEZ overlaps with part of the KSLA. Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
California (Cont.)			
		About 23,000 acres of the Danby Lake KSLA is within the northwest corner of the SEZ and is not likely developable.	
		Because of water availability limits, wet-cooling options would not be feasible.	
		Development in Danby Lake, Homer Wash, riparian, playa, chenopod scrub, sand dune, and dry wash habitats, and rocky cliff and outcrop habitats, should be avoided. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		Avoidance of significant sites (historic properties) within the proposed Iron Mountain SEZ, specifically in the vicinity of Danby Lake and near the Iron Mountain Divisional Camp, is recommended.	
Pisgah	23,950	Development in 2,237 acres in the western portion of the SEZ should be consistent with VRM Class II to mitigate impacts on the Cady Mountains WSA, an additional 7,961 acres should be consistent with VRM Class III objectives. Development in 454 acres of the SEZ located south of I-40 should be consistent with VRM Class III objectives to mitigate impacts on the Rodman Mountains WA and travelers on I-40 and Historic Route 66. Development on portions of the SEZ may be incompatible with existing military use.	44% (10,652 acres) could be restricted because of visual impacts. Additional restricted areas to be identified; extent unknown.
		Mining claims present in the portion of the SEZ south of I-40 represent a prior existing right that could preclude development as long as they are in place.	
		Because of water availability limits, wet-cooling options would not be feasible.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
California (Cont.)			
		Need to avoid impacts on playa, chenopod scrub, and desert dry wash habitat; sand dune and sand transport areas; and rocky cliff and outcrop habitats; particularly near Troy Dry Lake in the eastern portion of the SEZ, ephemeral drainages, and potential nesting habitat for ten desert bird focal species. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on three special status species.	
		Areas of significant prehistoric remains within the SEZ that are identified through the Calico Solar Power Project (to date, an area that includes a 400-ft [122-m] buffer, and in some instances, fencing) should be avoided.	
Riverside East	202,896	Development in 67,704 acres in the northwest portion of the SEZ should be consistent with VRM Class II to mitigate impacts on Joshua Tree NP and Palen-McCoy WA. Development in 11,926 acres in the northeast portion of the SEZ should be consistent with VRM Class II objectives; an additional 19,676 acres should be consistent with VRM Class III objectives. Development on portions of the SEZ may be incompatible with existing military use. Existing mining claims should be avoided. Because of water availability limits, wet-cooling options would not be feasible.	51% (total of 103,113 acres; 99,306 acres could be restricted due to visual impacts; an additional 3,807 acres of wetlands should be avoided). Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
California (Cont.)			
		Land disturbance activities should avoid impacts to the extent possible near the regions surrounding Palen Lake, Ford Dry Lake, McCoy Wash, and the Colorado River Aqueduct. Avoid 3,807 acres of wetland habitat within the SEZ. Avoid wetland, riparian, playa, dry wash woodland, sand dune and sand transport areas, and chenopod scrub habitats within the SEZ. Avoid ephemeral drainages, Ford Dry Lake, Palen Lake, McCoy Wash, and the Colorado River Aqueduct. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided. Additional cultural and historic resource surveys are needed. Development in the vicinity of Palen and Ford Dry Lakes and important WWII Desert Training Center areas, and along intact trail networks, should be avoided.	
Colorado			
Antonito Southeast	9,729	Development in 1,100 acres should be consistent with VRM Class II to mitigate impacts on the West Fork of the North Branch of the Old Spanish Trail, the Cumbres and Toltec Scenic Railroad, and the San Antonio WSA; an additional 3,250 acres should be consistent with VRM Class III objectives. Power tower development should be prohibited to avoid visual impacts. Development on portions of the SEZ may be incompatible with existing military airspace use.	47% (total of 4,600 acres; 4,350 acres could be restricted due to visual impacts; an additional 250 acres of pronghorn summer concentration area should be avoided). Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Colorado (Cont.)			
		Because of water availability limits, wet-cooling options would not be feasible.	
		Land disturbance activities should avoid impacts to the extent possible in the vicinity of Alta Lake and two additional wetland areas, along with ephemeral washes present on the site.	
		Avoid 253 acres of pronghorn summer concentration area and the Alta Lake area. Should avoid grassland, wetland, riparian, sagebrush, and woodland habitat. Prairie dog colonies should be avoided. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
De Tilla Gulch	1,522	Power tower development should be prohibited to avoid visual impacts. Wet-cooling technologies should incorporate water conservation measures to reduce water needs.	Restricted areas to be identified; extent unknown.
		Ephemeral drainages within the SEZ, and riparian, wetland, and grassland habitats should be avoided to the extent practicable.	
		Should avoid elk severe winter range and pronghorn winter concentration area. Should avoid prairie dog colonies and grassland habitat. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Colorado (Cont.)			
Fourmile East	3,882	Power tower development should be prohibited to avoid visual impacts. Development in 1,578 acres should be consistent with VRM Class II, to mitigate impacts to the Los Caminos Antiguos Scenic Byway, Old Spanish National Historic Trail, and the Sangre de Cristo WA; development in an additional 1,647 acres should be consistent with VRM Class III. Because of water availability limits, wet-cooling options would not be feasible. Wetland, sand dune, playa, and riparian habitats within the SEZ should be avoided. Prairie dog colonies, approximately 213 acres of elk summer range, nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	83% (3,225 acres) could be restricted due to visual impacts. Additional restricted areas to be identified; extent unknown.
Los Mogotes East	5,918	Power tower development should be prohibited to avoid visual impacts. Because of water availability limits, wet-cooling options would not be feasible. Land disturbance activities should avoid impacts to the extent possible near ephemeral washes on site and surrounding wetlands. Facilities should avoid drywash and wetland habitats, prairie dog colonies, approximately 135 acres of mule deer winter range, and pronghorn winter concentration area. Should avoid wetland, riparian, grassland, marsh, meadow, and woodland habitat, nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species.	Restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Nevada			
Amargosa Valley	31,625	Development within 15,359 acres in the southwestern portion of the SEZ should be consistent with VRM Class II objectives to mitigate impacts to Death Valley NP. DoD-authorized airspace from ground level to 9,400 ft above mean sea level; facilities over 50 ft may cause unacceptable electromagnetic interference. Because of water availability limits, wet-cooling options would not be feasible. Avoidance of groundwater withdrawals would reduce or prevent impacts on 25 groundwater-dependent special status species. Facilities should avoid the 100-year floodplain of the Amargosa River (3,915 acres), as well as dry wash, playa, riparian, and chenopod scrub habitat, nesting habitat for bird species listed under the MBTA, habitat for discovered populations and occupied habitats of special status species. Evaluation of impacts of solar development close to the Big Dune to the east of the SEZ is needed.	61% (total of 19,274 acres; 15,359 acres could be restricted due to visual impacts.; an additional 3,915 acres of Amargosa River floodplain should be avoided). Additional restricted areas to be identified; extent unknown.
Delamar Valley	16,552	Development within 2,080 acres in the SEZ should be consistent with VRM Class II objectives to mitigate impacts on the Delamar Mountains WA, an additional 5,485 acres should be consistent with VRM Class III objectives. Development within 4,921 acres of the SEZ should be consistent with VRM Class III objectives to mitigate impacts on the South Pahroc Range WA. There is some overlap of areas affected by visual restrictions. DoD-authorized airspace from 100 ft above ground level (AGL) to unlimited altitude; facilities over 50 ft may cause unacceptable electromagnetic interference.	65% (total of 10,821 acres [accounting for overlapping restricted areas] could be restricted due to visual impacts. Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Nevada (Cont.)			
		Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid intermittent streams, ephemeral washes, Delamar Dry Lake, habitat in playas, riparian, marsh, and greasewood flats within the SEZ. Joshua tree communities, nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided. Significant cultural sites within the proposed SEZ should be avoided, especially in the vicinity of the dry lake.	
Dry Lake	15,649	Military aviation concerns related to structures >250 ft. Wet-cooling and dry-cooling options would not be feasible unless further hydrologic study of the basin reveals that more water is available. Facilities should avoid the 100-year floodplain (1,569 acres), as well as the dry lake, dry washes, dry wash woodland, chenopod scrub, ephemeral washes, desert pavement, and playa habitats within the SEZ. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided. The Old Spanish Trail NRHP-listed site within the southeastern portion of the proposed SEZ should be avoided.	10% (1,569 acres) of floodplain should be avoided. Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Nevada (Cont.)			
Dry Lake Valley North	76,874	DoD authorized airspace from 100 to 60,000 ft AGL; facilities over 50 ft may cause unacceptable electromagnetic interference.	Restricted areas to be identified; extent unknown.
		Because of water availability limits, wet-cooling options would not be feasible.	
		Facilities should avoid intermittent streams, ephemeral washes, dry wash, playa, marsh, scrub-shrub wetland, riparian, and greasewood flat habitats within the SEZ. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	
East Mormon Mountain	8,968	Power tower development should be prohibited to avoid visual impacts.	Restricted areas to be identified; extent unknown.
		Military concerns related to location in Low Altitude Training Navigation Area.	
		Because of water availability limits, wet-cooling options would not be feasible.	
		Facilities should avoid all dry washes; ephemeral stream channels (including Toquop Wash and South Fork Toquop Wash); playa, riparian, rocky cliff and rock outcrop habitats; and Joshua tree communities. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided. Avoidance of Toquop and South Fork Washes would also address cultural resource concerns.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Nevada (Cont.)			
Gold Point	4,810	DoD-authorized airspace from ground level to 9,400 ft above mean sea level; facilities over 50 ft may cause unacceptable electromagnetic interference.	Restricted areas to be identified; extent unknown.
		Because of water availability limits, wet-cooling options would not be feasible.	
		Facilities should avoid the unnamed intermittent stream; the playa area in the northeast corner of the SEZ; ephemeral washes; riparian, dry wash, cliff, outcrop, canyon, playa, wetland, sagebrush, and greasewood flat habitats. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided.	
Millers	16,787	Facilities over 50 ft may cause unacceptable electromagnetic interference.	Restricted areas to be identified; extent unknown.
		Because of water availability limits, wet-cooling options would not be feasible.	
		Facilities should avoid the ephemeral stream channels of Ione Wash and Peavine Creek; alluvial fan features along the western edge of the SEZ; playa wetlands, dry washes, and greasewood flat habitats within the SEZ. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided.	
		Avoidance of areas with a high potential for a high density of sites, such as in the vicinity of both the former Lake Tonopah and Millers town site, is recommended.	

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
New Mexico			
Afton	77,623	Development in 12,528 acres in the eastern portion of the SEZ should be consistent with VRM Class II to mitigate impacts on communities within the Mesilla Valley. Development in 2,900 acres in the southwestern portion of the SEZ should be consistent with VRM Class II to mitigate impacts on the Aden Lava Flow WSA; an additional 9,600 acres should be consistent with VRM Class III. The height of power towers should be restricted such that the receiver and any navigation hazard lighting will not be directly visible from western portions of Mesilla Valley. Because of water availability limits, wet- and dry-cooling options would not be feasible. Siting of solar facilities and construction activities should avoid the areas identified as being within a 100-year floodplain that total 1,654 acres within the proposed SEZ. All ephermeral streams; and wetland, dry wash, playa, riparian, succulent, and dune communities; desert grasslands, sand dune and sand transport systems; rocky slopes, cliffs, and outcrops within the SEZ should be avoided to the extent practicable. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided. To avoid paleontological impacts, avoidance of the eastern edge of the SEZ may be warranted if a paleontological survey results in findings similar to those known south of the SEZ.	34% (26,682 acres; 25,028 could be restricted due to visual impacts; an additional 1,654 acres of floodplain should be avoided). Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
New Mexico (Cont.)			
Mason Draw	12,909	Consideration should be given to restricting the height of solar facilities in portions of the SEZ to minimize impacts on the Prehistoric Trackways National Monument and the Robledo Mountains WSA and ACEC. Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid the 100-year floodplain of Kimble Draw (325 acres), as well as all wetland, riparian, dry wash, playa, succulent and desert grassland habitats, as well as sand dune and sand transport systems within the SEZ. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided.	2.5% (325 acres) of floodplain should be avoided. Additional restricted areas to be identified; extent unknown.
Red Sands	22,520	Disturbance of gypsite crusts should be avoided to minimize the risk of soil loss by wind erosion. Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid the 100-year floodplain (54 acres), as well as all wetland, dry wash, playa, riparian, succulent, and desert grassland habitats as well as sand dune habitat and sand transport systems within the SEZ. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided. Power tower development should be prohibited to avoid visual impacts.	0.2% (54 acres) of floodplain should be avoided. Additional restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Utah			
Escalante Valley	6,614	Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid ephemeral washes, dry wash, dry lake, and playa habitats; sand dune and sand transport areas (particularly within the southwest portion of the SEZ); and pinyon-juniper and oak/mahogany woodlands. Nesting habitat for bird species listed under the MBTA and habitat for discovered populations and occupied habitats of special status species should be avoided.	Restricted areas to be identified; extent unknown.
Milford Flats	6,480	Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid ephemeral washes; dry wash, riparian, playa, greasewood flats, rocky cliff and outcrop, and woodland habitats; and Minersville Canal. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	Restricted areas to be identified; extent unknown.
Wah Wah Valley	6,097	Because of water availability limits, wet-cooling options would not be feasible. Facilities should avoid Wah Wah wash, other dry wash, playa, greasewood flat, wetland, rocky cliff and outcrop, woodland, and riparian habitats; and the inter-mountain big sagebrush shrubland cover type in the southwestern portion of the SEZ. Nesting habitat for bird species listed under the MBTA, and habitat for discovered populations and occupied habitats of special status species should be avoided.	Restricted areas to be identified; extent unknown.

TABLE 6.1-3 (Cont.)

State/SEZ	Total SEZ Acres	Environmental Impact Consideration[c]	Amount of SEZ with Possible Development Restrictions[d]
Utah (Cont.)			
	677,384 acres for all SEZs		Total Restrictions: 254,299 acres; 38% of total SEZ acreage, additional restricted areas to be identified.

Abbreviations: ACEC = Area of Critical Environmental Concern; BLM = Bureau of Land Management; DoD = U.S. Department of Defense; KOP = key observation point; KSLA = known sodium leasing area; MBTA = Migratory Bird Treat Act; MTR = military training route; NRHP = National Register of Historic Places; NP = National Park; SEZ = solar energy zone; VRM = visual resource management; WA = Wilderness Area; WWII = World War II.

[a] SEZs addressed in this Draft PEIS are proposed. Decisions on final SEZs, their size, and their boundaries will be made in the ROD for the PEIS.

[b] To convert acres to km^2, multiply by 0.004047. To convert ft to m, multiply by 0.3048. To convert mi to km, multiply by 1.609.

[c] All solar development in 100-yr floodplains and potential jurisdictional water bodies subject to Clean Water Act Section 404 permitting should be avoided, However, these areas have only been mapped in a few of the SEZs; where specific floodplain areas are known they have been stated in SEZ summaries.

[d] For purposes of analysis in this PEIS, the developable area was assumed to be up to 80% of the total area for all SEZs assuming that siting constraints likely would be identified during project-specific analyses. SEZ-specific analyses presented in Chapters 8 through 13 and summarized in this table have identified a number of potential conflicts that could restrict the amount of land available for development within the SEZs to 80% or less. These findings support the assumption that only 80% of any given SEZ would be developable. However, these restrictions need to be verified by additional project-specific evaluations. Restrictions related to potential visual impacts also need to be evaluated in light of ongoing BLM policy-making regarding mitigation of visual impacts.

long-term productivity, irreversible and irretrievable commitment of resources, and mitigation of adverse impacts.

6.1 IMPACTS OF THE SOLAR ENERGY DEVELOPMENT PROGRAM ALTERNATIVE

As discussed throughout the PEIS, all BLM-administered lands are not appropriate for solar energy development. Under the solar energy development program alternative, certain categories of land that are known or believed to be unsuitable for utility-scale solar development would be excluded from development to guide solar energy developers to areas where there are fewer resource conflicts and potential controversy. This process, described as "screening for success," would allow time and effort to be directed to those projects that have a greater chance of success. Under this alternative, the lands that would be excluded from utility-scale solar energy development include BLM-administered lands currently off-limits to development, including lands prohibited by law, regulation, Presidential proclamation or Executive Order (e.g., lands in the National Landscape Conservation System [NLCS]),[4] along with lands that (1) have slopes greater than or equal to 5%, (2) have solar insolation levels below 6.5 kWh/m^2/day, and (3) have known resources, resource uses, or special designations identified in local land use plans that are incompatible with solar energy development. A detailed discussion of these exclusions is provided in Section 2.2.2.2 and Table 2.2-2. On the basis of these exclusions, approximately 22 million acres (87,336 km^2) of BLM-administered lands would be available for ROW application under this alternative. A subset of these lands, approximately 677,400 acres (2,741 km^2), would be identified as SEZs where the agency would prioritize solar energy and associated transmission infrastructure development.[5]

This alternative would also establish comprehensive program administration and authorization policies and design features to be applied to utility-scale solar energy projects that are issued ROWs on BLM-administered lands in the six-state study area. These policies and design features were developed in part on the basis of impact analyses presented in Chapter 5. As part of this alternative, the BLM has identified additional SEZ-specific design features to address SEZ-specific resource conflicts. These SEZ-specific design features were identified on the basis of the analyses presented in Chapters 8 through 13 of this PEIS. The proposed policies and design features are presented in Section A.2 of Appendix A. The elements of the BLM's new

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[4] The boundaries of National Landscape Conservation System (NLCS) units may be expanded by legislation, or Congress may establish entirely new NLCS units. See, for example, P.L. 111-11. Such lands would be removed automatically from the area of BLM-administered public lands available for solar energy development. Wilderness areas within the NLCS do not include the Tabeguache Area in Colorado because it is not officially designated as wilderness; however, by act of Congress, this area is to be managed as wilderness and, as a result, solar energy development is prohibited in the Tabeguache Area.

[5] As discussed in Section 2.2.2.2, in the future, based on lessons learned from individual projects and/or new information (e.g., ecoregional assessments), the BLM could decide to expand SEZs, add SEZs, or remove or reduce SEZs. Changes to SEZs would have to go through a land use planning process, which would be subject to the appropriate environmental analysis.

program under this alternative would be implemented through amendment of the land use plans within the six-state study area.[6]

Under the solar energy development program alternative, individual ROW applications would continue to be evaluated on a project-by-project basis; however, the BLM proposes that these evaluations would tier to the programmatic analyses presented in this PEIS and the decisions implemented in the resultant ROD and land use plan amendments to the extent appropriate. Site- and project-specific data would be assessed in the individual project reviews and impacts not adequately mitigated by the program's administration and authorization policies and design features would be addressed through the implementation of additional mitigation requirements incorporated into the project plan of development (POD) and ROW authorization stipulations. Analysis of an application may result in a decision to deny the application.

As described in Section 2.2.2.1, as an element of the proposed program, the BLM would implement an adaptive management plan for solar energy development developed in coordination with potentially affected natural resource management agencies, to ensure that new data and lessons learned about the impacts of solar energy projects would be reviewed and, as appropriate, incorporated into the program through revised policies and design features. Changes to the BLM's Solar Energy Program will be subject to appropriate environmental analysis and land use planning.

The following subsections discuss the effectiveness of the solar energy development program alternative in meeting the BLM's established program objectives and describe the potential environmental impacts of the alternative.

6.1.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

Under this alternative, the BLM would establish a set of programmatic administration and authorization policies and design features that would facilitate development by establishing a clear, consistent, and unambiguous process and set of conditions for utility-scale solar energy development on BLM-administered lands. A number of program elements would contribute to these efficiencies, as follows:

- By excluding lands with known sensitive resources, resource uses, and special designations, the agency would accept ROW applications for utility-scale

6 Under this alternative, most of the land use plans in the six-state study area would be amended. Section 2815(d) of the National Defense Authorization Act for Fiscal Year 2000 (P.L. 106-65) placed a moratorium on planning efforts on BLM-administered lands "adjacent to, or near the Utah Test and Training Range (UTTR) and Dugway Proving Grounds or beneath Military Operating Areas, Restricted Areas, and airspace that make up the UTTR" (NDAA § 2815(a), 113 Stat. 512, 852 [1999]). This area encompasses a portion of the lands within the boundaries of the Box Elder, Pony Express, House Range, Warm Springs, and Pinyon land use plans. Within these areas, decisions related to whether lands would be available for ROW application, and adoption of the policies and design features of the PEIS, cannot be implemented via land use plan amendments at this time. Solar energy development ROW applications would be deferred until such time plan amendments or new land use plan(s) address solar energy development. No SEZs are located within the UTTR affected areas.

solar energy development only where such development may be expected to encounter fewer potential resource conflicts. Time and effort would be directed to those projects that have a greater chance of success. Review of projects proposed within any of the 24 proposed SEZs would be further streamlined, because these areas have undergone intensive site-specific analyses as part of this PEIS and mitigation has been proposed for identified resource conflicts (see Chapters 8 through 13).

- The identification of lands which would be excluded from utility-scale solar energy development, and lands which would be available, would help focus the efforts of BLM field staff and developers. However, the 22 million acres (87,336 km^2) that would be available for application are likely to include many areas not suitable for solar energy development because of as yet unidentified conflicts with other resources. As described in the authorization policies in Appendix A, BLM staff will be required to coordinate with federal, state, and local stakeholders and evaluate site-specific resource conflicts as part of the application analysis process.

- To the extent that decisions about future solar energy projects could be tiered to the analyses in this PEIS or decisions in the resultant ROD, project review and approval time lines would be shortened. The proposed program administration and authorization policies and design features are comprehensive and address the majority of operational and design requirements for most projects. The universe of issues that would be evaluated in detail at the project level would be reduced to site-specific and species-specific issues and concerns. For several of the SEZs, it is expected that, with the implementation of required design features, impacts on many resources would be minimal, and thus development could proceed with very limited additional environmental analysis.[7]

- Amending the land use plans within the six-state study area to implement the new program would facilitate individual project approvals and would ensure that multiple individual plan amendments would not be required.

It is anticipated that these program elements would collectively reduce the amount of time and resources required to obtain ROW authorizations and would speed up the pace of utility-scale solar energy development in the six-state study area without compromising the level of protection for natural and cultural resources. Shortened development time lines, particularly for projects proposed within SEZs, would reduce the cost to the government, developers, and stakeholders. These outcomes would likely increase the agency's ability to meet the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

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[7] Note that for all proposed SEZs, government-to-government consultation and inter-agency consultation are still ongoing and could result in the identification of additional concerns.

6.1.2 Minimize Environmental Impacts

Utility-scale solar energy facilities are industrial facilities that require large tracts of land and can generate substantial impacts on a variety of natural and cultural resources. Proper consultation, siting and design, and application of mitigation measures can avoid, minimize, or mitigate many of these impacts. The proposed program administration and authorization policies and design features under this alternative would ensure that potential environmental impacts are addressed thoroughly and consistently for all utility-scale solar energy projects on BLM-administered lands. Specific program elements have been developed to address the many aspects of managing environmental impacts, as follows:

- The proposed program administration and authorization policies establish requirements for coordination and/or consultation with other federal and state agencies and for government-to-government consultation, and establish requirements for public involvement. Collectively, these policies ensure that all projects are thoroughly reviewed, input is collected from all potentially affected land manager and interested stakeholders, and any project proposals that are anticipated to result in unacceptable adverse impacts are eliminated early in the application process.

- The proposed ROW exclusions would avoid impacts of utility-scale solar energy development on known sensitive resources, resource uses, and specially designated areas. Proposed projects on the lands that would be available for ROW application would be thoroughly reviewed to ensure that impacts to other sensitive resources and resource uses not currently identified would also be avoided or mitigated. As described in the program administration and authorization policies in Appendix A, BLM staff will be required to coordinate with federal, state, and local stakeholders and evaluate site-specific resource conflicts as part of the application analysis process. Analysis of an application may result in a decision to deny the application.

- By restricting utility-scale development to lands with slopes less than 5%, the BLM would effectively limit development to those BLM-administered lands assumed to be best suited with respect to technology limitations. By restricting development to lands with solar insolation levels greater than or equal to 6.5 kWh/m^2/day, the BLM would be making available those lands where utility-scale development is assumed to be most economically viable. These proposed restrictions will facilitate the efficient use of BLM-administered lands and meet the multiple-use intent of the Federal Land Policy and Management Act of 1976 (FLPMA) by reserving for other uses lands that are not well suited for solar energy development.

- The proposed design features, developed on the basis of extensive impact analyses conducted in this PEIS, address the full array of potential impacts associated with each phase of development (i.e., site evaluation, construction, operation, and decommissioning). For many project locations, the majority of potential impacts would be addressed by these requirements. Individual project environmental reviews would be required to address any additional site-specific and species-specific issues and concerns.

- By making 22 million acres (87,336 km^2) of land available for ROW application, the BLM would provide opportunities to site solar energy projects on lands that have been previously disturbed or developed.

- The larger land area available for solar energy development under this alternative would provide the flexibility to site projects in a manner that could reduce the negative impacts of issues such as fragmentation of habitat, and proliferation of projects that might interfere with other resource values and uses. However, this same flexibility also would increase the uncertainty regarding the siting of such projects, and limit the assurance that a reduction in negative impacts would, in fact, occur. That is, this flexibility might actually increase the possibility for fragmentation of habitat, or result in greater impacts to other resource values and uses.

- The prioritization of development in SEZs could limit some environmental impacts. These areas were selected as lands best suited for utility-scale solar development (i.e., lands with fewer potential resource conflicts). Although some potentially significant resource and resource use conflicts have been discovered for some SEZs, SEZ-specific design features have been identified to address those potential impacts. The concentration of development in the SEZs could also allow for the consolidation of related infrastructure (e.g., roads, transmission lines) and less total land disturbance.[8]

- Proposed adaptive management strategies would ensure that new data and lessons learned about the impacts of solar energy development are incorporated into future programmatic and project-specific requirements. At the project level, developers would be required to develop monitoring programs in coordination with the BLM to evaluate the environmental conditions at the site through all phases of development, to establish metrics against which monitoring observations could be measured, to identify potential mitigation measures, and to establish protocols for incorporating monitoring observations and new mitigation measures into standard operating procedures.

- Implementing a comprehensive program would allow the BLM to better assess potential cumulative impacts of solar energy development across the six-state study area over time.

- A program that would facilitate solar energy development on BLM-administered lands would ensure that the development would be subjected

[8] Based on the potential conflicts identified, some of the proposed SEZ areas may be reduced in size or eliminated entirely when the final SEZs are identified in the ROD for this PEIS.

to rigorous environmental review, including a thorough public involvement process.

Table 6.1-2 includes a summary the environmental impacts associated with solar energy development under this alternative and the ways in which the impacts would be mitigated by the programmatic exclusions, policies and design features. As reflected in that table, for several resource and impact areas, implementation of the proposed design features is expected to ensure that impacts would be negligible or minor. For certain resource areas (e.g., hazardous materials and waste, health and safety), there are few, if any, unique site- or project-specific issues that would not be fully addressed by the programmatic requirements. For other resource areas (e.g., lands and realty, rangeland resources, military and civilian aviation, geologic setting and soils, mineral resources, air quality, acoustic environment, paleontological resources, transportation), the programmatic requirements are comprehensive and broad enough to address most issues even though there could be some site- and project-specific variables. For example, although paleontological resources vary in occurrence and density by site, impacts on these resources can be mitigated and the design feature requiring a paleontological resources management plan would ensure potential impacts are identified and addressed. Similarly, although traffic patterns and local road use vary by location, the design features requiring development of a transportation plan and traffic management plan would ensure local issues are identified and addressed.

For other resource and impact areas, the full effectiveness of the proposed design features intended to reduce potential impacts can be assessed only through the additional project-specific analyses that would be required under the proposed program. These areas include specially designated areas and lands with wilderness characteristics, recreation, water resources, vegetation, wildlife and aquatic biota, special status species, visual resources, cultural resources, Native American concerns, and environmental justice. For example, the magnitude of potential impacts of a given project on water resources would depend on project-specific parameters and site-specific conditions. The water requirements would depend on the size of the project and the technology used (e.g., concentrating solar power [CSP] versus photovoltaic [PV], wet cooling versus dry cooling systems). The nature of the impacts would depend on the amount of locally and regionally available water resources; the source of water supply; and other water uses, including requirements to support sensitive species and/or their critical habitats. These types of impacts cannot be assessed fully until project and site specific information is known.

BLM's intent in identifying SEZs was to find areas well suited to utility-scale solar energy production, with few impediments to solar facility construction and operation, where BLM would prioritize solar energy and associated transmission infrastructure development. In identifying the 24 SEZs evaluated in this PEIS, the BLM targeted areas with low slope, near existing transmission or designated corridors and near existing roads, and with a minimum area of 2,500 acres (10 km^2). The BLM also excluded from the SEZs NLCS lands and other sensitive classes of lands (e.g., critical and sensitive habitat, ACECs, no surface occupancy areas, wilderness characteristic areas, SRMAs, ROW exclusion and avoidance areas, National Historic and Scenic Trails, areas of Tribal concern, and the like; see Table 2.2-2).[9]

Through the in-depth SEZ analyses presented in Chapters 8 through 13, the BLM discovered some potentially significant impacts on various resources and resource uses that could result from solar energy development in the proposed SEZs. The implementation of programmatic policies and design features required as part of this alternative could help to minimize environmental impacts in the SEZs. In addition, the BLM has proposed SEZ-specific design features that would further avoid and/or minimize potential impacts in these areas. These additional requirements would reduce the amount of developable land within some SEZs. The extent to which these impacts potentially would limit the amount of land available for development within each SEZ is provided in Table 6.1-3.

As discussed in Section 5.11.4, utility-scale solar energy development could result in reduced emissions of greenhouse gases (GHGs) and combustion-related pollutants, if the development offsets electricity generation by fossil fuel power plants. As discussed in Section 6.1.2, the pace of solar energy development is expected to be faster under this alternative, compared to the current pace, and therefore the potential beneficial impacts of reduced GHG emissions may be realized at a faster rate.

As a result of these considerations, the BLM anticipates that by implementing the proposed program administration and authorization policies and design features identified in the PEIS, the agency would maximize its ability to effectively identify and avoid, mitigate, or minimize potential adverse environmental impacts.

6.1.3 Minimize Social and Economic Impacts

Utility-scale solar energy development under this alternative is expected to result primarily in economic benefits in terms of both jobs and income created (see Section 5.17.2). These benefits would occur as both direct impacts, resulting from the wages and salaries, procurement of goods and services, and collection of state sales and income taxes, and indirect impacts, resulting from new jobs, income, expenditures, and tax revenues subsequently created as the direct impacts circulate through the economy. These benefits occur during both the construction and operations phases, with the construction phase benefits being temporary and the operations phase benefits being more long term. The specific benefits vary by technology, because some technologies generate more jobs than other technologies. For example, a 100-MW parabolic trough facility would create 350 new direct construction jobs and 43 new direct operations jobs, whereas a PV facility of comparable generation capacity would create 30 new direct construction jobs and very few direct operations jobs (see Tables 5.17.2-1 through 5.17.2-4 for detailed information about the economic impacts of construction and

[9] Although these classes of lands should have been excluded from the proposed SEZs, some may not have been because of incomplete information on the locations of these areas and incomplete GIS data.

operation of solar energy facilities by technology type).[10] The benefits in terms of indirect jobs and total income also vary by state, because the extent of in-state spending and economic multiplier effects vary by state.

Because utility-scale solar energy development would be accompanied by transmission system development and new access road construction in many locations, potential economic benefits also result from the direct and indirect jobs associated with this infrastructure construction. These impacts are discussed in Section 5.17.1.2.

The BLM would incur agency-related costs associated with developing, implementing, and managing solar energy development on BLM-administered lands. However, under the BLM's ROW program, which is a cost recovery program, a substantial portion of the costs for processing ROW applications, including environmental review requirements, would be paid for by developers. In addition, as discussed in Section 5.17.2, the Federal Government will collect income from ROW rental payments, which include an acreage component and capacity fee component (see Tables 5.17.2-1 through 5.17.2-4). As discussed in Section 2.2.2.2, the BLM anticipates that it may offer lands within the proposed SEZs through a competitive process. In areas where this is implemented, the revenue to the Federal Government likely would be higher than in other areas. A competitive process, however, could increase costs for developers of solar facilities.

As discussed in Section 5.17.1.1, there may be some adverse economic impacts to displaced public land users associated with solar development (e.g., loss of grazing allotments). There may also be adverse social impacts resulting from changes in recreation, property values, and environmental amenities (e.g., environmental quality, rural community values, or cultural values). There could also be beneficial social impacts associated with solar development resulting from economic growth and a positive reception to the presence of a renewable energy industry. At the programmatic level, it is difficult to quantify these impacts.

6.1.4 Provide Flexibility to Solar Industry

By making a relatively large amount of land available for utility-scale solar ROW applications, particularly when compared to the amount of land that would be needed to support the projected RFDS, this alternative provides a great degree of flexibility in identifying appropriate locations for utility-scale development (i.e., economically attractive locations with minimal environmental or cultural resource conflicts).

However, concerns exist that by excluding lands with slopes greater than or equal to 5% and with solar insolation levels below 6.5 kWh/m^2/day, the BLM could be removing lands that some developers may find both technically and economically feasible to pursue in the future.

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[10] The estimate provided in the text here for number of PV construction jobs is based on an extrapolation of data in Table 5.17.2-4.

6.1.5 Optimize Existing Transmission Infrastructure and Corridors

By making a relatively large amount of land available for utility-scale solar ROW applications, developers could identify and propose projects that optimize existing transmission infrastructure and designated transmission corridors. As discussed in Appendix G, an analysis of the extent to which the lack of transmission access could constrain solar energy development on lands that would be made available for ROW application under this application indicated that the majority of these lands are within 25 mi (40 km) of existing transmission lines or designated corridors.

Although it is likely that most new utility-scale solar energy development will require new transmission capacity, projects that can be located near existing transmission lines would incur fewer environmental impacts associated with connecting to and upgrading the existing lines. Similarly, solar projects that utilize existing corridors would incur reduced environmental impacts, assuming the designation process factored potential environmental and other siting concerns into the corridor alignment. The use of existing transmission infrastructure and corridors could also reduce cost, time, and controversy.

6.1.6 Standardize and Streamline the Authorization Process

The new program would standardize requirements and reduce uncertainty for project applications. It would streamline project review and approval processes, and ensure consistency in the way utility-scale ROW applications are managed. Individual ROW applications would continue to be evaluated on a project-by-project basis; however, the BLM proposes that these evaluations would tier to the programmatic analyses presented in the PEIS and the decisions implemented in the resultant ROD and land use plan amendments to the extent appropriate.

6.1.7 Meet Projected Demand for Solar Energy Development

On the basis of the RFDS for solar energy development (which is assumed to be largely the same for each alternative), the estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period (through approximately 2030) is about 24,000 MW, with a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands. As shown in Table 6.1-4, the BLM-administered lands that would be available for ROW application under the solar energy development program alternative, approximately 22 million acres (87,336 km^2), far exceed the amount of land that would be developed under the RFDS in each of the six states. The BLM recognizes that it is likely that the 22 million acres (87,336 km^2) includes some lands where development would conflict with existing resources or resource uses, so that the actual amount of lands available for utility-scale solar energy under this alternative would be something less than 22 million acres (87,336 km^2). The extent to which this is the case cannot be assessed at this time; however, it is likely that the actual amount of developable lands would easily accommodate the level of development projected by the RFDS.

TABLE 6.1-4 Percentage of Available Lands Developed by BLM Action Alternatives Based on Estimated Acres Developed under RFDS

State	Estimated Acres[a] Developed under RFDS[b]	Solar Energy Development Program Alternative		SEZ Program Alternative	
		Total Proposed Acres[a] Available[c]	Percentage Developed under RFDS	Total Proposed Acres[a] Available[d]	Percentage Developed under RFDS
Arizona	21,816	4,485,944	0.5	13,735	100[e]
California	138,789	1,766,543	7.9	339,090	40.9
Colorado	19,746	148,072	13.3	21,050	93.8
Nevada	15,309	9,084,050	0.2	171,265	8.9
New Mexico	7,497	4,068,324	0.2	113,052	6.6
Utah	10,971	2,028,222	0.6	19,192	57.2
Total	214,119	21,581,154	1.0	677,384	31.6

[a] To convert acres to km^2, multiply by 0.004047.

[b] See Table 2.4-1 for basis for these estimates.

[c] See Section 2.2.2.2 for basis for these estimates.

[d] See Section 2.2.2.3 for basis for these estimates. For the purpose of the RFDS estimates of development, the entire acreage is used in the calculation of percentage developed; however, some portion will not be developable because of various restrictions.

[e] The estimated number of acres developed based on the RFDS projection exceeds the acreage proposed to be available in Arizona under the SEZ program alternative, so it is assumed that 100% of the SEZs would be developed over the 20-year time line assessed in this PEIS.

6.2 IMPACTS OF THE SEZ PROGRAM ALTERNATIVE

Under the SEZ program alternative, the BLM would adopt the same set of standard program administration and authorization policies and design features for utility-scale solar energy development as proposed under the solar energy development program alternative, but would authorize such solar energy development only in SEZs. Unlike the solar energy development program alternative, lands outside of SEZs would be excluded from utility-scale solar energy ROW applications. Under this alternative, about 677,400 acres (2,741 km^2) of BLM-administered lands would be available for ROW applications. As discussed in Section 2.2.2.2, in the future, based on lessons learned from individual projects and/or new information (e.g., ecoregional assessments), the BLM could decide to expand, add, remove, or reduce SEZs. Changes to SEZs would have to go through a land use planning process, which would be subject to the appropriate environmental analysis.

Under the SEZ program alternative, the management of solar energy development on BLM-administered lands would be the same as described for the solar energy development program alternative. The BLM would establish comprehensive program administration and authorization policies and design features as part of this alternative. The elements of the BLM's new program under this alternative would be implemented through amendment of the land use plans within the six-state study area.[11]

The following subsections discuss the effectiveness of the SEZ program alternative in meeting the BLM's established program objectives and describe the potential environmental impacts of the alternative.

6.2.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

The impacts on the pace of development under this alternative would be much the same as those described for the solar energy development program alternative in Section 6.1.1; although it is possible, this alternative could speed up the pace of development even further. Elements of the new program would reduce the amount of time and resources required to obtain ROW authorizations, and this would translate into reduced costs to government, developers, and stakeholders. As with the solar energy development program alternative, these outcomes would likely increase the agency's ability to meet the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.2.2 Minimize Environmental Impacts

Similar to the solar energy development program alternative, environmental impacts under the SEZ program alternative would be minimized in the following ways:

- Government-to-government consultation and public input would ensure thorough review of the proposed locations of development within SEZs.

- Because the developable land area for utility-scale solar energy development would be restricted to SEZs, known sensitive resources would be avoided for the most part, SEZ-specific design features would protect any sensitive resources identified in SEZs, and uncertainty of the distribution of impacts, including possible fragmentation of habitat, would be reduced.

- The proposed design features listed in Appendix A, Section A.2, would address the full array of potential impacts associated with each phase of development.

- The concentration of development in the SEZs could allow for the consolidation of related infrastructure (e.g., roads, transmission lines) and less total land disturbance.

[11] See footnote 6.

- The requirement to implement adaptive management strategies would ensure that mitigation measures would be implemented if unforeseen impacts were identified during project planning, construction, or operations.

- Because of the proximity of solar development projects that could occur under the SEZ program alternative, cumulative impacts for some resources (e.g., water, visual, socioeconomics) in localized areas around the SEZs could be high; however the certainty of this location may allow these impacts to be more easily addressed. An analysis of the potential cumulative impacts for each SEZ is included in Chapters 8 through 13.

By making 677,400 acres (2,741 km^2) of land available for ROW application, the BLM would limit opportunities to site solar energy projects on lands that have been previously disturbed or developed.

Table 6.1-2 summarizes the environmental impacts that might be associated with solar energy development under this alternative and the extent to which the impacts would be mitigated by the programmatic exclusions, policies, and design features. As reflected in that table, it is not possible to fully assess the impacts on some resources (e.g., specially designated areas and lands with wilderness characteristics, recreation, military aviation, water resources, vegetation, wildlife and aquatic biota, special status species, visual resources, cultural resources, Native American concerns, and environmental justice), because they are dependent on specific project details not defined at the programmatic level. However, this type of analysis would be done thoroughly through additional project-specific analyses that would be required under the proposed program.

Table 6.1-3 summarizes the potentially significant impacts on some resources and resource uses from solar energy development in the SEZs; these are discussed in detail in Chapters 8 through 13. The implementation of program administration and authorization policies and design features as part of this alternative would minimize environmental impacts of development in the SEZs, although the SEZ-specific design features would also reduce the amount of land within some SEZs that could be developed.[12]

The BLM anticipates that by implementing the proposed policies and design features identified in the PEIS, the agency would maximize its ability to effectively identify and avoid, mitigate, or minimize potential adverse environmental impacts.

6.2.3 Minimize Social and Economic Impacts

The potential socioeconomic impacts of this alternative would be similar to those described in Section 6.1.3 for the solar energy development program alternative; however, both

[12] Based on the potential conflicts identified, some of the proposed SEZ areas may be reduced in size or eliminated entirely when the final SEZs are identified in the ROD for this PEIS.

the economic benefits and the potential adverse economic and social impacts would be concentrated solely in the vicinity of the SEZs.

The BLM's efforts to oversee utility-scale solar energy development in the six-state study area would be streamlined under the SEZ program alternative by virtue of the smaller geographic area and the opportunities for tiering to the SEZ-specific analyses provided in this PEIS. In addition to receiving ROW rental payments, the BLM would have the opportunity to offer lands within the SEZs through competitive processes and maximize the revenue to the Federal Government.

6.2.4 Provide Flexibility to Solar Industry

By making fewer BLM-administered lands available for utility-scale solar energy development, however, the SEZ program alternative might reduce the flexibility of both the agency and developers in terms of identifying appropriate locations for utility-scale development. There are likely to be economically attractive sites for solar energy development outside of the SEZs that can meet the environmental protection measures outlined in the PEIS. It is important to note however, that the BLM may identify additional SEZs in the future on the basis of lessons learned from individual projects and/or new information and, in doing so, the agency could increase the amount of land available for ROW application if needed to support solar energy development in specific areas of interest to industry. The BLM could also decide to amend individual land use plans to accommodate individual solar energy development projects if warranted.

6.2.5 Optimize Existing Transmission Infrastructure and Corridors

All of the SEZs are located near existing transmission lines and/or corridors, and development in the SEZs would optimize their use. However, as discussed in Section 6.1.5, there are many potentially suitable development areas for utility-scale solar outside the SEZs that are proximate to existing transmission infrastructure, and these lands would not be available for development under this alternative.

As discussed in Section 6.1.5, while most new utility-scale solar energy development will require new transmission capacity, projects that can be located near existing transmission lines would incur fewer environmental impacts associated with connecting to and upgrading the existing lines. Similarly, solar projects that utilize existing corridors would incur reduced environmental impacts, assuming the designation process factored potential environmental and other siting concerns into the corridor alignment. The use of existing transmission infrastructure and corridors could also reduce cost, time, and controversy.

6.2.6 Standardize and Streamline the Authorization Process

The new program would standardize requirements and reduce uncertainty for project applicants. It would streamline project review and approval processes and ensure consistency in the way utility-scale ROW applications are managed. Because this alternative would limit utility-scale development to those areas most intensively studied in this PEIS, it is likely that BLM staff efforts to review and approve ROW applications would be most efficient under this alternative.

6.2.7 Meet Projected Demand for Solar Energy Development

Assuming that all the lands within the SEZs could be developed, the amount of lands available for development (677,400 acres [2,741 km^2]) would be about 3% of the amount of lands that would be available under the solar energy development program alternative (22 million acres [87,336 km^2]). Across all six states, the lands available within the SEZs would be three times the amount of land required to support the RFDS projected development of 24,000 MW (214,000 acres [866 km^2]). However, as shown in Table 6.1-4, in at least two states (Arizona and Colorado), the amount of land that would be available for ROW application may not be enough to support the total state-specific development projected in the RFDS. Specifically, in Arizona, the RFDS development would require 21,816 acres (88.3 km^2), which exceeds the 13,735 acres (55.6 km^2) that would be available under the SEZ program alternative. In Colorado, 19,746 acres (80 km^2) would be developed under the RFDS which constitutes almost 94% of the 21,050 (85.2 km^2) acres that would be available.

Additionally, constraints on development within some SEZ areas are known to exist; these constraints are summarized in Table 6.1-3 and discussed in greater detail in each of the SEZ-specific analyses presented in Chapters 8 through 13. The SEZ-specific analyses identified distinct areas within many of the SEZs that either should not be developed or should have development restrictions (e.g., areas with ephemeral stream channels or floodplains, areas with military flight restrictions for facilities with tall structures, areas with potential visual resource conflicts, areas close to residences for noisy technologies). And it is recognized that some SEZ areas will likely require additional exclusions or restrictions, the extent of which may not be known until site- and project-specific environmental analyses can be completed. Given these factors, it is possible that the amount of lands that would be available under the SEZ program alternative might not be enough to support full development of the RFDS in states other than Arizona and Colorado. In particular, this is may be true for California, where the RFDS would require 41% of the available lands if all the lands in the SEZs were developable, and SEZ-specific analyses have shown that substantial portions of the SEZs would likely have development restrictions (see Chapter 9). The full development scenario under the RFDS for the state of Utah would require 57% of the total land available in Utah SEZs, so if additional restrictions on development within the Utah SEZs are identified, it is also possible that the SEZs would not adequately support solar energy development in that state over the 20-year study period.

Because this alternative may not make an adequate amount of lands available to support the RFDS projections, at least in some states, it is possible that the total amount of utility-scale solar energy developed on BLM-administered lands over the 20-year study period could be constrained unless the BLM identified additional SEZs.

6.3 IMPACTS OF THE NO ACTION ALTERNATIVE

Under the no action alternative, solar energy development would continue on BLM-administered lands in accordance with the terms and conditions of the existing Solar Energy Policies (BLM 2007; 2010a,b). The BLM would not implement a comprehensive program to provide guidance to BLM field staff, developers, and other stakeholders in the six-state study area. Specifically, the required program administration and authorization policies and design features, and land use plan amendments proposed in this PEIS would not be implemented. Future solar energy projects and land use plan amendments would continue to be evaluated solely on an individual, case-by-case basis.

The following subsections discuss the effectiveness of the no action alternative in meeting the BLM's established program objectives.

6.3.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

The pace of solar energy development on BLM-administered lands would not be enhanced by the no action alternative:

- Developers and stakeholders would not have clear direction from the BLM as to which lands (other than NLCS lands) would be excluded from or, conversely, available for utility-scale solar development and thus could spend time and resources investigating inappropriate locations.

- There would be no programmatic evaluation of solar energy development to which individual project analyses could tier, thereby requiring each project review to evaluate the entire suite of environmental, cultural, and socioeconomic impact issues, including those that have no site- or project-specific aspects, at an individual, detailed level.

- There would be no comprehensive design features to implement. BLM field staff, developers, and stakeholders would be required to identify and evaluate the effectiveness and appropriateness of potential mitigation measures on a case-by-case basis.

- The BLM would not identify SEZs to facilitate and prioritize utility-scale solar energy development in those areas well-suited for such development and where potential resource conflicts have been identified.

- As necessary, individual land use plans would have to be amended for individual projects as a part of the project evaluation and approval, which could delay the process.

The extended development time lines likely to result under the no action alternative could jeopardize developers' business agreements, potentially putting any given project at risk of abandonment. In addition, extended time lines could increase the costs for all concerned parties, including the government, developers, and stakeholders. Furthermore, developers could elect to avoid delay and uncertainty by shifting their projects to state, Tribal, and private land with potentially less federal environmental oversight (Section 6.3.2). If this shift were to occur, resulting in less development of solar energy on BLM-administered lands, this outcome would be in conflict with the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.3.2 Minimize Environmental Impacts

In general, direct and indirect environmental impacts associated with individual utility-scale solar energy projects under the no action alternative could be similar to those under the proposed action alternatives (see Sections 6.1.2 and 6.2.2), because the BLM is required to identify and address environmental impacts of all ROW authorizations and conform to existing land use plan decisions. However, under the no action alternative, the benefits of reducing the potential for environmental impacts by excluding utility-scale development from lands with slopes less than 5%, lands with solar insolation levels greater than or equal to 6.5 kWh/m^2/day, and lands where sensitive resources are present might not be fully realized. In addition, without comprehensive guidance on impact mitigation, the potential for field staff to require different mitigation measures from project to project would be high. Lack of consistency could translate into inadequate mitigation of impacts for some projects and overly onerous mitigation requirements for other projects. Furthermore, adaptive management strategies regarding solar energy development, associated impacts, and effective mitigation measures that would be integrated over time as suggested under the action alternatives would not be necessarily be part of the no action alternative.

Table 6.1-2 summarizes the environmental impacts that might be associated with solar energy development under this alternative. As reflected in that table, the no action alternative would do little to avoid impacts on sensitive resources, resource uses, and special designations by way of programmatic exclusions. Instead, BLM field staff would be required to review applications to ensure that these areas are properly addressed.

If the absence of a comprehensive program were to result in delays in processing ROW applications on BLM-administered lands or in increases in the cost of developing solar power on BLM-administered lands, developers could respond by focusing their development efforts on state-owned, Tribal, and private lands. While solar energy development on nonfederal lands is subject to a wide array of environmental reviews and approvals by virtue of state and local permitting processes, it may not be subject to NEPA requirements if federal funding or permitting is not required for the project.

In terms of the potential beneficial impacts of utility-scale solar energy development in offsetting the emissions of greenhouse gases and combustion-related pollutants from fossil fuel energy sources, if the pace of solar energy development is slower under the no action alternative, these benefits would be realized at a slower rate.

Maintaining access to the 99 million acres (400,000 km^2) of land currently available for ROW application would maximize opportunities to site solar energy projects on lands that have been previously disturbed or developed.

6.3.3 Minimize Social and Economic Impacts

If the pace of utility-scale solar energy development under the no action alternative were slower than under the action alternatives, there could be a delay in the economic benefits from the development in the six-state study area, in terms of direct and indirect jobs created and income in the communities.

Under the no action alternative, the BLM will not be able to conduct competitive leasing as easily as it might under the proposed action alternatives. As a result, potential revenues to the government related to utility-scale solar energy development on BLM-administered lands may be lower under this alternative.

In addition, it is anticipated that the no action alternative would cause BLM staff to spend additional time and resources on the reviews and approvals of utility-scale ROW applications, and this will incur greater costs to the agency and the applicants. Developers might propose projects in inappropriate locations, opportunities to tier analyses from this programmatic evaluation would not exist, and ROW authorizations would require individual land use plan amendments.

6.3.4 Provide Flexibility to Solar Industry

The relatively large amount of land available for utility-scale ROW applications under the no action alternative, particularly when compared to the amount of land that would be needed to support the projected RFDS, provides a great degree of flexibility in identifying appropriate locations for utility-scale development (i.e., economically attractive locations with minimal environmental or cultural resource conflicts). However, under the no action alternative, programmatic guidance would not be provided to developers with respect to lands and projects that ultimately may not be approvable by the BLM.

6.3.5 Optimize Existing Transmission Infrastructure and Corridors

The relatively large amount of land available for utility-scale ROW applications under the no action alternative provides a great degree of flexibility in identifying locations for utility-scale development that optimize existing transmission infrastructure and designated transmission corridors. However, under the no action alternative, little guidance would be provided to developers with respect to lands and projects that ultimately may not be approvable by the BLM.

6.3.6 Standardize and Streamline the Authorization Process

Under the no action alternative, the BLM would not implement a comprehensive program to standardize and streamline the agency's review and approval of utility-scale solar energy ROW authorizations that would include program administration and authorization policies and design features and land use plan amendments. The BLM would continue to address issues as they arise through individual policy statements and guidance.

6.3.7 Meet Projected Demand for Solar Energy Development

Lands currently off-limits to development (i.e., the NLCS lands identified in Section 6.1) would continue to remain off-limits and would not be available for ROW application. Applications for utility-scale solar development would be accepted in all other areas and reviewed in the context of existing land use plan decisions. Under the no action alternative, approximately 99 million acres (400,000 km^2) of BLM-administered lands could be considered for ROW application. This amount of land is several orders of magnitude greater than the amount of land likely to be developed on the basis of the RFDS projections (214,000 acres [866 km^2]), although ROW applications likely would not be approved on a large percentage of these lands because of conflicts with known resources, resource uses, and existing special designations.

6.4 COMPARISON OF ALTERNATIVES AND SELECTION OF PREFERRED ALTERNATIVE

This section provides a comparison of the alternatives evaluated in this PEIS on the basis of the evaluations presented in Sections 6.1 through 6.3. The comparison is included to support the BLM's decision regarding which alternative presents the best management approach to utility-scale solar energy development on BLM-administered lands based on the stated objectives. Table 6.4-1 provides a summary-level comparison of the management alternatives with respect to the objectives established for the action and the extent to which each alternative would assist the BLM in meeting the projected demands for solar energy development as estimated by the RFDS.

The BLM has selected the solar energy development program alternative as the preferred alternative for the purposes of the draft PEIS. On the basis of the comparisons presented in Table 6.4-1, it appears that the solar energy development program alternative would best meet the BLM's objectives for managing utility-scale solar energy development on BLM-administered lands. It would likely result in the highest pace of development at the lowest cost to the government, developers, and stakeholders. Simultaneously, it would provide a comprehensive approach for ensuring that potential adverse impacts would be minimized to the greatest extent possible. If the pace of development is greatest under this alternative, it would accelerate the rate at which the economic benefits would be realized at the local, state, and regional levels. This alternative would make an adequate amount of lands available to support the level of development projected in the RFDS and would provide a great deal of flexibility in siting both

TABLE 6.4-1 Comparison of BLM's Alternatives with Respect to Objectives for the Agency's Action

Objective	Solar Energy Development Program Alternative	SEZ Program Alternative	No Action Alternative
Facilitate near-term utility-scale development on public land	Increased pace of development Development in the prioritized SEZs likely to occur at an even faster pace Reduced costs to the government, developers, and stakeholders Effective in assisting BLM in meeting its mandates[a]	Increased pace of development likely due to detailed analyses of SEZs Reduced costs to the government, developers, and stakeholders Effective in assisting BLM in meeting its mandates[a]	No discernible effect on pace of development Development could shift toward nonfederal lands, making it more difficult for BLM to achieve its mandates[a]
Minimize potential environmental impacts	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Protection of resources, resource uses, and special designations through combination of exclusions and mitigation Prioritization of development in SEZs, which were identified as lands well-suited for solar energy development where potential resource conflicts have been identified and appropriate mitigation has been suggested Potentially would allow a greater degree of development on previously disturbed lands	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Development limited to the SEZs, protecting more resources, resource uses, and special designations through avoidance Additional mitigation required in SEZs Limits possibilities for focusing development to previously disturbed lands outside SEZs	Environmental impacts evaluated project-by-project with potential for inconsistencies in the type and degree of required mitigation If development shifts to nonfederal lands, it would be subject to less federal environmental oversight and public involvement Potentially would allow a greater degree of development on previously disturbed lands

TABLE 6.4-1 (Cont.)

Objective	Solar Energy Development Program Alternative	SEZ Program Alternative	No Action Alternative
Minimize potential social and economic impacts	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the Federal Government Prioritization of development in the SEZs, could concentrate benefits in a smaller number of local economies Potential adverse and beneficial social impacts	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the Federal Government With development limited to the SEZs, benefits would be concentrated in a smaller number of local economies Potential adverse and beneficial social impacts	Potential economic benefits essentially the same as under the action alternatives, although realized at a slower rate if pace of development is slower Less potential for these benefits to be concentrated in specific areas
Provide flexibility to solar industry	A great degree of flexibility in identifying appropriate locations for utility-scale development	Limited flexibility in identifying appropriate locations for utility-scale development	Maximum degree of flexibility in identifying appropriate locations for utility-scale development Limited guidance to developers on which lands and projects would ultimately be approvable
Optimize existing transmission infrastructure and corridors	Opportunities for developers to identify and propose projects that optimize existing transmission infrastructure and/or designated corridors	Opportunities for developers to identify and propose projects that optimize existing transmission infrastructure and/or designated corridors limited to SEZs Opportunities to consolidate infrastructure required for new solar facilities	Maximum opportunities for developers to identify and propose projects that optimize existing transmission infrastructure and/or designated corridors

TABLE 6.4-1 (Cont.)

Objective	Solar Energy Development Program Alternative	SEZ Program Alternative	No Action Alternative
Standardize and streamline authorization process	Streamlining of project review and approval processes; more consistent management of ROW applications With prioritization of development in the SEZs, additional streamlining of opportunities over development on other available lands	Streamlining of project review and approval processes; more consistent management of ROW applications	No discernible effect in terms of standardizing and streamlining the authorization process
Meet projected demand for solar energy development as estimated by the RFDS	About 22 million acres[b] available for ROW application, which is more than adequate to support the RFDS projected level of development	Less than 677,400 acres available for ROW application, which may not be enough land to support the RFDS projected level of development in some states BLM identification of additional SEZs in the future would make additional land available but would require additional environmental review and land use plan amendments	About 99 million acres available for ROW application, which is more than adequate to support the RFDS projected level of development

[a] These mandates are established by the Energy Policy Act of 2005 (P.L. 109-58) and Secretarial Order 3285A1 (Secretary of the Interior 2010) (see Section 1.1).

[b] To convert acres to km^2, multiply by 0.004047.

solar energy facilities and associated transmission infrastructure. In addition, the solar energy development program alternative would be very effective at facilitating development on BLM-administered lands in accordance with the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.5 CUMULATIVE IMPACTS

This cumulative impact assessment describes how the environmental, social, and economic conditions within the six-state study area may be incrementally impacted over the next 20 years by utility-scale solar energy development that is likely to take place on BLM-administered lands consistent with the proposed action. The Council on Environmental Quality (CEQ), in its regulations implementing the procedural provisions of NEPA (40 CFR 1500-1508), defines cumulative effects as follows:

> ...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7).

The discussion of cumulative impacts in this chapter describes the impacts of solar energy development in the context of other activities that also could impact environmental resources over the next 20 years. Cumulative impact analyses have also been developed for individual SEZs as part of Chapters 8 through 13. The SEZ-specific cumulative impact analyses evaluate the impacts of a maximum development scenario for each SEZ, regardless of the state-specific RFDS projections, at a level of detail suitable for supporting analyses of specific projects proposed within and near the SEZs.

The cumulative analysis in this chapter encompasses the same resources analyzed in Chapter 5 and considers the impacts that could occur as a result of solar energy development over the next 20 years assuming that the proposed policies and design features common to both action alternatives are adopted. Individual projects will include a comprehensive, on-going environmental monitoring component to evaluate environmental conditions and adjust impact mitigation requirements as necessary. As a result, the BLM's Solar Energy Program would be expected to continue to provide needed impact mitigation over time, consistent with an adaptive approach.

The scope of the cumulative impact analysis in this chapter assumes solar energy development at the level projected in the RFDS. Potential differences in cumulative impacts between alternatives are highlighted as appropriate. In applying the RFDS to all alternatives, the following caveats must be considered.

As discussed in Section 6.2, there is the possibility that the total level of development could be curtailed under the SEZ program alternative, at least in some states, because this alternative may not make enough lands available for ROW application. The extent to which this might occur cannot be quantified at least in part because the BLM might identify additional

SEZs in the future to make more land available. Furthermore, because the RFDS is based on the state-specific renewable portfolio standards (RPSs), which are mandatory in each of the six states except Utah, it was assumed that development that does not occur on BLM-administered lands for various reasons would be made up for by development on non-BLM-administered lands within each state.

As discussed in Section 6.3, the no action alternative would make ample lands available for ROW application to support the projected RFDS development levels. Although this alternative would not likely enhance the pace of utility-scale development over the next 20 years (see Section 6.3.1), the extent to which development would occur cannot be quantified. As with the SEZ program alternative, under the no action alternative solar development that did not occur on BLM-administered lands was assumed to be made up for by development on non-BLM-administered lands.

By restricting and/or prioritizing development in the SEZs under the two action alternatives, cumulative impacts may be more concentrated and/or severe within individual SEZs than described in this section. On the other hand, the concentration of development in the SEZs may also allow for the consolidation of related infrastructure (e.g., roads, transmission lines) and less total land disturbance. Cumulative impacts analyses for individual SEZs are presented in Chapters 8 through 13.

An overview of ongoing and reasonably foreseeable future activities in the six-state study area is presented in Section 6.5.1, including energy production and distribution (Section 6.5.1.1), and other activities such as recreation, mineral production, military operations, grazing and rangeland management, fire management, forestry, transportation, and industrial development (Section 6.5.1.2.1). General trends in population growth, energy demand, water availability, and climate change are discussed in Section 6.5.1.2.2. Cumulative impacts for the resource areas are discussed in Section 6.5.2.

6.5.1 Overview of Activities in the Six-State Study Area

Activities in the six-state study area considered in the cumulative impact analysis include projects, actions, and trends that could affect human and environmental receptors within the defined regions of influence and the defined 20-year time frame. Tables 6.5-1 and 6.5-2 present the types of future actions and trends that have been identified in the study area as part of the cumulative impact analysis. Programmatic-level actions on federal lands are presented in Table 6.5-3; these include actions that have been approved and are under way, and those that are still in the planning stages.

TABLE 6.5-1 Types of Actions in the Six-State Study Area

Type of Actions	Associated Activities and Facilities
Oil and gas production	*Exploration and development* Geophysical seismic surveys Access roads and well pads Well drilling and construction Pipeline and utility corridors Gas compressor stations and oil production batteries Site reclamation and rehabilitation Spills/releases
	Production Production and processing plants Refineries Carrier pipelines Spills/releases Power plants Access roads
	Oil shale mining and processing Surface mines Underground mines In situ retorting Processing plants (rock crushing and retorting) Refineries Solid waste (overburden, waste rock, spent shale, and tailings) Site reclamation and rehabilitation
	Tar sands mining and processing Surface mines Underground mines In situ recovery (e.g., steam injection) Extraction plants Solid waste (overburden, waste sand, spent sand, tailings) Refineries Site reclamation and rehabilitation
Coal production	*Exploration and development* Exploratory drilling and trenching Access roads and helipads
	Production Surface mines Underground mines Access roads Processing (beneficiation) plants Transportation (e.g., railroads) Solid waste (overburden, waste rock, and tailings) Site reclamation and rehabilitation

TABLE 6.5-1 (Cont.)

Type of Actions	Associated Activities and Facilities
Coal production *(Cont.)*	*Electricity generation* Construction Operations Decommissioning
Nuclear electricity generation	*Uranium exploration and production* Exploration Mining and milling Access roads Transportation (e.g., railroads) Solid waste (overburden, waste rock, and tailings) Leachate mining wastes Site reclamation and rehabilitation
	Electricity generation and transmission Construction Operations Decommissioning
Renewable energy development	*Wind energy* Installation of meteorological towers Access roads Installation and operation of turbine towers Electrical collector lines, transformers, and substations Transmission interties Ancillary facilities (e.g., control building and sanitary facilities) Site reclamation and rehabilitation
	Geothermal energy Geophysical gravity, seismic, and temperature well surveys Access roads Well drilling and construction Power plants Pipeline and transmission interties Solid waste Hydrogen sulfide recovery and recycling Site reclamation and rehabilitation
	Hydropower Generating stations Dam or diversion structures Access roads Electrical substations and transformer pads Transmission interties Ancillary facilities (e.g., control building and sanitary facilities)

TABLE 6.5-1 (Cont.)

Type of Actions	Associated Activities and Facilities
Renewable energy development *(Cont.)*	*Solar energy* Vegetation clearing and excavation Construction of solar collectors Generation facilities Access roads Electrical substations and transformer pads Transmission interties Ancillary facilities (e.g., control building and sanitary facilities) Site reclamation and rehabilitation
	Biomass resources Feedstock cultivation and harvesting Power plants Ethanol and biodiesel facilities Biogas facilities Access roads Electrical substations and transformer pads Transmission interties Ancillary facilities (e.g., control building and sanitary facilities) Site reclamation and rehabilitation
	Mandatory renewable portfolio standards
Transmission and distribution systems	*Utility corridors* Carrier pipelines Oil and gas pipelines Fuel transfer stations Spills/releases Transmission lines Substations Access roads
Recreation	Visiting scenic and historic places Cross-country and downhill skiing Hunting and fishing ATV use Horseback riding Camping, hiking, and picnicking Viewing wildlife Rock climbing River rafting Driving for pleasure

TABLE 6.5-1 (Cont.)

Type of Actions	Associated Activities and Facilities
Minerals production	*Exploration and development* Exploratory drilling and trenching Access roads and helipads *Production* Surface mines Underground mines Access roads Transportation (e.g., railroads) Solid waste (overburden, waste rock, and tailings) Leachate mining wastes
Military operations	Air space operations Spills/releases Training and equipment testing Housing Expansion Realignment and closure
Grazing and rangeland management	Livestock grazing Rangeland improvements (e.g., water pipelines, reservoirs, and fences) Rangeland restoration, rehabilitation, or other conservation measures
Fire management	Fire suppression Fuels management Wildland fire reclamation
Forestry	Timber and vegetation harvesting Access roads Interim and final reclamation
Transportation	Highways, roads, and parkways Railroads (coal transport) Hazardous material releases Airport construction/expansion
Remediation	Abandoned mine lands Hazardous material sites

TABLE 6.5-2 General Trends in the Six-State Study Area

General Trend	Associated Activities
Population growth	Agricultural, residential, commercial, and industrial property development adjacent to federal land Urbanization Roads and traffic Land use modification Employment Resource use (e.g., water) Tax revenue
Energy demand	Resource use Energy development Energy transmission and distribution
Water demand	Resource use
Climate change	Water cycle changes Wildland fires Habitat changes

6.5.1.1 Energy Production and Distribution

6.5.1.1.1 Oil and Gas Production

Oil and gas provide 62% of the energy supply in the United States and almost all of its transportation fuels (EIA 2010a). In 2009 about 16% of domestic oil and in 2008 about 17% of domestic natural gas were produced in the six-state study area (EIA 2010b,c).

Table 6.5-4 compares oil production between 2000 and 2009 and gas production between 2000 and 2008 in the study area. During this period, overall production of oil in the study area decreased by about 14% (although it increased significantly in Colorado and Utah); overall gas production increased by about 9%. The Energy Information Administration (EIA) projects that the reliance on fossil fuels will decline in the coming decades and that fossil fuels (oil, gas, and coal) will provide a 78% share of the total U.S. primary energy supply in 2035 (compared to 84% in 2008) (EIA 2010a). Future actions will focus on the development of new recovery techniques to enhance oil and gas recovery in the field.

Onshore oil and gas production on federal lands make up about 5% and 11%, respectively, of domestic production. In fiscal year (FY) 2009, sales of oil and gas from BLM-administered lands in the six-state study area accounted for about half of the total oil and gas sales volume from federal lands. In that year, 53,114 oil and gas wells operated on more than 10,000 leases (Table 6.5-5). Across the United States, federal leases with at least one producing well increased from 19,036 in FY 1992 to 22,599 in FY 2009, while the number of producing wells increased from 52,926 to 85,330 (BLM 2010c).

TABLE 6.5-3 Programmatic-Level Actions on Federal Land

Description	Responsible Agency	Status	Primary Impact Location
Oil shale and tar sands development	BLM	Notice of Availability of final PEIS published September 5, 2008, and Record of Decision published Nov. 19, 2008	Colorado, Utah, and Wyoming
Wind energy development	BLM	Notice of Availability of Record of Decision published Jan. 11, 2006	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
West-wide energy corridors	DOE, BLM, FS	Notice of Availability of final PEIS published Nov. 28, 2008, and Record of Decision published Jan. 14, 2009	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
Vegetation management	BLM	Notice of Availability of Record of Decision published Oct. 5, 2007	Alaska, Arizona, California, Colorado, Idaho, Montana, Nebraska, New Mexico, Nevada, North Dakota, South Dakota, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming
Geothermal energy development	BLM, FS	Notice of Availability of final PEIS published Oct. 24, 2008, and Record of Decision published Dec. 17, 2008	Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming

A recent interagency study of the oil and gas resources on federal lands focused on 11 geologic provinces across the United States, 7 of which are located in the western United States: the Montana Thrust Belt, Powder River Basin, Wyoming Thrust Belt, Greater Green River Basin, Denver Basin, Uinta-Piceance Basin, and Paradox/San Juan Basin (DOI 2006). The study found that approximately 22,814,000 acres (92,324 km^2) of the federal land in these basins is available for oil and gas leasing with standard stipulations. Based on resource estimates, these lands contain 737 million barrels (117 billion L) of oil and 24.733 trillion ft^3 (0.7015 trillion m^3) of natural gas. Approximately 17,283,000 acres (66,941 km^2) of the federal land is available for leasing with restrictions beyond standard stipulations. Based on resource estimates, these lands contain 2,760 million barrels (438.8 billion L) of oil and 76.983 trillion ft^3 (2.180 trillion m^3) of natural gas. The potential for the future expansion in oil and gas exploration, development, and production on federal lands is high.

TABLE 6.5-4 Trends in Oil and Gas Production in the Six-State Study Area

	Oil Production (tbbl)[a]			Gas Production (mcf)[b]		
State	2000	2009	Percentage Change	2000	2008	Percentage Change
Arizona	59	46	–22.0	368	523	42.1
California	271,132	207,094	–23.6	418,865	296,469	–29.2
Colorado	18,481	28,324	53.3	760,213	1,389,399	82.8
Nevada	621	455	–26.7	7	4	–42.9
New Mexico	67,198	61,146	–9.0	1,820,516	1,446,204	–20.6
Utah	15,636	22,927	46.6	281,117	433,566	54.2
Total	373,127	319,992	−14.2	3,281,086	3,566,165	8.7

[a] tbbl = thousand barrels. To convert bbl to L, multiply by 159.

[b] mcf = million cubic feet. To convert cf to m^3, multiply by 0.02832.

Sources: EIA (2001, 2010b,c).

TABLE 6.5-5 Oil and Gas Activities on Public Lands of the United States in FY 2009

State	Producible and Service Holes	Producible Leases	Acres[a] in Producing Status	Oil Sales Volume (bbl)[b]	Gas Sales Volume (mcf)[c]
Arizona	2	0	0	–[d]	–
California	7,281	317	78,826	19,606,220	4,623,593
Colorado	5,543	2,266	1,522,230	4,087,627	269,878,099
Nevada	121	29	14,998	430,586	15,509
New Mexico	33,523	6,554	4,347,437	26,939,311	780,102,883
Utah	6,644	1,427	1,092,640	11,240,070	285,857,559
Total	53,114	10,593	7,056,041	62,303,814	1,340,477,643

[a] To convert acres to km^2, multiply by 0.004047.

[b] bbl = barrels. To convert bbl to L, multiply by 159.

[c] mcf = million cubic feet. To convert cf to m^3, multiply by 0.02832.

[d] A dash indicates no activity.

Source: BLM (2010c).

Oil shale is a sedimentary rock that releases petroleum-like liquid when heated. The mining and processing of oil shale is more complex and expensive than conventional oil recovery; however, increasing oil prices and advances in technology are making it a more feasible energy option. It is estimated that about 72% of the U.S. acreage containing oil shale deposits occurs under federal land in the Green River Formation, a geologic unit that underlies portions of Colorado, Utah, and Wyoming. The oil shale in the Green River Formation has the potential to yield as much as 800 billion barrels (127 trillion L) of oil (BLM 2008a). While there are currently no federal oil shale leases for commercial development, the likelihood of future leases is high. The BLM has prepared a PEIS for oil shale leasing in these three states (BLM 2008b).

Tar sand deposits are another oil-yielding resource under western federal land, primarily in eastern Utah. These deposits are a combination of clay, sand, water, and bitumen that can be mined and processed to produce oil. It is estimated that these deposits could yield as much as 76 billion barrels (12 trillion L) of oil (BLM 2005). While there are currently no federal tar sand leases, the likelihood of future leases is high. The BLM has prepared a PEIS for tar sands leasing (together with oil shale leasing) in Colorado, Utah, and Wyoming (BLM 2008b).

6.5.1.1.2 Coal Production

The electric power sector is the largest consumer of coal, and coal accounts for about half of the electricity generation in the United States (EIA 2010d). Coal production in the West reached a record level in 2008, with a total of 678.5 million short tons (615.5 million MT) being produced in the western states, about half of the total U.S. coal production (1,170.4 million short tons [1,061.8 million MT]) in 2008 (EIA 2010d). Table 6.5-6 compares coal production between 2002 and 2008 in the four producing states within the six-state study area. During this period, overall production decreased in these states by almost 12% (after peaking in 2005). Although coal production is declining in the study area states, the EIA (2010d) projects continued growth

TABLE 6.5-6 Coal Production in the Producing States within the Six-State Study Area in 2002 and 2008[a]

State	2002 (thousand short tons)	2008 (thousand short tons)	Percentage Change from 2002 to 2008
Arizona	12,804	8,025	−37.3
Colorado	35,103	32,028	−8.8
New Mexico	28,916	25,645	−11.3
Utah	25,304	24,365	−3.7
Total	102,127	90,063	−11.8

[a] To convert short tons to metric tons (MT), multiply by 0.9072.

Sources: EIA (2003, 2010d).

in the West through 2030, although most of the growth is attributed to increased output of surface mines in the Powder River Basin in Wyoming outside the six-state study area. Demand for low-sulfur western coal isexpected to increase because of its environmental benefits relative to other coal sources (National Energy Development Policy Group 2001).

6.5.1.1.3 Nuclear Electricity Generation

Nuclear reactors generating electricity are operating in only two of the six states in the study area (see http://www.nrc.gov/reactors/operating.html): Arizona and California. In Arizona, the Palo Verde Nuclear Generating Station, which is located approximately 36 mi (58 km) west of Phoenix, has three operating reactors, generating approximately 3,870 megawatts of electricity (MWe). In California there are two operating nuclear reactors at the Diablo Canyon Power Plant, about 12 mi (19 km) west-southwest of San Luis Obispo and two reactors at the San Onofre Nuclear Generating Station 4 mi (6.4 km) southeast of San Clemente. The total generating capacity of the Diablo Canyon reactors is 2,240 MWe; the combined rated capacity of the San Onofre reactors is 2,150 MWe (NRC 1996).

6.5.1.1.4 Renewable Energy Development

Solar Energy. In 2008, solar energy accounted for about 1% of renewable electricity generation and about 0.097% of the total U.S. electricity supply (EIA 2010e). As discussed in Section 1.3.3, as of February 2010, there were 127 active applications pending for utility-scale solar power–generating facilities on BLM-administered public lands, with a total estimated capacity of approximately 74,000 MW (see Appendix B). However, it is not expected that all active applications will result in ROW authorizations; applications are often terminated either because the developer decides to drop the project or because the BLM determines that the application is not viable. The RFDS assumed for this PEIS estimates that solar development on BLM-administered lands over the 20-year study period will be about one-third of that represented by the active BLM applications, or 24,000 MW. An additional 8,000 MW is projected to be developed on non-BLM lands in the study area.

Manufacturing of components for utility-scale solar facilities occurs in all states in the study area; these facilities are generally located in larger urban areas (Momentum Technologies 2010).

Wind Energy. In 2008, wind energy accounted for about 5% of the renewable electricity generation and 0.34% of the total U.S. electrical supply (EIA 2010e). In 2009, the total wind generation capacity in the United States was 35,086 MW and provided 1.9% of the national energy demand; this represented a 39% increase in installed wind capacity (IEA 2010). The BLM manages 20.6 million acres (83,368 km^2) of public lands with wind potential and has authorized a total of 192 ROWs for the use of public lands for wind energy. Of these, 27 authorizations have a total installed capacity of 437 MW on land in western states.

Geothermal Energy. Geothermal energy resources are the steam and hot water generated by heat from within the earth. In 2008, they accounted for about 5% of the renewable electricity generation and 0.36% of the total U.S. electricity supply (EIA 2010e). Approximately 530 million acres (2.4 million km^2) in 12 western states have geothermal resources with potential for generation of electricity or for heating applications; about 47% of this is on federal lands (BLM and USFS 2008). Nevada is currently the highest-producing state (Table 6.5-7). The number of geothermal energy leases in the study area issued by BLM doubled between FY 2002 and FY 2009, with the greatest increase occurring in Nevada. The total number of acres used for geothermal development tripled during this period.

Hydroelectric Power. In 2008, hydroelectric power generation accounted for about 2.5% of the total U.S. electricity supply (EIA 2010e). California depends heavily on this resource. Since the areas best suited for this technology have already been developed, it is likely that future development of this technology will be relatively low.

The U.S. Army Corps of Engineers (USACE) maintains a database of dams in the United States, called the National Inventory of Dams (NID). The NID is a searchable database of about 79,000 U.S. dams. The Website also provides links to state Web sites containing information on dams and hydroelectric projects. It can be accessed at http://crunch.tec.army.mil/.

TABLE 6.5-7 Competitive and Noncompetitive Geothermal Leases on BLM Public Lands in FY 2002 and FY 2009

			FY 2009			
	FY 2002		Competitive[d]		Noncompetitive	
State	Acres[a,b]	Leases[c]	Acres	Leases	Acres	Leases
Arizona	0	0	0	0	2,084	1
California	100,766	72	78,693	58	11,399	13
Nevada	236,601	171	530,425	206	342,917	231
New Mexico	4,581[c]	4[e]	2,941	3	0	0
Utah	6,906	8	96,360	38	1,761	1
Total	348,854	255	708,419	305	358,161	246

[a] Number represents acreage for both competitive and noncompetitive leases.

[b] To convert acres to km^2, multiply by 0.004047.

[c] Number represents total for both competitive and noncompetitive leases.

[d] Includes both Energy Policy Act of 2005 leases and pre-act leases.

[e] There were only competitive geothermal leases in New Mexico.

Sources: BLM (2003, 2010d).

Biomass Resources. In 2008, biomass resources accounted for about 52% of renewable electricity generation and about 3.9% of the total U.S. electricity supply (EIA 2010e). It is estimated that restoration activities on as many as 12 million acres (48,562 km^2) of federal land administered by the BLM would remove biomass that could be used as an energy source.

Mandatory State Renewable Portfolio Standards. Five of the six states in the study area have set mandatory standards, known as Renewable Portfolio Standards (RPSs), that require electric utilities to generate a specified amount of electricity from renewable sources (e.g., solar, wind, geothermal, or biomass) by a given date; Utah has set a voluntary RPS. States cite various reasons for mandating the increased use of renewable energy. These generally include greenhouse gas (GHG) reduction, as well as the benefits of job creation, energy security, and cleaner air (Pew Center on Global Climate Change 2010).

Some states allow utilities to comply with the RPS through tradable renewable energy credits. The standards differ in the portions of renewable energy required (from 15% by 2025 in Arizona to 33% by 2020 in California) (North Carolina Solar Center and Interstate Renewable Energy Council 2010). In Nevada and New Mexico the RPSs include a solar set-aside, requiring that 5% and 20%, respectively, of the utilities' portfolios be provided from solar energy. The state RPS requirements are discussed in greater detail in Appendix D.

6.5.1.1.5 Transmission and Distribution Systems

About 90% of the oil and gas pipeline and electricity transmission ROWs in the western United States cross public lands (National Energy Policy Development Group 2001). In FY 2009, the BLM had a total of 62,905 existing ROWs for oil and gas pipelines and electricity transmission lines in the six-state study area (BLM 2010d). This represents a 19.3% increase over the number of ROWs (52,724) in existence in FY 2002.The largest increase in ROWs issued between FY 2002 and FY 2009 occurred in California (up 26.9%), Utah (up 23.9%), and New Mexico (up 21.6%) (Table 6.5-8). BLM processed 2,135 ROW applications and issued or amended 1,834 ROWs in FY 2009 (BLM 2010d).

The National Energy Policy Development Group (2001) projects that the demand for additional energy and electricity will increase the number of ROWs across public lands in the years to come. Other federal agencies authorized to issue ROWs for electric, oil, and gas transmission include the U.S. Forest Service (USFS), the National Park Service (NPS) (electric only), the U.S. Fish and Wildlife Service (USFWS), the U.S. Bureau of Reclamation (BOR), and the Bureau of Indian Affairs (BIA).

Transmission Line Projects

Numerous energy projects in the western states are proposing to build inter- and intrastate transmission lines. Some projects emphasize the need to transmit energy from renewable

TABLE 6.5-8 Number of Existing Oil and Gas Pipeline and Transmission Line ROWs on BLM Public Lands in FY 2002 and FY 2009

State	Total ROWs in FY 2002	Total ROWs in FY 2009			Percentage Increase from FY 2002 to FY 2009
		MLA[a]	FLPMA[b]	Total	
Arizona	4,503	285	4,429	4,714	4.7
California	5,700	268	6,966	7,234	22.2
Colorado	5,836	1,361	5,308	6,669	14.3
Nevada	7,062	167	7,995	8,162	15.6
New Mexico	24,809	20,604	9,556	30,160	21.6
Utah	4,814	1,193	4,773	5,966	23.9
Total	52,724	23,878	39,027	62,905	18.8

[a] MLA = Mineral Leasing Act of 1920.

[b] FLPMA = Federal Land Policy and Management Act of 1976.

Sources: BLM (2003, 2010d).

sources; others are intended to improve system reliability and meet the growing demand for electricity in a given region. The following sections describe planned transmission line projects and related studies in the Southwest (including states in the study area).

TEPPC's Synchronized Study Plan. The Transmission Expansion Planning Policy Committee (TEPPC) of the Western Electricity Coordinating Council developed its Synchronized Study Plan (TEPPC 2008) to evaluate transmission expansion needs within the Western Interconnection and addresses potential reliability and congestion issues associated with energy transmission. The TEPPC provides support for the long-term regional planning of the transmission system in the West. The planning process includes a sequence of steps that take a transmission project from inception to operation: investigation of expansion needs; project formation to respond to needs; technical ratings studies for specific proposals; and licensing and construction. Transmission projects, including the expansion projects listed in the TEPPC study, are listed in Table 6.5-9. These cases will be evaluated by TEPPC to determine their effectiveness in reducing congestion costs to system users.

Western Renewable Energy Zones. The Western Governors' Association (WGA) and the DOE have launched the Western Renewable Energy Zone (WREZ) initiative. The initiative is intended to facilitate the construction of utility-scale renewable energy facilities and expansion of the electricity transmission system needed to develop and deliver energy from renewable resources areas within the Western Interconnection to load centers. Participants include several western states as well as two Canadian provinces and areas in Mexico that are part of the Western Interconnection. The work is being conducted in four phases, the first of which was documented in the June 2009 Phase 1 Report (WGA and DOE 2009). The WREZ initiative is described in detail in Appendix D, Section D.1.1.

TABLE 6.5-9 Planned Transmission Projects, Including Expansions, in the Six-State Study Area

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Northern Lights Montana–Las Vegas HVDC Line	500-kV HVDC from Montana to Las Vegas, Nevada, following the SWIP corridor from Borah, Idaho	TransCanada		2008 TEPPC study requested
Northern Lights Wyoming–Las Vegas HVDC Line	500-kV HVDC from Wyoming to Las Vegas, Nevada, following the Southwest Intertie Project (SWIP) corridor from Borah, Idaho	TransCanada		2008 TEPPC study requested
TransWest Express Project	±600-kV HVDC from Powder River Basin, Wyoming, through Utah to Las Vegas, Nevada	National Grid, Arizona Public Service (APS), PacifiCorp, Western Area Power Administration (Western), and Wyoming Infrastructure Authority (WIA)	2015	Initial feasibility studies completed. 2008 TEPPC study requested.
Zephyr Project (formerly Northern Lights Inland Project)	New 500-kV DC line from Medicine Bow area in Wyoming, through Midpoint, Idaho, southward down the eastern side of Nevada to the Las Vegas area	TransCanada	2015	Preliminary application filed with BLM
Southwest Intertie Project (SWIP)	New 500-kV line from Twin Falls, Idaho, to Las Vegas, Nevada	LS Power, NV Energy		ROW approved in 1998. EA August 2007
Gateway South Segment #1	500-kV AC from Mona, Utah, to Crystal, Nevada	PacifiCorp, National Grid, APS, and WIA	2014	Initial feasibility studies completed. 2008 TEPPC study requested.

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Gateway South Segment #2	500-kV AC double circuit from Aeolus, Wyoming, to Mona, Utah	PacifiCorp, National Grid, APS, and WIA	2014	Initial feasibility studies completed. TEPCC study requested.
Wyoming - Colorado Intertie Project	345-kV line connecting northeastern Wyoming to the Denver, Colorado, area	Trans-Elect, Inc., Western, WIA	2014	Phase II status (WECC path rating process), TOT 3 (Western Electricity Coordinating Council Path 36) rating increase to 900 kV in 2007.
Populus –Terminal Project	345-kV double circuit from new substation in Idaho looping in various lines with connections at terminal substations in Utah	PacifiCorp	2010	2008 TEPPC study requested.
Midpoint – White Pine Project (SWIP North)	500-kV line from Midpoint, Idaho, to White Pine, Nevada	LS Power and Great Basin Transmission LLC	2011	2008 TEPPC study requested.
Wyoming–Colorado Intertie Project	345-kV line from northeastern Wyoming to Denver, Colorado, area (Pawnee)	TransElect, WIA, and Western	2012	
Power River – Denver Project		North American Power Group	2003	

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
High Plains Express	High-voltage backbone transmission path from Wyoming, across eastern Colorado and New Mexico to connect with facilities in Arizona	Colorado Springs Utilities, Platte River Power Authority, Public Service Company of New Mexico, Salt River Project (SRP), TransElect, Tri-State Generation & Transmission Association (TSG&T), Western, Xcel Energy, WIA, New Mexico Renewable Transmission Authority, Colorado Clean Energy Authority	2018	Feasibility study completed; ROW and permitting scheduled for 2009.
Eastern Plains Project	500-kV line running south to north in the eastern plains region of Colorado	TSG&T and Xcel	2012–2013	
Devers–Palo Verde Project No. 2	Single-circuit, 500-kV line following the route of Devers-Palo Verde #1, from Devers, Calif., west to Colorado River Substation (midpoint) west of the City of Blythe, Calif. and from Devers to Valley substations in Calif., along the existing Devers-Valley #1 right of way	Southern California Edison (SCE)	2013	Pending ROD. The Arizona portion of the project was canceled.
SunZia Project	Addition to Path 47 to provide 1,200 MW+ non-simultaneous capacity from southern New Mexico to southern Arizona	Southwestern Power Group II, LLC	2011	Scoping to begin in early 2009

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Sonora–Arizona Interconnection Project	500-kV line from Palo Verde, Arizona, to Santa Ana, Mexico; other sources report two 345-kV circuits, approximately 300 mi[a] long	Public Service Company of New Mexico (PNM)	2004	
Palo Verde – Yuma West Project	500-kV line	NRG	2002	
Canada–Northern California Transmission Project, Phase 1	500-kV line from British Columbia to Round Butte/Grizzly, Oregon, and ±500-kV HVDC from Round Butte/Grizzly, Oregon, to Tesla/Tracy, California	Pacific Gas & Electric (PG&E)	2015	
Interconnection to California–Northern California Transmission Project	500/230-kV transformer at Devils Gap Substation in Spokane, Washington ,area and possible phase shifters	Avista Corp.	2015	
Central California Clean Energy Transmission Project	500-kV double circuit from Midway to Fresno, California	PG&E		
Lake Elsinore Advance Pumped Storage Project and Interconnection	500-kV line Talega Escondido /Valley Serrano, California	Nevada Hydro Company, Inc., and the Lake Elsinore Valley Municipal Water District	2012	
San Francisco Bay Area Bulk Transmission Reinforcement Project	500/230-kV substation and 500-kV and 230-kV lines with configuration changes	PG&E		

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Southern Navajo Path 51	Increase rating to 3,200 MW (upgrade of four existing series capacitors)	APS	2010	
TOT 3 (Western Electricity Coordinating Council Path 36) Upgrade Project (Miracle Mile)	230-kV line	Western	2019	WECC Phase II status
Navajo Transmission Project–Segment 1	500-kV line from Four Corners, New Mexico, to a point south of Navajo, Arizona, on Navajo–Moenkopi line and 500-kV line from Moenkopi to Mead/Marketplace area, Nevada	Dine Power Authority	2010	Pending ROD; access across Indian reservation is on hold.
Sigurd to Red Butte to Crystal (Segment G) Project (part of the Gateway South Project, running from Wyoming to the desert Southwest)	345-kV line from Sigurd to Red Butte in southwest Utah and from Red Butte to the existing substation at Crystal	Rocky Mountain Power		Scoping meetings were held in October 2009. Draft EIS pending.
Ely Energy Center Project (SWIP South)	500-kV Robinson Summit–Harry Allen Project in Las Vegas area	Sierra Pacific Resources	2011	

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Sunrise Powerlink Project	New line about 123 miles from the Imperial Valley Substation in Imperial County to the western part of San Diego County (in Imperial County the line is a 500-kV line extending to a new Suncrest Substation south of I-8; from there, the line proceeds as a 230-kV line to the Sycamore Canyon Substation on Marine Corps Air Station Miramar.	San Diego Gas & Electric (SDG&E)	2012	
Path 27 Upgrade	Intermountain DC line (Utah)	Los Angeles Department of Water & Power	2009	
Indian Hills–Upland Project	500-kV line	Los Angeles Department of Water & Power; Imperial Irrigation District	2010	

[a] To convert mi to km, multiply by 1.609.

Sources: APS et al. (2007); TEPPC (2008).

The WREZ Phase 1 Report identified and mapped the preliminary WREZs and described the criteria and methodology used to define these areas. The multistep process presented in the Phase 1 report included identifying Qualified Resource Areas (QRAs), which are defined as areas with sufficient potential generation capacity to justify the construction of new regional transmission, while excluding lands on the basis of statutory or regulatory limitations and existing conflicts. (The QRAs identified in the Phase 1 Report will be further analyzed in the next phase of work and, ultimately, may be designated as WREZs.) The locations of WREZs with respect to BLM-administered lands being analyzed in this PEIS are shown in Figures D-2 through D-7.

Next steps for undertaking the WREZ initiative include further study of the QRAs, such as the addition of wildlife considerations, in order to define the WREZs. Additionally, work will be done to identify local transmission corridors, coordinate energy purchasing from the WREZs, and foster interstate cooperation for renewable energy generation and transmission (see Appendix D).

Natural Gas Pipeline Projects

Currently 10 interstate and 9 intrastate natural gas pipeline companies provide transportation services within the Western Region (Arizona, California, Idaho, Nevada, Oregon, and Washington), the fewest number serving any region. A little more than half of the capacity entering the region is on pipeline systems carrying natural gas from the Rocky Mountain area and the Permian and San Juan Basins. These systems enter the region at the New Mexico–Arizona and Nevada–Utah state lines; the remaining capacity arrives on natural gas pipelines that access Canadian natural gas at the Idaho and Washington state borders with British Columbia, Canada (EIA 2010f). The following sections describe several planned expansion projections on the interstate natural gas pipeline system in the Western Region.

- *Rockies Express-West Pipeline.* In April 2007, the Federal Energy Regulatory Commission (FERC) approved approved the Rockies Express-West interstate pipeline project to transport more than 1.5 billion ft^3 (42.5 million m^3) per day of Rocky Mountain natural gas to supply states east of the Rockies. Two related components, proposed by TransColorado Gas Transmission Co. and Questar Overthrust Pipeline Co., were also approved. Together, these projects will consist of approximately 800 mi (1,287 km) of new pipeline and more than 237,000 horsepower (hp) of compression, meter stations, and other related facilities. The pipeline system will span portions of Colorado, Wyoming, Nebraska, Kansas, Missouri, and New Mexico (FERC 2008).

- *Bronco Pipeline Project.* The Bronco Pipeline Project is a natural gas pipeline system being proposed by Spectra Energy to connect natural gas supplies in the Rocky Mountains to underserved markets in the Western Region. The pipeline system will be more than 650 mi (1,046 km) long and will have an initial capacity of more than 1 billion ft^3 (28,326,847 m^3) per day. The system will include three compressor stations (for 64,000 hp in total). The pipeline will access supply basins in Wyoming, Utah, and Colorado and will stretch westward toward its terminus in Malin, Oregon, interconnecting with several pipelines on the way. The project is planned to be in service as early as 2011 (Spectra Energy 2008).

- *2010 Gas Expansion Project.* The Kern River Gas Transmission Company is constructing the 2010 Expansion Project to increase the amount of natural gas transported on its system by approximately 145 million ft^3 (4,105,943 m^3) per day. The Kern River system stretches from Wyoming, through Utah, Nevada, and California, providing take-away capacity for the developing natural gas supplies in the producing areas of the Rocky Mountains. The Kern River system has a design capacity of 1.9 billion ft^3 (53,802,000 m^3) per day. The project was placed in service in April 2010 (Kern River Gas Transmission Company 2010).

- *White River Lateral Expansion.* The White River Lateral Expansion, constructed by the Questar Overthrust Pipeline Company, would consist of a 140-mi (225-km) natural gas pipeline with a capacity of 810 million ft^3 (22,936,646 m^3) per day. The pipeline would extent from the White River Hub in the Piceance Basin to Wamsutter, Wyoming. The in-service date is January 1, 2011, with an in-service date for partial volumes on January 1, 2010 (Questar Overthrust Pipeline Company 2008).

- *Magnum Gas Storage Project.* Magnum Gas Storage, LLC proposes to construct the Magnum Gas Storage Project, a project including four new natural gas storage salt caverns, a 62-mi (100-km) header pipeline, a 9-mi (14.5-km) local pipeline, and associated facilities in Millard, Juab, and Utah Counties, Utah. The pipeline will be capable of transporting as much as 1.2 billion ft^3 (34 million m^3) of natural gas per day. The first cavern is expected to be available for natural gas storage beginning in early 2012 (Magnum Gas Storage, LLC 2010).

- *Sunstone Pipeline Project.* Williams and TransCanada Corporation are proposing to build the Sunstone Pipeline between the Opal Hub in Wyoming and Stanfield, Oregon. The 602-mi (969 km), 42-in. (107-cm) diameter pipeline would have a capacity of up to 1.2 billion ft^3 (33,980,216 m^3) per day. The pipeline would deliver gas to markets in the northwest. The project is temporarily on hold (Williams Northwest Pipeline 2010).

6.5.1.2 Other Activities and Trends

6.5.1.2.1 Other Activities

Recreation

Table 6.5-10 lists the number of recreation visits for the BLM, USFS, and NPS in the six-state study area in FY 2000 and FY 2005. By far, the USFS experienced the greatest number of visits (more than 90 million). Visits to BLM lands in the study area increased by 3.9 million (about 12%), with the greatest increases occurring in Colorado and Nevada. Visits to USFS sites decreased by about 4.4 million (about 6%) in the three states for which data were available (Arizona, California, and Colorado). Visits to NPS sites decreased by 3.9 million (about 6%) between FY 2000 and FY 2005. The greatest declines occurred in Nevada and Utah.

The fastest growing outdoor recreation activities through 2050 (as measured by the number of participants) are projected to be cross-country skiing (95% growth); downhill skiing

TABLE 6.5-10 Recreation Visits for the BLM, USFS, and NPS in FY 2000 and FY 2005

State	Visits to BLM Lands			Visits to FS Lands			Visits to NPS Lands[a]		
	FY 2000	FY 2005	Percentage Change	FY 2000	FY 2005	Percentage Change	FY 2000	FY 2005	Percentage Change
Arizona	4,997,000	5,557,000	11.2	13,859,000	14,309,000	3.2	11,525,818	10,799,429	–6.3
California	8,400,000	9,604,000	14.3	32,403,000	29,786,000	–8.1	34,410,505	33,400,604	–2.9
Colorado	4,756,000	5,746,000	20.8	27,948,000	25,728,000	–7.9	5,807,033	5,352,839	–7.8
Nevada	5,045,000	6,183,000	22.6	–[b]	7,188,000	–[b]	6,647,299	5,847,070	–12.0
New Mexico	2,380,000	2,384,000	<1.0	–[b]	2,912,000	–[b]	1,766,079	1,650,441	–6.6
Utah	6,169,000	6,208,000	<1.0	–[b]	10,620,000	–[b]	8,843,646	8,046,646	–9.0
Totals:	31,747,000	35,682,000	12.4	–[b]	90,543,000	–[b]	69,000,380	65,097,029	–5.7

[a] NPS data are reported for calendar year (January through December).

[b] Data for 2000 not available.

Sources: BLM (2001, 2006); Parker (2007); NPS (2001, 2006).

(93% growth); visiting historic places (76% growth); sightseeing (71% growth); and biking (70% growth). By activity days, increases through 2050 are projected to be in visiting historic places (116% growth); downhill skiing (110% growth); snowmobiling (99% growth); sightseeing (98% growth); and non-consumptive wildlife activity (97% growth) (Bowker et al. 1999). Public lands offer opportunities for these activities; for example, most downhill skiing capacity is located in the western states, especially on national forest lands (Cordell et al. 1990). Therefore, the potential for increased tourism and recreational use of public lands over the next 20 years is considered high.

Minerals Production

Economic production of mineral resources on BLM-administered land includes locatable, leasable, and salable solid minerals. Locatable minerals, defined under the General Mining Law of 1972, can be obtained by locating a mining claim; they include both metallic and nonmetallic materials. Locatable minerals mined on BLM land include, but are not limited to, gold, silver, and lead. By the end of FY 2009, there were 282,118 active mining claims in the six-state study area on file with the BLM, with the highest number (176,958) in Nevada (BLM 2010d). This represents a 52% increase from FY 2002, in which 145,676 mining claims (88,124 in Nevada) were on file (BLM 2003).

Leasable minerals are subject to the Mining Leasing Act of 1920 and include energy and nonenergy resources; leases to these resources are obtained through a competitive bidding process. Leasable minerals mined on BLM land include, but are not limited to, sodium, potassium, phosphate, and gilsonite. The number of leases and associated acres for sodium, potassium, phosphate, and gilsonite on BLM-administered land in FY 2002 and FY 2009 are shown in Table 6.5-11. The number of leases and associated acres for sodium mining has decreased since FY 2002; potassium, phosphate, and gilsonite leases have remained relatively steady (gilsonite is a natural, resinous hydrocarbon that is similar to a hard petroleum asphalt).

Salable minerals include basic natural resources such as sand and gravel that the BLM sells to the public at fair market value. Other salable materials include soil, stone, clay, and pumice. In FY 2009 in the six-state study area, about 8.4 million yd^3 (6.4 million m^3) of mineral materials was disposed of through exclusive and nonexclusive sales and free use permits, representing a decrease of about 3 million yd^3 (2.3 million m^3) (27%) from FY 2002 (BLM 2003, 2010d).

Military Operations

The U.S. Department of Defense (DoD) currently owns and manages 229 installations occupying over 19.1 million acres (77,500 km^2) in the six-state study area, with the greatest acreages in New Mexico, California, and Nevada (DoD 2008). Table 6.5-12 shows a breakdown in the number and acreages of installations by military service. Implementation of the 2005 Base Realignment and Closure Program will result in the closure of 9 sites and realignment at an additional 44 sites.

TABLE 6.5-11 Solid Mineral Leases on BLM Public Lands in FY 2002 and FY 2009

Leasable Mineral Resource	Number of Leases		Acres[a]	
	FY 2002	FY 2009	FY 2002	FY 2009
Sodium				
Arizona	1	1	4	4
California	31	13	25,567	21,266
Colorado	8	8	16,674	16,675
New Mexico	4	3	2,000	1,560
Total	44	25	44,245	39,505
Potassium				
California	8	6	10,286	10,286
Nevada	0	1	0	2,320
New Mexico	111	117	134,396	143,833
Utah	18	18	34,612	34,612
Total	137	142	179,294	191,051
Phosphate				
Utah	7	7	13,028	13,029
Gilsonite				
Utah	13	14	3,640	3,680

[a] To convert acres to km^2, multiply by 0.004047.

Sources: BLM (2003, 2010d).

Grazing and Rangeland Management

In FY 2002, grazing land accounted for about 63% of the land area in the six-state study area. Grazing takes place on lands the Economic Research Service (ERS) categorizes as cropland pasture, grassland pasture and range, and forest land-grazed (Table 6.5-13). Cropland pasture is the smallest, but generally the most productive component of grazing acreage, accounting for only about 1% of the land area in the study area. Grassland pasture and range occupies almost half (48%) of the land area. Grazing is also high on forest land in the study area, accounting for about 14% of land area. New Mexico, Nevada, and Arizona have the greatest percentage of grazing land. Almost all BLM lands, as well as the majority of the acreage of the USFS, are available for grazing by private livestock ranchers.

The total grazing land in the United States has declined by about 25% since 1945, mainly because of changes in land use to recreational, wildlife, and environmental uses (with some acres converted to urban uses). Other reasons cited by Lubowski et al. (2006) include fewer farms and less land in farms, increases in forest stand density (making grazing more difficult), and changes in livestock feeding practices.

TABLE 6.5-12 Number and Acreage of DoD Facilities by Military Service in the Six-State Study Area in FY 2007

	Military Service									
	Army		Navy		Air Force		Marine Corps		Total	
State	No.[a]	Acres[b]	No.	Acres	No.	Acres	No.	Acres	No.	Acres
Arizona	6	1,151,498	0	0	9	2,693,262	3	700,419	18	4,552,149
California	28	909,176	76	1,341,389	30	501,768	12	1,282,991	146	4,035,324
Colorado	8	408,265	1	17	10	75,157	0	0	19	483,439
New Mexico	4	4,653,285	1	85	8	198,344	0	0	13	4,851,714
Nevada	2	147,662	7	119,416	8	3,137,291	0	0	17	3,404,369
Utah	10	865,391	1	525	5	947,469	0	0	16	1,813,385
Total	58	8,135,277	86	1,461,432	70	4,867,909	15	1,983,410	229	19,140,380

[a] Numbers represent small, medium, and large installations with plant replacement values greater than zero.

[b] To convert acres to km^2, multiply by 0.004047.

Source: DoD (2008).

TABLE 6.5-13 Grazing Land in the Six-State Study Area, 2002[a]

State	Cropland Pasture (1,000 acres[b])	Grassland Pasture and Range (1,000 acres)	Forest Land Grazed (1,000 acres)	Total Grazing Land (1,000 acres)	Percentage of State Land Area
Arizona	214	40,533	11,709	52,456	72.2
California	1,345	21,729	12,070	35,144	35.1
Colorado	1,835	28,158	10,516	40,509	60.9
Nevada	314	46,448	6,887	53,649	76.4
New Mexico	837	51,676	9,482	61,995	79.7
Utah	602	24,339	9,596	34,537	65.5
Total	5,147	212,883	60,260	278,290	63.2

[a] Includes both federal and nonfederal land.

[b] To convert acres to km^2, multiply by 0.004047.

Source: ERS (2007).

At the beginning of FY 2009, there were 7,235 permits and leases for livestock grazing, with a total of about 6.8 million active animal unit months (AUMs) on BLM-administered land in the six-state study area. Of those, about 4.3 million AUMs (63%) were authorized and in use (BLM 2010d). About 90% of the authorizations were for the grazing of cattle, 9.5% for sheep and goats, and less than 1% for horses and burros. The nonuse AUMs are generally attributed to drought and financial conditions (BLM 2004). Table 6.5-14 shows the number of grazing permits and leases and AUMs by state for BLM-administered rangeland in FY 2002 and FY 2009. The number of permits and leases in FY 2009 was down about 3.4% compared to FY 2002; authorized AUMS were also down relative to FY 2002, by about 6%. An additional 8 million AUMs is authorized by the USFS annually (Schuster and Krebs 2003).

Since 1996, there has been a general downward trend in the number of permits and leases and active use of federal lands for grazing. This trend continues a decades-long trend for public land livestock operators and for the livestock industry as a whole as it consolidates into fewer but larger operations. Studies have shown, however, that federal rangelands administered by the BLM and the USFS will continue to be an important part of the livestock-raising subsector of the agriculture industry (BLM 2004).

Fire Management

Wildland fires on federal lands are managed by the BLM and other federal agencies. BLM's fire management and aviation program has three levels of organization: the national office (leadership and oversight as well as policy, procedures, and budgets); state offices (coordination of policies and interagency activities at the state level); and field offices (on-the-ground fire management and aviation activities). Together these agencies and offices employ a

TABLE 6.5-14 Grazing Permits and Leases and AUMs on BLM Public Lands in FY 2002 and FY 2009

	FY 2002			FY 2009		
State	Permits or Leases	Active AUMs[a]	Authorized AUMs[b]	Permits or Leases	Active AUMs[a]	Authorized AUMs[b]
Arizona	767	676,970	469,833	764	644,585	455,213
California	593	316,971	199,383	529	326,664	201,240
Colorado	1,609	644,603	389,314	1,549	616,359	374,879
Nevada	661	2,221,140	1,295,744	659	2,137,105	1,085,641
New Mexico	2,312	1,872,958	1,463,818	2,279	1,853,015	1,443,567
Utah	1,550	1,236,840	758,984	1,455	1,208,575	736,308
Total:	7,492	6,969,482	4,577,076	7,235	6,786,303	4,296,848

[a] An AUM (animal unit month) is the amount of forage needed by an "animal unit" (i.e., a mature 1,000-lb cow and her calf) for 1 month. The active AUMs reported are the total number that could be authorized on BLM public lands.

[b] For FY 2002, the authorized AUM count is for the period March 2001 through February 2002; for FY 2009, it is for March 2008 through February 2009.

Source: BLM (2003, 2010d).

broad range of activities, including fire suppression, preparedness, predictive measures, fuels management, fire planning, community assistance and protection, prevention and education, and safety. Suppression operations and safety are the core activities for the fire management program.

In FY 2009, 2,090 fires affected 430,299 acres (1,741 km^2) of forest and nonforest federal lands (of which 127,497 acres [516 km^2] were BLM-administered). Of these fires, 67% were attributed to lightning strikes; the remainder were attributed to human factors (BLM 2010d).

Forestry

About 33% of the land in the United States is forest land (749 million acres [3,031,107 km^2]); of this, about one-third (246 million acres [995,531 km^2]) is owned by the Federal Government. The remainder is classified as nonfederal forest land (406 million acres [1,643,030 km^2]) and forest land in parks and other special use areas (98 million acres [396,593 km^2]) (Lubowski et al. 2006). The USFS defines forest land as "land at least 10% stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially reforested." Timberland is a class of forest land that is capable of commercial timber production and not removed from timber use by statute or administrative regulation (Alig et al. 2003).

As of 2002, about 17% of U.S. forest land (124 million acres [501,812 km^2]) was located in the six-state study area (Table 6.5-15). Of the six states, California has the greatest forest land acreage (40.2 million acres [162,684 km^2]), followed by Colorado (21.6 million acres [87,412 km^2]) and Arizona (19.4 million acres [78,506 km^2]). About 34% (42.3 million acres [171,183 km^2]) of forest land in the study area is classified as timberland, of which about 27.3 million acres (110,480 km^2) is federally owned. Timberland makes up the highest percentage of forest land in Colorado (54%) and California (44%).

The USDA reports that in recent decades, U.S. timberland acreage has had an upward trend, gaining 19 million acres (76,891 km^2) between 1987 and 1997 and stabilizing at 504 million acres (2,039,634 km^2) between 1997 and 2002. These increases were due in part to reclassification in response to rising prices for forest products (Lubowski et al. 2006). Forecasts of forest land acreage in the West over the next 40 years show a slight decline (about 3% relative to 2002), although total public forest land acreage is not expected to change. The total area of timberland in the West (including public, forest industry, and nonindustrial private land) is also projected to decline by about 3% by 2050 (Alig et al. 2003).

Major timber products include roundwood, lumber (softwood and hardwood), plywood, turpentine, rosin, pulpwood, and paperboard. Production levels for these products rose steadily between 1965 and 1988, then experienced declines until the mid-1990s. Since the mid-1990s, roundwood production has fallen slightly. Lumber production has been increasing but, as of FY 2002, remains below the record levels of the late 1980s. The USDA reported a record in per-capita consumption of lumber in the United States in 2002, which was below the high set in 1999

TABLE 6.5-15 Forest Land in the Six-State Study Area by Major Class, FY 2002

	Total Forest Land (1,000 acres[a])			Timberland (1,000 acres)			Reserved Timberland and Other Forest Land[c] (1,000 acres)
State	Federal	Nonfederal	Total[b]	Federal	Nonfederal	Total[b]	
Arizona	10,192	9,235	19,427	2,438	1,089	3,527	15,901
California	22,371	17,862	40,233	10,130	7,651	17,781	22,451
Colorado	15,075	6,562	21,637	8,020	3,587	11,607	10,030
Nevada	9,608	596	10,204	265	99	363	9,841
New Mexico	9,522	7,159	16,682	2,829	1,530	4,359	12,323
Utah	11,913	3,764	15,676	3,586	1,097	4,683	10,994
Total	78,681	45,178	123,859	27,268	15,053	42,320	81,540

[a] To convert to km^2, multiply by 0.004047.

[b] Distributions may not add to totals due to rounding.

[c] Includes forest land in parks, wildlife areas, and other special use areas.

Source: ERS (2007).

but greater than per-capita consumption levels in the 1960s, 1970s, and early 1980s. About 40% of the lumber consumed was used for housing. Other uses include manufacturing, 13%; nonresidential construction (e.g., railroads), 8%; and shipping (pallets, containers, and dunnage), 11% (Howard 2003).

The potential for continued growth in the wood products markets will follow the trends in new housing construction and residential improvements. Demand by the furniture and fixtures industry, another major market for hardwood lumber, plywood, veneer, and particleboard, is on the decline, falling 11% in 2002, because of continued growth in furniture imports from China (Howard 2003).

Transportation

The Federal Lands Highway Program is administered by the Federal Lands Highway Division of the Federal Highway Administration (FHWA) within the U.S. Department of Transportation. The program provides funding and engineering services for the planning, design, construction, and rehabilitation of forest highway system roads, bridges and tunnels, park roads and parkways, Indian reservation roads, defense access roads, other federal lands roads, and public authority–owned roads serving federal lands (FHWA 2010). A recent Transportation Research Board task force report cites the important relationship between transportation and visitation levels on federal lands. As tourism-related visits (and traffic) rise, access and user demands are exceeding the system's carrying capacity. Current interagency initiatives are focusing on meeting these demands (Eck and Wilson 2000).

Coal is an important commodity transported by rail. Over the past decade, coal's share of rail traffic has increased mainly because of the increased production in the western states of low-sulfur coal, which is transported long distances over rail. The Bureau of Transportation Statistics (BTS 2008a,b) reported a total of 78.9 million tons (71.6 MT) of coal transported (exported) by domestic railroads from Colorado, New Mexico, and Utah in 2005, up from 76.3 million tons (69.2 MT) in 2002. The demand for clean coal (i.e., low-sulfur coal) is expected to increase in the coming decades. This increase in demand could result in capacity shortfalls and delays in transportation, since the current rail system has little excess capacity (National Energy Policy Development Group 2001). Currently, two rail expansion projects have been proposed for the Powder River Basin of Wyoming to meet this increased demand: the Dakota, Minnesota, & Eastern Railroad Powder River Basin Expansion Project and the Burlington Northern and Santa Fe Railway Company's expansion projects (to four tracks).

Remediation

The U.S. Environmental Protection Agency (EPA) uses the National Priorities List (NPL) as an informational tool to identify sites that may present a significant risk to public health and/or the environment. Sites included on the NPL undergo an initial assessment to determine whether further investigation to characterize the nature and extent of the public health and environmental risks associated with the site is necessary, and to determine what response action, if any, may be warranted. Inclusion of a site on the NPL does not necessarily mean that the EPA will require a response action. The number of sites on the NPL in each of the six western states, as of September 2010, is as follows (numbers in parentheses indicate additional sites that have been deleted from the NPL): Arizona, 9 (3); California, 94 with an additional 2 proposed (12); Colorado, 18 with an additional 2 proposed (3); Nevada, 1 (0); New Mexico, 13 with an additional 1 proposed (4); and Utah, 16 with an additional 3 proposed (4). Additional information on these sites, including site name, description, threats/contaminants, and cleanup status, can be found at http://www.epa.gov/superfund/sites/npl/ (EPA 2010).

As of the end of FY 2009, the BLM reported a total of 3,113 sites on its public lands in the six-state study area that have had releases of hazardous substances and other pollutants, with the greatest number (1,234 sites, or 40%) having occurred in California. Two other states had release sites numbering more than 15% of the total: Arizona (647) and Nevada (602). Of the total sites, 2,398 have been closed and administratively archived with no further action planned. During FY 2009, 450 removal actions and 19 remedial actions were conducted on BLM lands in the study area (BLM 2010d).

6.5.1.2.2 General Trends

Population Trends

The West is the fastest growing region in the United States. Between 1990 and 2000, it grew at a faster rate (19.7%) than the nation as a whole (13.2%). Four states within the six-state study area had population increases greater than 25% in the 10-year period, with Nevada growing by more than 66% (Table 6.5-16). The West is also the most urbanized of the four U.S. regions, with more than 88% of the population living in urban areas in 2000 (Table 6.5-17). In 2000, the percentages of populations living in urban areas in five of the six states in the study area were above the national average of 79%, with the highest being California (at 94.4%) (BLM 2004).

The BLM (2004) also reported an important trend in the relationship between the amount of public land and the population growth in western state counties. In 1994, the ERS classified counties into three groups: metropolitan (22% of counties); nonmetropolitan nonpublic lands (31% of counties); and nonmetropolitan public lands (47% of counties). *Nonmetropolitan public lands* were defined as counties with federal lands occupying more than 30% of the total area. Between 1990 and 2000, counties designated by the ERS as *nonmetropolitan public land* experienced an increase in population of 25%, about 10% higher than the increase for counties designated *nonmetropolitan nonpublic land* and 5% higher than the increase for counties designated *metropolitan* over the same period. This disproportionate rate of population increase is changing the environmental context of public lands throughout the West.

TABLE 6.5-16 Population Change in the Six-State Study Area and the United States from 2000 to 2009

	Population		Percentage Increase
	2000	2009	2000 to 2009
State			
Arizona	5,130,632	6,595,778	28.6
California	33,871,648	36,961,664	9.1
Colorado	4,301,261	5,024,748	16.8
Nevada	1,998,257	2,643,085	32.3
New Mexico	1,819,046	2,009,671	10.5
Utah	2,233,169	2,784,572	24.7
Region			
West	63,197,932	71,568,081	13.2
Northeast	53,594,378	55,283,679	3.2
Midwest	64,392,776	66,636,911	3.5
South	100,236,820	113,317,879	13.1
Total for United States	281,421,906	307,006,330	9.1

Source: U.S. Bureau of the Census (2010).

TABLE 6.5-17 Rural and Urban Populations in the Six-State Study Area and the United States from 1990 to 2000

	1990 (%)		2000 (%)		Urban Increase (%)
	Urban	Rural	Urban	Rural	1990 to 2000
State					
Arizona	87.5	12.5	88.2	11.8	0.7
California	92.6	7.4	94.4	5.6	1.8
Colorado	82.4	17.6	84.5	15.5	2.0
Nevada	88.3	11.7	91.5	8.5	3.2
New Mexico	73.0	27.0	75.0	25.0	2.0
Utah	87.0	13.0	88.2	11.8	1.2
Region					
West	86.3	13.7	88.6	11.4	2.4
Northeast	78.9	21.1	84.4	15.6	5.5
Midwest	71.7	28.3	74.7	25.3	3.0
South	68.6	31.4	72.8	27.2	4.2
Total for United States	75.2	24.8	79.0	21.0	3.8

Source: BLM (2004).

Energy Demand

Energy consumption in the United States is on the rise and projected to increase by 14.4% between 2006 and 2035 (Table 6.5-18). Fossil fuels, including liquid fuels, natural gas, and coal, would account for about 80% of energy consumption in 2035, down from 85% in 2006. The decline in fossil fuel use is attributed to the greater use of renewable energy resources, which is projected to increase to 8.4% in 2030, from 5.7% in 2006 (EIA 2008, 2010a).

In the West, energy consumption is projected to grow at a faster rate (1.1% annually) than in the nation as a whole (0.7% annually). During the period between 2006 and 2030, the energy consumption in these states is projected to increase by 29% (Table 6.5-19). The highest growth areas for energy consumption in the West would be in nonhydroelectric renewables, coal, liquid fuels, and natural gas. Little or no growth is expected in the nuclear and hydroelectric categories. Note that coal consumption in the western states is projected to grow at an annual rate (2.7%) that is more than two times that for the United States (at 1.2%), primarily because of the regional abundance of coal (Section 4.4.1.2) (EIA 2008).

Currently, coal and nonhydroelectric renewables account for more than half of the resources used for electric power generation in the West (Table 6.5-19). The coal share is projected to increase to 44% by 2030. Electricity generation from other fossil fuels and natural gas is expected to decrease over the same period, with natural gas falling off sharply after 2016. The share of nonhydroelectric renewable resources would increase to 34% in 2030 (with an even higher share, 57%, projected for the Pacific Region) (EIA 2008).

Water Availability

In 2005 (the latest year for which annual statistics are available at publication), freshwater and saline water withdrawals in the United States were estimated to be 410,000 million gal/day (460,000 thousand ac-ft/yr), with 80% of the total withdrawals coming from surface water. In the six-state study area, freshwater and saline water withdrawals were estimated to be 76,370 million gal/day (84,740 thousand ac-ft/year), with the highest usage occurring in California and Colorado. Surface water accounted for 73.6% of total water withdrawals in the study area; although about half of the water withdrawals in Arizona and New Mexico were from groundwater sources (Table 6.5-20).

The U.S. Geological Survey (USGS) defines eight categories of water use in the United States: public supply, domestic, irrigation, livestock, aquaculture, industrial, mining, and thermoelectric power. Water withdrawals for these categories for 2000 and 2005 are shown in Table 6.5-21. The greatest water consumption in the states with highest usage (California and Colorado) is in the category of freshwater for irrigation. Consumption of freshwater via the public supply is generally proportional to the state population. The highest per-capita usage in 2005 occurred in Nevada (350 gal [1,325 L] per day) and Utah (238 gal [901 L] per day).

TABLE 6.5-18 Total Energy Consumption, Population, and Carbon Dioxide Emissions for the United States and the Western Region, 2008 to 2030

Energy-Related Parameter	Year 2008	2015	2025	2035	Percentage Change from 2008 to 2035 (annual rate)
United States					
Energy consumption (quadrillion Btu)[a]					
Liquid fuels	38.35	38.81	40.14	42.02	9.6 (0.3)
Natural gas	23.91	22.35	24.24	25.56	6.9 (0.2)
Coal	22.41	22.35	23.63	25.11	12 (0.4)
Nuclear electricity	8.46	8.75	9.29	9.41	11 (0.4)
Renewables [b]	5.70	8.37	9.27	9.63	69 (2.5)
Biofuels heat and coproducts	1.03	0.77	1.49	2.56	148 (5.3)
Net electricity imports	0.11	0.07	0.08	0.09	-18 (-0.5)
Total[c]	100.09	101.61	108.26	114.51	14.4 (0.5)
Population (millions)	305.37	326.70	358.62	390.70	28 (0.9)
CO_2 emissions (million metric tons)	5,814.4	5,730.7	6,015.8	6,320.4	8.7 (0.3)
	2006	2010	2020	2030	Percentage Change from 2006 to 2030 (annual rate)
Western Region[d]					
Energy Consumption (quadrillion Btu)[a]					
Liquid fuels	8.11	8.40	9.23	10.06	24 (0.9)
Natural gas	5.02	5.23	5.58	5.45	9 (0.3)
Coal	2.51	2.73	3.35	4.74	89 (2.7)
Nuclear electricity	0.77	0.77	0.78	0.78	1 (0.1)
Hydroelectricity	2.01	1.93	2.01	2.01	0 (0)
Nonhydro renewables	0.64	1.05	1.36	1.61	150 (3.9)
Net electricity imports	–0.02	–0.02	–0.02	–0.03	26 (1.0)
Total[c]	19.05	20.12	22.30	24.64	29 (1.1)
Population (millions)	69.09	72.62	82.11	92.65	34 (1.2)
CO_2 emissions (million metric tons)	1,060.59	1,100.55	1,220.42	1,406.06	33 (1.2)

a One million billion, i.e., 10^{15}.

b Includes conventional hydroelectric.

c Totals may not equal sum of components due to independent rounding.

d Population and electricity divisions used in projected energy analysis by the EIA cover an area in the western United States that contains but is not exactly matched with the study area.

Source: EIA (2008, 2010a).

TABLE 6.5-19 Total Electric Power Generation for the United States and the Western Region, 2006 to 2030

Electric Power Generation	Electric Power Generation (quadrillion Btu)[a] 2006	2010	2020	2030	Percentage Change from 2006 to 2030 (annual rate)
United States					
Liquid fuels and other petroleum	0.64	0.56	0.59	0.63	–2 (–0.1)
Natural gas	6.42	6.89	6.09	5.13	–20 (–0.9)
Steam coal	20.48	21.01	23.67	27.55	35 (1.2)
Nuclear power	8.21	8.31	9.05	9.57	17 (0.6)
Renewable energy[b]	3.74	4.53	5.64	6.13	64 (2.1)
Others[c]	0.19	0.18	0.17	0.20	8 (0.3)
Total	39.68	41.46	45.21	49.21	24 (0.9)
Western Region[d]					
Liquid fuels and other petroleum	0.12	0.11	0.12	0.15	19 (0.7)
Natural gas	1.56	1.64	1.59	1.13	–28 (–1.4)
Steam coal	2.34	2.56	3.00	4.19	79 (2.5)
Nuclear power	0.77	0.77	0.78	0.78	1 (0.1)
Renewable energy[b]	2.36	2.68	3.01	3.25	38 (1.3)
Others[c]	–0.01	–0.01	–0.01	–0.02	52 (1.8)
Total	7.15	7.75	8.49	9.48	33 (1.2)

[a] One million billion, i.e., 10^{15}.

[b] Includes conventional hydroelectric, geothermal, wood and wood waste, biogenic municipal solid waste, other biomass, petroleum coke, wind, and photovoltaic and solar thermal sources.

[c] Includes nonbiogenic municipal wastes and electricity imports.

[d] Population and electricity divisions used in projected energy analysis by the EIA cover an area in the western United States that contains but is not exactly matched with the study area.

Source: EIA (2008).

Climate Change

There is a growing consensus in the scientific community that human activity is contributing substantially to the increase in the Earth's surface temperature (IPCC 2007). The phenomenon is very likely due to human-generated increases in GHG concentrations. GHGs include water vapor, CO_2, methane, O_3, N_2O, and several fluorine- and chlorine-containing gases. Of these gases, CO_2 is believed to be contributing the most to recent warming. In the atmosphere, GHGs trap heat that would otherwise escape into space, creating a "greenhouse effect." Since the inception of the industrial era, the burning of fossil fuels and clearing of forests have greatly intensified the natural greenhouse effect, causing global average temperatures to rise at a fast rate; for example, in the United States, average temperatures have risen at a rate of nearly 0.6°F (0.3°C) per decade in the past few decades (National Science and Technology Council 2008).

TABLE 6.5-20 Total Water Withdrawals by Source, 2005[a,b,c]

State	Population (thousands)	Water Withdrawals (million gal/day) Groundwater	Surface Water	Total[d]	Water Withdrawals (thousand ac-ft/yr) Total
Arizona	5,940	3,050	3.200	6,240 (48.9)	7,000
California	36,100	11.000	34,800	45,700 (24.1)	51,300
Colorado	4,670	2,520	11,100	13,600 (18.5)	15,300
Nevada	2,410	981	1,400	2,380 (41.2)	2,670
New Mexico	1,930	1,680	1,650	3,330 (50.5)	3,740
Utah	2,550	955	4,160	5,120 (18.7)	5,730
Total	53,600	20,186	56,310	76,370 (26.4)	84,740

[a] Figures may not add up to totals because of independent rounding.

[b] Totals for groundwater and surface water include both fresh and saline sources.

[c] To convert gal to L, multiply by 3.785. To convert ac-ft to m^3, multiply by 1,234.

[d] Number in parentheses represents percentage groundwater.

Source: Kenny et al. (2009).

This effect is sometimes referred to as global warming; however, because the warming phenomenon is not distributed evenly across the Earth's surface, it is increasingly referred to as "global climate change." Climate change is a more flexible term, reflecting the fact that changes in the climate due to warming are not universal across the globe—some regions will warm, others will cool. Some of the critical climate changes already observed in the United States are increased numbers of heat waves; changes in annual precipitation and drought, with significant regional variability; regional changes in snow cover; sea level rises along the Atlantic and Gulf coasts; and increases in the number and intensity of tropical storms and hurricanes.

The physical effects of climate change in the western United States include warmer springs (with earlier snowmelt), melting glaciers, longer summer drought, and increased wildland fire activity (Westerling et al. 2006). All these factors contribute to detrimental changes to ecosystems (e.g., increases in insect and disease infestations, shifts in species distribution, and changes in the timing of natural events). Adverse impacts on human health, agriculture (crops and livestock), infrastructure, water supplies (reduced stream flow and rising stream temperatures), energy demand (due to increased intensity of extreme weather and reduced water for hydropower), and fishing, ranching, and other resource use activities are also predicted (GAO 2007; Backlund et al. 2008; National Science and Technology Council 2008).

6.5.2 Cumulative Impacts Assessment for Solar Energy Development

Cumulative impacts on important resources that would result from the construction, operation, and decommissioning of solar energy development projects, when added to other past,

TABLE 6.5-21 Total Water Withdrawals by Water-Use Category in 2000 and 2005[a]

	Water Withdrawals (million gal/day)[b]											
						Industrial		Mining		Thermoelectric Power		
State	Public Supply Fresh	Domestic Fresh	Irrigation Fresh	Livestock Fresh	Aquaculture Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total
2000												
Arizona	1,080	28.9	5,400	–[c]	–	19.8	0	85.7	8.17	100	0	6,730
California	6,120	286	30,500	409	537	188	13.6	23.7	153	352	12,600	51,200
Colorado	899	66.8	11,400	–	–	120	0	–	–	138	0	12,600
Nevada	629	22.4	2,110	–	–	10.3	0	–	–	36.7	0	2,810
New Mexico	296	31.4	2,860	–	–	10.5	0	–	–	56.4	0	3,260
Utah	638	16.1	3,860	–	116	42.7	5.08	26.3	198	62.2	0	4,970
2005												
Arizona	1,170	27.2	4,810	12.6	11.5	22.4	0	101	2.61	89.9	0	9,960
California	6,990	486	24,400	197	646	72.2	23.4	53.1	255	49.6	12,600	45,700
Colorado	864	34.4	12,300	33.1	88.0	142	0	6.44	15.0	123	0	13,600
Nevada	676	37.4	1,500	8.51	15.3	5.90	0	99.1	0	36.8	0	2,380
New Mexico	286	32.0	2,810	50.7	20.2	13.2	0	58.7	0	55.9	0	3,330
Utah	607	13.9	4,000	17.8	87.7	35.4	127	5.14	162	58.0	4.18	5,120

[a] Figures may not add up to totals because of independent rounding.

[b] To convert gal to L, multiply by 3.785.

[c] Data not collected.

Sources: Hutson et al. (2004); Kenny et al. (2009).

present, and reasonably foreseeable future actions described in the previous section are discussed below. Although the locations and sizes of specific facilities are not known, on the basis of the RFDS developed for this PEIS (see Section 2.4), it is assumed that overall solar development in the six-state study area would be approximately 24,000 MW on BLM-administered lands, with an additional 8,000 MW on non-BLM lands. This level of development would require a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands and 71,000 acres (287 km^2) of non-BLM lands. As discussed in the introduction to the cumulative impacts section (Section 6.5), the RFDS is considered generally applicable to solar development occurring under any of the alternatives evaluated in this PEIS. Because of the uncertain nature of future projects in terms of size, number, location, and the types of technology that would be employed, the impacts are discussed qualitatively or semi-quantitatively, with ranges given as appropriate. Detailed cumulative impact analyses are provided for individual SEZs in Chapters 8 through 13. More detailed analyses of cumulative impacts would be performed in the environmental reviews for specific projects in relation to all other existing and proposed projects in the relevant geographic area.

6.5.2.1 Lands and Realty

Solar energy facilities, for the most part, would be built in rural areas within the six Western states covered by this PEIS in large tracks of flat, open, lands where high levels of solar insolation are present. Such lands are typically sparsely populated, often isolated, and typically lightly used, including for grazing, mineral production, limited recreation, and ROWs for wind energy development, transmission lines, other linear utilities, and roads. Placing solar energy facilities in these areas usually represents a new and different land use, creating areas of commercial/industrial character in rural environments. Utility-scale facilities would block out large tracks of land, cumulatively totaling approximately 285,000 acres (1,153 km^2) over the next 20 years, removing or limiting many current land uses. Primary effects would be on access for grazing and mining and road access for recreation or transport. Existing ROWs representing prior rights would be honored, however, and BLM land use plans would be revised to accommodate solar development.

Contributions of solar energy development to cumulative impacts on lands and realty would be in addition to those from other ROWs for transmission lines, roads, and other facilities on public lands and from other energy development on public and private lands that would further affect and limit other land uses within a given region. The intensive coverage of land surface required by solar facilities renders the land used incompatible for most other uses, including grazing, mineral development, and recreation. Although wind and geothermal facilities also encompass large areas, they are generally more compatible with such other uses, because they require less land and can accommodate multiple uses.

The magnitude of land use effects from solar development could be fairly large locally, but significantly smaller regionally, and small overall over the six-state region. On a local scale, solar facilities would dominate several square kilometers of land lying in basin flats and would introduce an industrial land use in typically an otherwise rural area. On a regional and statewide basis, while facilities would affect areas of similar topography, thus increasing their relative impacts on such land types, the percentage of such land types affected would remain quite small for the amount of land required to meet the RFDS.

Renewable energy development is by far the largest potential new future use of rural lands. No other major contributors to cumulative impacts on lands and realty are foreseeable, beyond perhaps additional energy transmission and other linear systems, some of which would be built to serve renewable energy development. Thus, renewable energy development would be the major contributor to cumulative impacts on land use in the affected regions. Solar energy development, because of its intensive land use, would be a major contributor to those impacts.

6.5.2.2 Specially Designated Areas and Lands with Wilderness Characteristics

Lands suitable for solar energy development in the six-state area, whether public or private, are typically basin flats surrounded by mountains. As such, these lands are often located near one or more specially designated areas and lands with wilderness characteristics, which often lie in the surrounding mountains but also include protected desert areas. Potential effects of nearby solar facilities on these sensitive areas include visual impacts, reduced access, impacts on wildlife that use the developed areas, and fugitive dust during construction, which may affect visibility.

Cumulative impacts on these sensitive areas would be from increased development and visual clutter in general in the surrounding areas, reduced local and regional visibility due to construction-related air particulates, light pollution, road traffic, and impacts on wildlife and plants. As for land use noted above, renewable energy development is the major foreseeable contributor to cumulative impacts on these resources, with solar energy the primary contributor in many areas. Other future developments that could affect these areas include mining, off-road vehicle use, military and civilian aviation, and new transmission lines and other linear facilities. Most such developments would affect the viewshed and would produce fugitive dust emissions during construction, while mining and aviation would also have noise and vibration effects. While all solar technologies would produce visual effects, other impacts would depend on the employed solar technology, with PV having generally the lowest overall impacts. Solar trough and power tower technologies including a power block would have the greatest impacts, while noise from dish engine facilities might affect some nearby areas. Cumulative effects would be dominated by solar facilities in favorable areas and by renewable energy development in general. Because of the general vastness of the affected area, foreseeable impacts on specially designated areas in the six-state region under the RFDS assuming a total of approximately 285,000 acres (1,153 km^2) of land disturbance would be relatively small overall, but moderate to large in localized areas for individual specially designated areas, especially with respect to visual impacts. Several design features required under the BLM action alternatives would minimize the impacts from solar development, including (1) siting solar facilities as far as possible from key observation points (KOPs) and (2) limiting fugitive dust generation during construction through best management practices and proper timing of work.

6.5.2.3 Rangeland Resources

Solar facilities will be located in areas that are currently grazed, while some may also affect areas managed for wild horses and burros. However, the number of affected grazing allotments is generally small, and in many cases the allotments would incur only a small reduction in size. Indirect impacts could result from disruption of livestock movement or access to water sources. A small number of permit holders could be significantly affected, although permit holders could be compensated for losses. Solar energy facilities would be a major contributor to foreseeable impacts on grazing, since wind and geothermal energy facilities and other foreseeable development are generally more compatible with grazing. Cumulative impacts on grazing would, however, be small.

Similarly, wild horse and burro management areas could be affected by solar facilities if management areas are located within the area of indirect effects, nominally within 5 mi (8 km) of the facilities. Solar facilities would generally not be sited directly within herd management areas. Design features required under the BLM action alternatives would also require protective measures for wild horses and burros as needed, such as the provision of movement corridors, traffic management, and fencing. Cumulative impacts on wild horse and burro management areas would be small overall, as would any contributions from solar facilities. Wild horse and burro management areas encompass a small fraction of total available lands, and they also include lands not suitable for solar development because of topography and other factors, thus reducing conflicts.

6.5.2.4 Recreation

Under the BLM action alternatives, special recreation management areas (SRMAs) have been excluded from solar development, so these areas could be affected only indirectly by solar facilities located close to their boundaries. SRMAs identify public lands with many of the BLM's most well known and highly used recreational opportunities, so excluding SRMAs from solar development would limit the significance of impacts to recreation. High levels of intensive recreational use generally do not occur within the basin flats suitable for solar development. The presence of solar facilities would affect mainly off-highway vehicle (OHV) use and low levels of hunting, camping, and photography, for example. In addition, access to recreational areas could be restricted by solar facilities. The level of solar energy development projected by the RFDS would occupy a relatively small portion of the BLM-administered lands in the six-state study area. Since alternative locations for such recreation are generally abundant within the six-state region, direct impacts from solar facilities on the overall availability of recreation opportunities are anticipated to be low. Future site-specific analyses of potential solar facilities would identify measures that would reduce anticipated impacts on local recreational use patterns and public access needs, which would further mitigate potential impacts to public land recreation opportunities. Other renewable energy facilities would also affect areas of low recreational use, as would most other types of foreseeable development in the region, including mining, agriculture, and linear transmission facilities. Thus, cumulative impacts on recreation from foreseeable development are expected to be small.

6.5.2.5 Military and Civilian Aviation

The air space above many of the areas suited to solar energy development is currently heavily used as military training routes. Military training routes located over prospective solar facility locations have varying airspace authorizations (i.e., specific heights designated for military use), and coordination and/or consultation with the DoD may identify restrictions on the height of any facilities that might be constructed within these routes. Such restrictions could constrain the types of solar technologies that might be deployed. The construction of high-voltage transmission lines could also conflict with such military airspace use, which could constrain the size and routes of such lines. Glint and glare from solar facilities and any other facilities with reflective surfaces are an additional concern to military pilots. Small cumulative impacts on military aviation could occur from general development in the region, including that from solar facilities, even with established training routes and height restrictions, because of general infringement on formerly wide-open spaces. The military has expressed concerns regarding the possible effects of solar facilities on its training mission. A policy applicable to both BLM's action alternatives requires coordination with the military regarding the location of solar power projects early in the application process.

Civilian aviation would likely be much less affected than military aviation by solar development in the six-state region. Airports are generally located near towns or cities and at some distance from prospective solar development areas. Moreover, civilian aviation would not involve low-altitude flights and the attendant need for height restrictions on infrastructure. No cumulative effects on civilian aviation are expected.

6.5.2.6 Geologic Setting and Soil Resources

The primary concern for geologic and soil resources from solar development is the large acreages that would be disturbed for the construction of utility-scale facilities. While the topography of suitable areas is necessarily flat in general, the entirety of areas where solar fields are built would have to be graded to produce a very smooth, very flat surface for solar collectors. Such grading would render large areas susceptible to soil erosion. This would be particularly of concern in areas where biological soil crusts are present. While soil erosion mitigation measures would be in place, some soil loss would be unavoidable, given the large acreages disturbed, typically dry soil conditions, and occurrence of high winds in development areas. Solar energy development would be a major contributor to cumulative impacts on soil from foreseeable development in the six-state region. Other foreseeable actions that would contribute to soil erosion are road construction, including that associated with solar and other renewable energy development, transmission lines, pipelines, mining, agriculture, and OHV use. Overall foreseeable cumulative impacts on soil would be small to moderate with appropriate mitigations in place and given the relatively small fraction of total land area potentially affected by all development.

6.5.2.7 Mineral Resources

Recoverable minerals that may occur in prospective solar energy development areas include oil and gas, coal, copper, silver, gold, sodium minerals, and sand and gravel. Numerous existing mining interests lie within prospective solar development areas that represent prior existing rights. Solar facilities would be incompatible with most types of mineral production because of the intensive land coverage required. Underground mining might remain viable beneath solar facilities, as would oil and gas recovery using directional drilling. Geothermal resources might also be recoverable in solar development areas. Other foreseeable development, which generally requires less land than solar development, would contribute small additional impacts on mineral resources.

6.5.2.8 Water Resources

Solar thermal energy technologies that employ a conventional steam turbine generator within a power block (mainly trough and power tower technologies) can require large quantities of water for cooling unless air cooling or hybrid cooling is employed. Far smaller quantities of water are required by all solar technologies for mirror or panel washing and for potable water uses. Water-cooled facilities would typically rely on groundwater within the six-state region, because surface water sources are scarce. Recirculating wet-cooled facilities would be practical only in locations with ample groundwater supplies of suitable water quality where water rights could be obtained as well as the approval of state and local water authorities. SEZ-specific design features would not allow wet cooling at solar facilities on most of the SEZs, and it is unlikely that facilities using wet cooling would be permitted in most locations within the study area.

Where groundwater or surface water use for cooling was available, the operation of solar energy facilities could affect surface water flows and groundwater supplies and water levels. Environmental effects from such use could include effects on aquatic, riverine, and wetland habitats and communities, municipal and agricultural water supplies, and ground surface subsidence. Effects could occur at significant distances downgradient from the point of use, depending on local hydrology. A design feature under the BLM action alternatives would require developers to conduct hydrologic studies and avoid impacts on surface water features from groundwater use. Other design features would require long-term monitoring of groundwater resources. Overall, the impacts on water supplies from dry-cooled solar thermal facilities and dish engine facilities would likely be minor, since such facilities would not be permitted unless studies had shown that there would be no significant impacts on the hydrologic system. PV facilities would have minor impacts on water supplies.

Wind energy facilities would not require water for operation. Water would be required for other energy generation and development activities, including coal, natural gas, and geothermal power plants, mining, oil shale and tar sands development in some of the affected states, and possibly biofuels production. All new construction would require water for fugitive dust control. Solar facilities, in particular, require large volumes of water during construction to control dust emissions over large acreages. An additional large increase in water use in the area would be associated with increased domestic use as the population increases.

Cumulative impacts on water supplies in the six-state region from foreseeable development could range from small to moderately high. Impacts will be constrained by the limited availability of water rights, and via oversight by state and local water authorities. Large drawdowns due to solar energy demands are not expected under the RFDS given state and locale oversight of groundwater supplies and fully allocated supplies in most regions. However, pressure on water supplies will continue to grow from multiple demands. In addition, changes in regional precipitation and temperature that have been attributed to global climate change are expected to reduce total water supplies in the southwestern United States (USGCRP 2009). Some water demand will be met by increased reuse of municipal wastewater, while water conservation measures will be increasingly applied. Effects of diversion of water use from agriculture to solar energy development could appear as effects on land use or as socioeconomic effects.

6.5.2.9 Ecological Resources

6.5.2.9.1 Vegetation

The construction of solar energy facilities will require the total removal of vegetation over large portions of land. Most of this land is located in arid or semiarid regions where restoration of vegetation is difficult and where the introduction of invasive species is a significant concern. Development of an integrated vegetation management plan is a design feature applicable under both BLM action alternatives. This plan would require long-term control of invasive species through several means, including monitoring, use of certified weed-free seed and mulching, treating infestations, and integrated pest management.

The main cover types affected are typically abundant in the affected regions, so impacts to these plant communities would not be large. However, a number of minor species, associated with rare or limited habitats, such as dunes, woodland, or riparian areas in desert regions, might incur greater impacts if not avoided or protected. Biological soil crusts also could incur greater impacts that would be long-term or possibly irreversible. Design features applicable under the BLM action alternatives require that projects not be sited in critical habitat or occupied habitat for sensitive plant species, and that sensitive habitats be protected to the extent possible. Coordination with appropriate federal and state agencies to identify these habitats would be required. While solar facilities would avoid wash areas and wetlands to the extent practicable, some sensitive areas could still be affected by the facilities or by access roads, transmission lines, or pipelines that traverse them.

Cumulative direct impacts on plant communities from foreseeable development in the six-state region could be moderate for some sensitive species. Because of the large land areas disturbed and the presence of sensitive communities, solar energy facilities could be a significant contributor to such impacts. Mitigation measures, including avoidance, could protect most sensitive plant communities. Cumulative impacts on primary cover species would be small due to their abundance in the region and the relatively small portion of total lands required under the RFDS.

Plant communities outside of the areas directly affected by solar facilities could be indirectly affected by dust deposition from construction activities, increased surface water runoff and related erosion, or through the introduction of invasive species. Development of a dust abatement plan with extensive measures to limit dust generation during construction and operations is a design feature applicable under both BLM action alternatives. Similarly, multiple design features require the control of surface water runoff and erosion. Spread of invasive species would be addressed through integrated vegetation management as discussed above. With implementation of these measures, indirect cumulative impacts to vegetation are expected to be small.

6.5.2.9.2 Wildlife and Aquatic Biota

Potentially affected wildlife in solar development areas includes numerous species of amphibians and reptiles, birds, mammals, and aquatic biota. Species would be affected by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, noise, and habitat fragmentation. Solar facilities could affect bird migration patterns and attract birds to retention ponds. Transmission towers provide nesting and perching sites, while conductors present collision hazards to birds. Aquatic species could be affected by changes in drainage patterns due to site grading and the implementation of storm water management systems that might divert flows. Groundwater drawdown could dry up wetlands or other areas hosting aquatic species. Design features to address these impacts include timing of activities to avoid affecting breeding seasons and winter use areas, use of noise reduction devices, use of fencing to protect wildlife, traffic control, and preservation of wetlands. These design features would reduce, but not eliminate impacts.

Cumulative impacts on wildlife and aquatic biota from foreseeable development in the six-state region would be small provided mitigation measures to preserve important habitat and migration corridors are implemented (or sufficient alternative lands are set aside as compensation). This assessment assumed that solar development would affect the largest amount of acreage in the study area in comparison with other activities, on the basis of the assessment of other foreseeable actions and projects in the study area (see Section 6.5.1). However, based on the RFDS land use projections, solar development would still affect a relatively small fraction of total BLM-administered lands in the study area, and solar facilities would affect mainly flat basin floors, habitat that is abundant in the region. Design features required under the BLM action alternatives would also require the avoidance of rare habitats. Effects on aquatic habitats from drainage changes and sedimentation from soil erosion would be mitigated but not eliminated. Effects from groundwater drawdown would depend largely on solar cooling technologies employed. Large drawdowns due to solar energy demands are not expected under the RFDS given state and local oversight of groundwater supplies and fully allocated supplies in most regions.

6.5.2.9.3 Special Status Species

Special status species, those given special protections under the Endangered Species Act (ESA) or identified as sensitive species by the affected states or the BLM, are present in much of the area suited for solar development. The ESA protects individual animals or plants, as well as critical habitat. The ESA requirements are reflected in and expanded on in the design features applicable for both BLM action alternatives. Design features include requirements for project developers to identify and protect listed and sensitive species through field surveys and other measures prior to breaking ground. Designated and proposed critical habitat must be avoided wherever feasible. Wherever feasible, projects also must avoid surface water or groundwater uses that affect habitats occupied by special status species. If avoiding or minimizing impacts on occupied habitats is not possible, translocation of individuals from areas of direct effect or compensatory mitigation of direct effects on occupied habitats could reduce impacts. A comprehensive mitigation strategy for special status species that uses one or more of these options to offset the impacts of development should be developed in coordination with the appropriate federal and state agencies.

Cumulative impacts from foreseeable development in the six-state region could be small to moderate for some species, with solar development being a major contributor to cumulative impacts. A few species would be of concern in many areas, including the desert tortoise, Western burrowing owl, and ferruginous hawk. Impacts on individuals would be the most difficult to mitigate. Contributions to cumulative impacts from solar development owe to the large, continuous, areas disturbed and disturbance from associated roads, transmission lines, and pipelines.

6.5.2.10 Air Quality and Climate

6.5.2.10.1 Local and Regional Impacts

Air quality would be affected locally and temporarily from fugitive dust emissions during construction of solar facilities; associated particulate matter (PM) concentrations could temporarily exceed ambient air quality standards near construction areas and possibly affect visibility in pristine areas such as national parks. Application of measures included in an extensive dust abatement plan (a design feature for both BLM action alternatives) would substantially reduce the PM levels generated during construction. The operation of solar facilities would produce very few emissions. Power-block facilities in solar thermal plants could produce some cooling tower drift if water cooling were used, as well as small levels of pollutants from natural gas or propane combustion from backup generators, as well as occasionally from emergency diesel generators. Portions of facilities that are maintained vegetation-free during operations could be a source of windblown fugitive dust, although design features requiring dust minimization would reduce this source. There also would be limited emissions from vehicles and natural gas-fired pre-heat boilers (if used).

Overall, however, emissions from solar facilities are low and would not contribute to local or regional air pollution problems. Contributions to cumulative effects on air quality would likewise be low, and cumulative effects from other foreseeable development in most solar development regions would be low, given that renewable energy facilities are the major type of new development expected to occur in the generally remote areas where solar facilities would be built. Portions of the study area have well-known ongoing air quality problems, primarily Southern California. Solar developments in such regions would not worsen air quality, except for particulate matter during construction. To the extent that solar facility operations offset energy production from fossil fuels, pollutants loads would be reduced for combustion-related pollutants such as CO, SO_2, and NO_x.

6.5.2.10.2 Global Climate Change

As discussed in Section 6.5.1.2.2, increasing atmospheric levels of GHGs (primarily CO_2) are linked to global climate change (IPCC 2007; USGCRP 2009). Utility-scale solar energy development contributes relatively minor GHG emissions as a result of emissions from heavy equipment, primarily used during the construction phase; vehicular emissions; and natural gas or propane combustion from backup generators. The removal of plants from within the footprint of solar energy facilities would reduce the amount of carbon uptake by terrestrial vegetation, but only by a small amount (about 1% of the CO_2 emissions avoided by a solar energy facility compared to fossil-fuel generation facilities [see Section 5.11.4]).

Utility-scale solar energy production over the next 20 years may result in fewer CO_2 emissions from utilities by offsetting emissions from new fossil fuel energy sources. CO_2 emission offsets related to increased solar energy production could range from a few percentage points to more than 20% in some of the study area states if future fossil energy production were offset by solar energy. Table 6.5-22 provides a comparison of the CO_2 emissions of different generation technologies during facility operations.

TABLE 6.5-22 Comparison of CO_2 Emissions from Different Generation Methods per Average Megawatt

Type of Energy Generation	CO_2 Emissions (ton/MW)
Wind	0
Solar	0
Hydropower	0
Geothermal	636
Coal	7,551–8,843
Natural gas combined-cycle	3,313–5,142
Nuclear	0
Wood-fired co-generation	11,959
Solid-waste-fired co-generation	13,256

Source: BPA (2003).

In the near term, solar facilities would tend to offset facilities serving peak loads rather than baseline loads served by large fossil fuel plants. Emissions from future fossil fuel plants serving peak loads, typically natural gas–fired plants, would nevertheless be offset. The addition of thermal energy or electrical storage to solar facilities could allow offsets of baseload fossil fuel plants in the long term.

Because GHG emissions are aggregated across the global atmosphere and cumulatively contribute to climate change, it is not possible to determine the specific impact on global climate from GHG emissions associated with solar energy development on BLM-administered lands over the next 20 years. It is possible to predict, however, that increased solar energy generation could cumulatively result in fewer GHG emissions if it offsets electricity generation from new fossil fuel facilities.

6.5.2.11 Visual Resources

The introduction of solar facilities in remote rural areas would alter the landscape and produce dramatic changes in the visual character of many affected areas. In addition, suitable solar energy production locations are in basin flats surrounded by mountains or highlands where sensitive viewing locations exist. Thus, visual impacts could be acute for some observers, including hikers and park visitors, and also for certain groups, including Native American tribes or other ethnic groups who live in affected areas.

In addition to visual impacts from solar facilities, impacts would accrue from associated transmission lines, roads, pipelines, and lighting—all of which can have high visual impacts over long distances. Thus, solar development would be a major contributor to cumulative visual impacts from foreseeable development in the six-state region. Overall, cumulative impacts for all development could be significant, including impacts from wind and geothermal development, new roads, transmission lines, pipelines, canals, fences, communication systems, mining, agriculture, commercial development, aviation, road traffic, and OHV use. Visual impacts from solar facilities would be mitigated to the extent practical through the implementation of design features and through careful siting of facilities relative to sensitive viewing sites. Concerns for visual impacts could also affect solar technology selection, including, for example, concerns related to the height of solar tower facilities.

6.5.2.12 Acoustic Environment

Noise effects from heavy equipment and power tools during construction of solar facilities would be similar to those from any large construction project. Such impacts would depend on the type of solar technology being installed, with the lowest noise impacts for PV and dish engine installation and the greatest noise impacts and ground vibration associated with power block construction for solar energy facilities. Facility construction typically requires from 1 to 3 years, with intermittent noise nuisance effects possible on nearby residents and/or wildlife. Facilities would generally not be located near sensitive noise receptors such as schools, hospitals, or residential areas but could affect individual residences. Design features under the BLM action alternatives to address noise during construction include limiting the daily hours of activities, construction of noise barriers if needed and practicable, and coordination with nearby residents.

Noise for solar facility operations would be generally low and depend on the solar technology. PV facilities would produce little or no noise. Solar thermal facilities would produce low levels of continuous noise from power blocks and from cooling towers or cooling fans in air-cooled plants. Power blocks represent a localized noise source typically located near the center of a solar facility and far from facility boundaries. Dish engine facilities present the greatest concern for noise, because each dish represents a single, distributed noise source. While a single dish engine produces modest noise levels, a solar facility might employ thousands of them, presenting a significant noise concern near facility boundaries. Careful siting would mitigate such impacts. For example, SEZ-specific design features generally require siting of dish engine solar fields from 1 to 2 mi (2-3 km) from residential areas. Since noise impacts are short range and solar development areas are mainly sparsely populated and otherwise largely undeveloped, few cumulative noise impacts would occur.

6.5.2.13 Paleontological Resources

Paleontological resources, mainly fossils, can be affected by construction excavation for solar facilities. Such effects can be mitigated by collecting or documenting fossils when encountered, with the aid of a paleontologist, or by avoiding areas rich in fossils. Many prospective solar areas have not been surveyed for fossils, and the presence of fossils can be inferred only by the types of geological deposits and soils present. Such areas would be surveyed prior to facility construction. Because of the vastness of the area, cumulative effects on paleontological resources in the six-state area from foreseeable development are expected to be small, while solar development could represent a major contribution to these small effects because of the large acreages disturbed for construction. However, while large in size, much of the area encompassed by solar arrays would not require deep excavation and thus would not likely disturb buried fossils. Foundations for solar collectors, reflectors, or dish engines typically involve minor or no excavation or employ a single piling driven into the ground. Deep excavations would occur for power block foundations, retention ponds, and other structures for some types of solar facilities. Shallow to moderately deep excavations for underground utilities and energy collector lines would be required at most facilities.

6.5.2.14 Cultural Resources

Cultural resources are subject to loss during construction of solar facilities and associated roads and transmission lines. Historic properties, including prehistoric and historic archaeological sites, structures, and features and traditional cultural properties, that have been listed in or are eligible for listing in the *National Register of Historic Places* (NRHP) are of concern. Cultural resource surveys, evaluations, and any necessary mitigation of NRHP-eligible resources adversely affected by a project must be conducted prior to construction. Consultation with affected local Native American Tribes regarding their knowledge of and/or concerns for cultural resources in a given project area must be implemented early and often throughout the project development process. In the event that cultural resources are unexpectedly encountered during construction activities, provisions should be in place (e.g., a historic properties treatment plan, mitigation and monitoring plan) to address the appropriate evaluation and treatment of such cultural resource discoveries. Areas rich in cultural resources would be avoided if possible. Cumulative effects on cultural resources from foreseeable development in the six-state region are expected to be small because of the relatively small fraction of total land disturbed. Solar energy development could be a major contributor to these impacts. However, for the most part, solar facilities could, and would wherever possible, be sited away from areas rich in cultural resources. Such areas would include individual properties (sites, structures, features, traditional cultural properties) and districts listed in the NRHP, National Historic Landmarks, National Historic Trails, and prehistoric and historic sites possessing significant scientific, heritage, or educational values.

6.5.2.15 Native American Concerns

Solar development areas lie on or near lands of current and historical interest to numerous Native American Tribes. Solar energy facilities could be of concern to Tribes because of an array of potential impacts. Foremost among these would be impacts on the landscape, which would be dramatically altered by solar facilities. Other resources of concern include trails, sacred sites, burial sites, as well as traditionally collected plants and game. Water bodies and aquatic habitats are also of concern. Consultation with affected Tribes is required prior to siting and construction of solar facilities. Mitigations of impacts would involve any and all mitigations otherwise identified for the affected resources. Cumulative impacts on Native American concerns from foreseeable development in the six-state region are currently unknown, because consultation is still ongoing (see Appendix K for concerns that have been raised to date). Solar development could make a significant contribution to impacts, as would wind and geothermal development. Other future development that would affect the visual landscape, ecological communities, water resources, or cultural resources would also contribute to cumulative impacts.

6.5.2.16 Socioeconomics

On the basis of the RFDS projection of 24,000 MW of solar energy generation, the number of construction jobs created would range from approximately 7,700 to 84,000, and the number of permanent operations jobs would range from about 450 to 10,000, depending on the mix of solar energy technologies employed. PV facilities require the fewest workers, and parabolic solar thermal trough technologies the most. The total income estimated to result from solar development under the RFDS varies by state. In California, the largest of the six states, total estimated construction income would be $2,544 million for build-out with PV technology and $28 billion for parabolic trough technology. Total operations annual income would be $750 million in California. Construction income would be realized over an assumed development period of 20 years (approximately through 2030), while operations income would be ongoing.

As a point of comparison, the gross domestic product of California in 2008 was $1,545 billion, so the new income related to permanent operations jobs from solar development in the state over the study period would be a small percentage of the state's gross domestic product, roughly 0.05%. However, for all the states, the economic impact would occur in areas of low population, resulting in relatively larger local economic benefits. The relatively small operations workforce would not be expected to strain local services or cause significant social impacts in communities. During the build-out phase, however, large numbers of construction workers might cause temporary social disruption in small communities.

Cumulative social impacts for all development would likely be minor, due to the slow pace of other types of development in the rural areas that would be utilized for solar and other renewable energy development. However, the overall cumulative economic activity related to general development in the study area would benefit the economies of any of the affected localities.

6.5.2.17 Environmental Justice

Environmental justice effects concern any disproportionately high and adverse human health or environmental effects of federal actions, programs, or policies on minority and low-income populations. Solar energy development has potential for such effects where minority or low-income populations may be affected. Such effects may derive from air pollution, noise, land use, cultural, or socioeconomic impacts. These effects may be negative, as in the case of increased noise levels or altered land use patterns, or positive, as in the case of local or regional economic benefits resulting from increased jobs and revenue. Mitigation of effects would include surveys to identify potentially affected minority and low-income populations, direct mitigation of effects on natural resources, and social programs to mitigate economic and social effects. Cumulative effects on environmental justice from foreseeable development in the six-state study area are expected to be small. Contributions from solar development would likely be small, due to the low level of health and environmental effects associated with solar facilities, sparse populations in solar areas, and the availability of effective mitigation.

6.5.2.18 Transportation

Effects on transportation systems from solar development would occur mainly during construction of facilities and would affect primarily local road systems and traffic flow. Such effects would be temporary and could be mitigated through minor road improvements at access points and through reduction in traffic congestion through car pooling and coordination of shift changes. Only minor contributions to cumulative effects on transportation would be expected in the six-state study area during the development of solar facilities. Because of the small number of workers required to operate plants and the relatively low level of delivery traffic to and from facilities required for operation, cumulative impacts on transportation systems during facility operations would be minimal.

6.6 OTHER NEPA CONSIDERATIONS

6.6.1 Unavoidable Adverse Impacts

Utility-scale solar development under the action alternatives and under the no action alternative would result in some unavoidable adverse impacts, as follows:

- Short-term air quality impacts due to dust generated during site-preparation and construction, and noise impacts due to use of heavy construction equipment;
- Short-term influx of workers and transportation-related impacts (e.g., increased traffic) during the construction phase;
- Long-term loss of grazing allotments;
- Long-term reduction in available water supply (relatively insignificant for PV facilities);
- Long-term loss of soil, vegetation, and habitat for wildlife (including sensitive species) and, potentially irreversible impacts to biological soil crusts;
- Long-term impacts on some species, both at the population level and on individual organisms;
- Long-term visual impacts on residents of communities near solar facilities, users of roads passing near solar facilities, and patrons of specially designated areas within the viewshed of solar facilities; and
- Long-term noise impacts for solar dish engine facilities and trough or power tower facilities employing thermal energy storage.

The magnitude of these adverse impacts would to some degree depend on a specific project and would be decreased by implementing the programmatic design features required under the action alternatives (e.g., siting facilities away from the most sensitive resources), although the extent to which these impacts could be mitigated cannot be assessed, except at the project level, and it is possible these impacts could not be completely avoided.

6.6.2 Short-Term Use of the Environment and Long-Term Productivity

For this assessment, short-term uses are defined as those occurring over a 2- to 3-year period, generally applicable to site characterization/preparation and construction phases. Long-term uses and productivity are those that occur throughout the 20-year time frame considered in this PEIS.

Although land disturbance within the footprint of solar energy generation facilities would be long term, additional areas affected during the construction of the generation facilities and related infrastructure (e.g., roads, transmission lines, and natural gas or water pipelines) would result in relatively short-term disturbance. Land clearing and grading and construction and operation activities would disturb surface soils and wildlife and their habitats, and affect local air and water quality, visual resources, and noise levels within and around the solar facility areas and on additional lands used for project-related infrastructure. Short-term influxes of construction workers would affect the local socioeconomic setting.

The lands used for solar facilities long term would produce electricity generated from a renewable source and would result in reduced emissions of GHGs and combustion-related pollutants, assuming the solar facilities offset electricity generated by fossil fuel power plants. These facilities would generate stable jobs and income for nearby communities (although at a lower rate than during the short-term construction phase), sales and income tax revenues, and income for the Federal Government in the form of ROW rental revenues over the life of the projects.

6.6.3 Irreversible and Irretrievable Commitment of Resources

Solar energy development on BLM-administered lands would result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials, some of them special-use materials (i.e., metals used in PV solar cells). At decommissioning, some of these materials would be available for reuse.

Water resources would be consumed during the construction phase and during operations, with the extent of water use varying by the technology selected; this would be an irreversible and irretrievable loss.

For most plant and animal species, population-level effects would be unlikely, based on the assumption that required design features are implemented; however, population-level effects are possible for some species. Additionally, during construction, operation, and decommissioning, individual plants and animals would be affected. Site-specific and species-specific analyses conducted at the project level for all project phases would help ensure that the potential for such impacts would be minimized to the fullest extent possible. There would be long-term reductions in habitat due to fencing of large areas during the operational period; this impact would be partially mitigated through siting in locations that do not contain critical habitat. Additional programmatic policies (e.g., requiring long-term monitoring and related additional mitigation) and design features would reduce the impacts over time. However, it is unknown whether irreversible and irretrievable impacts to species would occur.

Biological soil crusts are fragile and damage to them could constitute an irreversible and irretrievable impact. When these biological soil crusts are removed, the underlying soils may be subject to increase erosion by both wind and water. Programmatic design features that minimize the amount of land disturbance could be applied to reduce the impacts to these resources.

Cultural and paleontological resources are nonrenewable. Impacts on these resources would constitute an irreversible and irretrievable commitment; however, implementation of the programmatic design features would minimize the potential for these impacts to the extent possible.

Impacts on visual resources in specific locations could constitute an irreversible and irretrievable commitment. Implementation of the programmatic design features would minimize the potential for these impacts to the extent possible; additional mitigation efforts would be undertaken at the project level with stakeholder input.

6.6.4 Mitigation of Adverse Effects

An extensive set of required programmatic design features addressing impacts on important resources and resource uses from solar development has been assembled and is presented in Section A.2 of Appendix A. These design features would be implemented for all solar facilities issued ROW authorizations on BLM-administered lands. In addition, SEZ-specific design features, presented in Section A.2 of Appendix A, would be implemented to ensure that unique issues and conditions are addressed. This comprehensive set of mitigation requirements would ensure that impacts from solar energy development on BLM-administered lands would be mitigated to the fullest extent possible. Any potential adverse impacts that could not be addressed at the programmatic level would be addressed at the project level, where resolution of site-specific and species-specific concerns is more readily achievable.

Under both action alternatives, the BLM would incorporate adaptive management strategies to ensure that new data and lessons learned about the impacts of solar energy projects would be used to avoid, minimize, or mitigate impacts to acceptable levels. The program administration and authorization policies and design features would be updated and revised as new data on the impacts of solar power projects become available. At the project level, operators would be required to develop monitoring programs, to establish metrics against which monitoring observations can be measured, to identify additional potential mitigation measures, and to establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures and project-specific stipulations.

6.7 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

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