SECTION 6.0

Alternatives

This section discusses alternatives to the Rice Solar Energy Project (RSEP) as proposed in this Application for Certification (AFC). These include the "no project" alternative, solar plant site alternatives, linear facility route alternatives, technology alternatives, and water supply alternatives. These alternatives are discussed in relation to the environmental, public policy, and business considerations involved in developing the project. The RSEP main objective is to provide sustainable, carbon-free, renewable electricity from solar energy with operational flexibility to help meet California's power needs.

The Energy Facilities Siting Regulations (Title 20, California Code of Regulations [CCR], Appendix B) guidelines titled *Information Requirements for an Application* require:

> A discussion of the range of reasonable alternatives to the project, including the no project alternative…which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and an evaluation of the comparative merits of the alternatives.

The regulations also require:

> A discussion of the applicant's site selection criteria, any alternative sites considered for the project and the reasons why the applicant chose the proposed site.

6.1 Project Objectives

The RSEP is being developed to provide sustainable, renewable, cost-effective energy, with energy storage for operating flexibility that contributes to the achievement of the renewable portfolio standards. Project objectives include the following:

- Provide sustained renewable power using integral thermal storage technology that is controllable and predictable and that can:
  - Capture solar energy throughout the day, in varying sunshine and cloud cover conditions
  - Retain thermal energy for electricity production later, during hours of peak electricity demand, including nighttime hours
  - Generate stable power to facilitate integration of increasing quantities of intermittent resources enhancing grid system stability
  - Diminish the necessity for grid system backup resources such as spinning reserve and peaking turbines
- Deliver a minimum of 450,000 MWh of cost-competitive renewable power annually

- Concentrate energy deliveries around high electric demand hours with generator output sized at 150 MW
- Minimize use of public lands by siting the project on previously disturbed private property
- Produce a reliable electricity supply free of carbon emissions to help diversify California's electrical power generation portfolio

In addition to technology alternatives described in this section, project objectives for site selection included minimizing or eliminating the length of transmission interconnections. These objectives reduce potential offsite environmental impacts, minimize the extent and complexity of mitigation, and reduce the overall cost of construction.

In responding to and addressing the need for environmentally responsible, cost-effective, operationally flexible, and efficient solar energy capacity in California, the project took into consideration the following criteria related to site selection:

- Excellent solar energy resource
- Site control readily available, disturbed brownfield site preferred
- Proximity to existing 115-kV or 230-kV high-voltage electrical transmission lines
- Adequate land to accommodate the project including temporary construction staging
- Slope of less than 6 percent

The proposed RSEP site meets all project siting objectives.

The RSEP will provide reliable solar energy to the grid to be responsive to California's on-peak demand for electricity and to contribute to the displacement of dirtier, less-efficient fossil fuel generation resources throughout the region, including peaking turbines. This facility will help the State of California to achieve the goal of 33 percent renewables by 2020 recently mandated by Governor Schwarzenegger in Executive Order S-21-09.

Additionally, as demonstrated by the analyses contained in this AFC, the project would not result in any significant, unmitigated environmental impacts. Therefore, as will be detailed in the following sections, there are no alternatives that would be preferred over the project as proposed.

6.2 The "No Project" Alternative

The "no project" alternative would forego all of the intended benefits associated with development of the RSEP project, including integral energy storage. The "no project" alternative would also likely result in demand for more energy production from the region's existing power plants and increasing reliance on conventional resources to manage intermittency associated with other renewable energy supplies such as wind and solar photovoltaic. In addition to the global environmental impact of using the less sustainable and carbon-dependant generation, there would likely be some negative economic consequences for the region's commercial and residential ratepayers and for the regional economy if no project were pursued.

In summary, the "no project" alternative would not serve the growing needs of California's businesses and residents for sustainable, carbon-free renewable electrical energy with operational flexibility and reliability similar to a traditional power generator. Moreover, the "no project" alternative would not satisfactorily meet the specified project objectives and thus was rejected in favor of the proposed project.

6.3 Solar Plant Site Alternatives

For comparison purposes, and to meet the requirements of the California Environmental Quality Act (CEQA) and Title 20, alternative sites were chosen that could feasibly attain most of the project's basic objectives. The alternative sites are shown in Figure 6.3-1. The key siting criteria in considering these alternatives and the proposed RSEP site are provided in Section 6.1.

6.3.1 Proposed Project Site

The project location is private land in eastern Riverside County. During World War II, the project site was used as a training airfield. After the war, the airfield was used privately for a short time and was eventually abandoned.

The land use designation for the project site is OS-RUR, Open Space Rural, and is zoned W-2 Controlled Development Areas, which allows development of a power plant. While the portion of the transmission route which is privately-owned is designated N-A Natural Assets, the majority of the transmission line route and interconnection substation location is on federal land under U.S. Bureau of Land Management (BLM) jurisdiction.

The site would require an approximately 10.0-mile-long electrical transmission line to connect to the nearby Western Area Power Administration's (Western) Parker-Blythe #1 transmission line. Two new onsite water wells will provide water for steam-cycle makeup, mirror washing, and other uses.

The project site is located in a very sparsely settled portion of the Mojave Desert/Sonoran Desert. The nearest residences are located approximately 15 miles to the northeast, at Vidal Junction. To the west, the nearest settlement is a cluster of homes located at the Metropolitan Water District (MWD) Iron Mountain Pumping Plant, 17 miles to the west. The nearest town offering significant services is Parker, Arizona, approximately 32 miles to the east. Blythe, California is 40 miles to the south. Twentynine Palms, California is 75 miles to the west.

The site is currently under option by RSE, meets all of the project's objectives, and the project would, after mitigation, result in no significant, unmitigated, environmental impacts.

6.3.2 Alternative 1: McCoy Site

The McCoy alternative project site (McCoy site) is located in Riverside County, approximately 25 miles southeast of the RSEP site. It is approximately 8 miles northwest of the city of Blythe, California, and approximately 6 miles north of the Blythe Airport. The McCoy site consists of five parcels, four of which are owned by the U.S. government and managed by BLM; the remaining parcel is under private ownership. The parcels are currently open desert.

The property is zoned OS-RUR, Open Space Rural. The site would require an electrical transmission line of less than 1 mile to connect to Western's Parker-Blythe transmission line. A solar energy project at this site would rely on groundwater for steam-cycle makeup and mirror washing; an onsite well would be required.

Rural residences are scattered throughout the nearby area; the nearest cluster of residences is approximately 5 miles to the southeast, along the northwestern edge of Blythe.

6.3.3 Alternative 2: Cadiz Site

The Cadiz alternative project site (Cadiz site) is located in San Bernardino County, approximately 45 miles northwest of the RSEP site. This alternative site is located in a sparsely settled portion of the Mojave Desert, approximately 6 miles south of National Trails Highway (formally known as Route 66) and approximately 20 miles south of Interstate 40. The town of Amboy is located approximately 15 miles to the west; the nearest town with full services is Twentynine Palms, approximately 65 miles to the southwest. The 7 parcels that form the Cadiz site are owned and controlled by Cadiz, Inc. and are currently open desert.

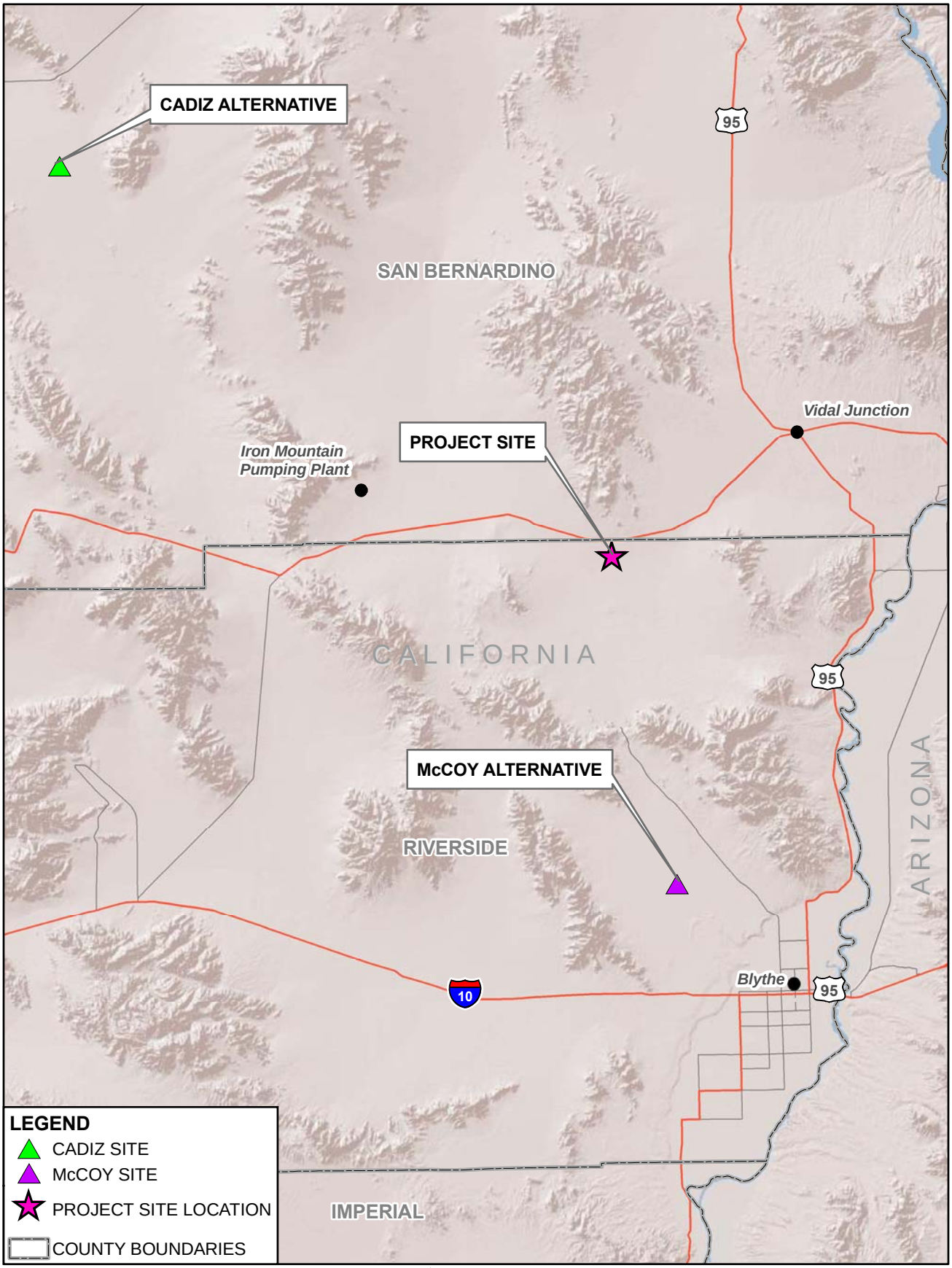
The property is zoned AG-160. The site would require an approximately 60-mile-long electrical transmission line to connect to the Pisgah Substation outside of Barstow, California. A solar energy project at this site would rely on groundwater for water needs and would require an onsite well.

The nearest residences are located around the unincorporated town of Chambless, which is located approximately 6 miles north of the site, along the National Trails Highway.

6.4 Comparative Evaluation of Alternative Sites

In the discussion that follows, the sites are compared in terms of each of the 16 topic areas required in the AFC, as well as in terms of project development constraints. The most useful topics for comparison are as follows:

- **Project Development Constraints**—are there site characteristics that would prohibit or seriously constrain development, such as significant contamination problems, or lack of fuel, transmission capacity, or water?
- **Land Use Compatibility**—is the parcel zoned appropriately for industrial use and compatible with local land use policies?
- **Routing and Length of Linear Facilities**—can linear facilities be routed to the site along existing transmission lines, pipelines, and roads? Will linear facilities be significantly shorter for a given site?
- **Visual Resources**—are there significant differences between the sites in their potential for impact on valuable or protected viewsheds?
- **Biological Resources**—would there be significant impacts on wetlands or threatened or endangered species such that mitigation of these effects would be unduly expensive or constrain the supply of available mitigation resources?



This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

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FIGURE 6.3-1
ALTERNATIVE SITE LOCATIONS
RICE SOLAR ENERGY PROJECT
RIVERSIDE COUNTY, CALIFORNIA

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- **Contamination**—is there significant contamination on site, such that cleanup expense would be high or such that cleanup would cause significant schedule delay?
- **Noise**—is the site sufficiently near a sensitive receptor area such that it would be difficult to mitigate potential noise impacts to below the level of significance?
- **Use of Previously Disturbed Areas**—has the site been previously disturbed? Does the site minimize the need for clearing vegetation and otherwise present low potential for impact on biological and cultural resources?
- **Other Environmental Categories**—are there significant differences between the sites in their potential for impact in other environmental categories?

There is no precise mathematical weighting system established for considering potential impacts in alternatives analyses. Some of the criteria used to compare the alternatives are more or less important to consider than others. For example, an impact that could affect public health and safety or could result in significant environmental impacts is obviously of greater concern than a purely aesthetic issue associated with an advisory design guideline. It is important in comparing alternatives to focus on the key siting advantages and the potential adverse environmental effects of a particular site. Comparing each of the environmental disciplines and giving each discipline equal weight would provide a misleading analysis because effects in one area are not necessarily equivalent in importance to effects in another area.

For example, although the sites may differ in terms of available local road capacities and the current levels of traffic congestion, the number of workers during the operational phase of the project is low and would be unlikely to have a significant effect on local traffic. The sites may differ widely in the amount of traffic congestion they would cause during construction, but this is a temporary impact and should not be a strong consideration in site selection, as long as measures to mitigate this impact are feasible. The sites would not differ significantly in terms of geological hazards, though proximity to a major fault would call for more rigorous and expensive seismic engineering. Hazardous materials handling and worker health and safety issues would be the same or nearly the same for most sites. Though the risk of a release of hazardous materials during transport might be seen as more or less likely depending on location (roadway hazards, in particular), the record of safe transport and handling of such materials is clear.

6.4.1 Project Development Constraints

As indicated in the introductory descriptions of each of the alternative sites, the basic needs of solar plant siting for land, access to electrical transmission, and water are met at the RSEP site. Both of the alternative sites meet the project's basic needs for land and slope (less than a 6 percent slope). The McCoy site would be 1 mile away from a transmission tie-in, which is much closer than the Cadiz site, which would require a 60-mile line to connect the nearest substation. Either site would require an onsite well for water; the availability of water would need to be determined.

6.4.2 Air Quality

The quantity of emissions from project operation would be the same at any of the sites. Each of the sites has similar emissions and, therefore, would be subject to similar review and permitting requirements. Each site is on relatively flat terrain that will help to promote dispersion of emissions. The differences between the sites in terms of their distances from the nearest residences would not be likely to make a significant difference in air quality impacts at these residences. Mitigation would bring any potential impacts to a level below significance for any of the alternatives.

6.4.3 Biological Resources

The RSEP site and two alternative sites are within the Mojave and Sonoran deserts and would have similar biological resources permitting and mitigation requirements. All three sites are located within the BLM's Northern and Eastern Colorado (NECO) Management Plan boundary. This regional plan identifies measures to manage the desert tortoise, which is a federal and state listed threatened species.

Habitat conditions at each of the alternative sites are similar to those at the RSEP site and most species with potential to occur at the RSEP site also potentially occur at the alternative sites. A California Natural Diversity Database (CNDDB) search of the quadrangles within which the alternative sites are located indicated that all potentially occurring special-status species at the alternative sites—including desert tortoise, Nelson's bighorn sheep, and vermilion flycatcher—are among those that have been observed or may also potentially be present at the RSEP site (California Department of Fish and Game, 2009). A search of the California Native Plant Society (CNPS) Inventory of Rare and Endangered Species by quadrangle indicated that there are special status plant species that could potentially occur at the alternative sites that were not observed at the RSEP site (CNPS, 2009). California satintail potentially occurs within or near the McCoy site, and Harwood's woollystar potentially occurs within or near the Cadiz site. Surveys of the RSEP site discovered populations of Harwood's milk-vetch and chaparral sand verbena. Each of the three sites consists of open desert. The RSEP site has a higher degree of disturbance, however, due to its use as an airfield during and after World War II. Its habitat quality for some species may therefore be lower than the other two sites. In general, the project's effects on biological resources would be expected to be similar for the three sites.

6.4.4 Cultural Resources

Further studies would be required to identify the exact number and location of significant cultural resources, if any, at each of the alternative sites. However, it is considered that each site holds similar potential to contain significant cultural resources. A recent cultural resources assessment for a separate project near the McCoy site found 200 archaeological sites and one historic archaeological site within the project area (Solar Millennium, 2009). The Cadiz site is located in a region that was used by Native Americans, including Mojave and Chemehuevi groups and archaeological sites would be expected to occur there, as well. The RSEP is located at the former site of the Rice Army Airfield, a historical site associated with the World War II-era Desert Training Center/California-Arizona Maneuver Area. Although previous disturbance due to the site's use as an airfield means that prehistoric

archaeological sites there may have been damaged or destroyed, the Rice Army Airfield site is potentially significant as a historical site.

6.4.5 Geological Resources and Hazards

There would be no significant difference among the sites in terms of geological resources and hazards. Neither of the alternative sites is within a designated Alquist-Priolo zone, and the Pinto Mountain fault is a substantial distance away from the alternative sites, as well as the RSEP site. Ground rupture at any of these sites is therefore unlikely. The seismicity of the alternative site areas can be characterized as an area of low seismic activity, with potentially low-magnitude earthquakes.

Both of the alternative sites are located in the southeastern part of the Mojave Desert, on alluvial deposits similar to those at the RSEP site. As discussed in Section 5.4, these units are not unique in terms of recreational, commercial, or scientific value. Similarly, the alternative sites are not likely to substantially differ from the RSEP site in terms of presence of mineral deposits, active permitted mines, and known oil or natural gas deposits. It is therefore likely that there are no geological resources located on or near the alternative sites.

6.4.6 Hazardous Materials Handling

The RSEP will use hazardous materials during construction and during project operation as described in Section 5.5. There would be no significant difference among the site locations in terms of hazardous materials handling. The uses of hazardous materials would be the same for any of the sites. Though there might be differences in the distances that trucks carrying hazardous materials would travel to deliver the materials, these differences would be minor and would not necessarily be consequential, given the effective mitigation measures available and the excellent safety record for transport of these materials.

6.4.7 Land Use and Agriculture

The RSEP site is located on privately owned land that is designated Open Space-Rural (OS-RUR) by the Riverside County General Plan and is zoned Controlled Development Area (W-2-10) according to the County land use ordinance. The OS-RUR land use designation is applied to remote, privately owned open space areas with limited access and a lack of public services. The W-2 zone allows for a variety of uses. Public utilities uses are allowed, and permitted uses include supporting structures and the pertinent facilities necessary and incidental to the development and transmission of electrical power and gas such as hydroelectric power plants, booster or conversion plants, transmission lines, and pipelines. The project is consistent with the W-2 zoning.

The McCoy site, which is also in Riverside County, is similarly designated OS-RUR and zoned W-2-10.

The Cadiz site is located on land zoned Agriculture (AG)-160. This district provides sites for commercial agricultural operations, agriculture support services, rural residential uses and similar and compatible uses. Open space and recreation uses may occur on non-farmed lands within this district (County of San Bernardino, 2007). Parcels are a minimum of 160 acres in size. Electrical power generation is a permitted use in this zone, but requires a General Plan Amendment to apply the Energy Facilities overlay in San Bernardino County.

There is no designated prime farmland, unique farmland, or farmland of statewide importance within either of the alternative sites and neither the RSEP site nor the alternative sites are under a Williamson Act contract.

6.4.8 Noise

Development at the RSEP site would be able to meet the appropriate county noise standards. The nearest sensitive receptor is in Vidal Junction, approximately 15 miles away. The nearest sensitive receptor to the McCoy site is farm residence approximately 2 miles away from the southeastern edge of the McCoy site. The nearest sensitive receptors to the Cadiz site are residences located around the unincorporated town of Chambless, approximately 6 miles away from the northern edge of the Cadiz site. While it is likely that construction and operation of a solar facility at either of the alternative sites would be able to meet all appropriate noise standards, verification by noise modeling would likely be necessary.

6.4.9 Paleontology

There would be no significant difference between the sites in terms of potential effects on paleontological resources. The probability of encountering significant fossils is approximately the same at each site, as each of them is located on Holocene alluvial sediments that are of low sensitivity for significant fossils.

6.4.10 Public Health

The project would not be likely to cause significant adverse long-term health impacts regardless of the site chosen.

6.4.11 Socioeconomics

The RSEP site is located in Riverside County, along the northern border with San Bernardino County. The McCoy site is located in Riverside County, northwest of Blythe. The Cadiz site is located in south central San Bernardino County. The number of workers, construction costs, payroll, and property tax revenues would be nearly the same for the project at each of the sites. Unemployment in Riverside County is 15 percent and in the city of Blythe it is 17.7 percent compared with statewide unemployment of 12.2 percent[1]. Most of the construction workers are expected to come from Riverside and San Bernardino counties, commuting daily or weekly to the plant site. Some may move temporarily to the local area during construction. Therefore construction of the project is expected to have substantial direct and induced economic benefits to the surrounding area. Disproportionate impacts on minority and low-income populations would be unlikely because environmental impacts associated with operation of the project are minimal. The project is not likely to cause adverse public health impacts, particularly to areas of disproportionately minority or low income populations.

6.4.12 Soils

Development of the project at either the proposed or alternative sites would not require any conversion of any land currently in agricultural use to other uses. Due to the similarity of

[1] State of California, Employment Development Department, Labor Market Information Division, *Monthly Labor Force Data for Cities and Census Designated Places*, August 2009 (Preliminary), dated September 18, 2009.

soils in the general areas containing each site, potential for water erosion at each of the sites would be relatively low, and potential for wind erosion is estimated to be relatively high.

6.4.13 Traffic and Transportation

The number of employees working at a given time during project operation (approximately 47) will not significantly impact local traffic conditions at any of the sites. The peak number of employees during construction (438) will cause level-of-service impacts during shift change on some local roadways which will be temporary, predictable, and can be mitigated by transportation management planning. Therefore, the effect of construction-phase traffic should not figure as a major consideration in evaluating or comparing the sites.

6.4.14 Visual Resources

Typically, the potential for visual resource impacts associated with a site varies depending on the relative visibility of the site from roads and residences, and the length and potential visibility of any new transmission lines that the power plant would require. Visual impacts are also a function of the surrounding facilities.

Potential impacts from the project to visual resources were examined from areas identified as being sensitive viewing areas in the vicinity of the RSEP site. These include State Route (SR) 62, which is eligible, but not designated as a State Scenic Highway, and the four wilderness areas within 10 miles of the project site: the Turtle Mountain Wilderness, Palen/McCoy Wilderness, Rice Valley Wilderness, and Riverside Mountain Wilderness (see Section 5.13). Construction of the RSEP would create visible changes that would cause a degree of alteration to the character of some views toward the site from the surrounding area and would produce small to moderate levels of change to existing levels of visual quality. However, these changes would not be so great as to constitute a substantial degradation of the existing visual character and quality of the site and its surroundings.

Visual impacts would not be significant at either of the alternative sites. Both the 653-foot-tall solar receiver tower and any associated transmission lines would be visible from locations throughout the featureless landscape surrounding each of these sites. However, as with the RSEP site, given the alternative sites' distance from most viewing locations and the existing, somewhat disturbed character of each site, construction of the project at either alternative location would not substantially degrade the existing visual character and quality of the site and its surroundings. No official scenic vistas are located within the vicinity of either location, though the National Trails Highway (former Route 66) passes within approximately 2.3 miles of the northern edge of the Cadiz site. There are no eligible or officially adopted State Scenic Highways within the areas surrounding either alternative site.

6.4.15 Water Resources

Onsite groundwater wells are proposed as the source of water for the RSEP, and studies have shown that sufficient water will be available at the RSEP site. Furthermore, the use of the small quantities of water required for a dry-cooled plant will not result in adverse impacts to groundwater supplies or quality and will not affect distant, neighboring wells. Availability of adequate water supplies at the two alternative sites is unknown based on existing information.

6.4.16 Waste Management

The management of wastes would not differ between the proposed project site and two alternatives.

6.4.17 Summary and Comparison

Based on the site selection criteria as described in Section 6.3, it is clear that solar plant siting is feasible at all three sites. Following is a summary of site selection factors:

- **Project Development Constraints**—none of the sites would prohibit or seriously constrain development; however, transmission and conveyance distances would vary for each location.
- **Land Use Compatibility**—land use designations and zoning at each of the sites would allow for development of the RSEP. For the Cadiz site, however, a General Plan Land Use Amendment would be required to apply an Energy Facilities overlay.
- **Routing and Length of Linear Facilities**—access to the nearest major roadway (SR 62) would be closest at the proposed site. The likely transmission route for the McCoy site (approximately 1 mile) would be substantially shorter than that for the proposed site (approximately 10 miles); the transmission route for the Cadiz site (approximately 60 miles) would be substantially longer than that for the proposed site.
- **Visual Resources**—the RSEP and associate transmission facilities would likely be visible from areas surrounding each of the sites. However, impacts to visual resources in each of the areas would be insignificant. Constructing the project at any of the three sites would be unlikely to substantially degrade or alter the existing visual character in these areas, nor would it result in an impact to visual quality. There would be no impact to valuable or important viewsheds.
- **Biological Resources**—there would be no significant impacts on wetlands or threatened or endangered species such that mitigation of these effects would be unduly expensive or constrain the supply of available mitigation resources. Development of any of the three sites would be likely to involve the removal of desert tortoise habitat and would require mitigation for this effect. The Cadiz site would involve construction of a 60-mile-long transmission line and so would be likely to cause more habitat disturbance that the other two sites.
- **Waste Management**—one of the project objectives is to redevelop a brownfield site and avoid impacts to pristine desert sites. The proposed RSEP site is a former World War II-era Army airfield. Phase I and II Environmental Site Assessments were conducted and found that there are no significant areas of contamination. The alternative sites do not appear to have contained previous uses that would result in the anticipation of substantial contamination on site, but are greenfield sites.
- **Noise**—none of the sites is sufficiently near a sensitive receptor area such that it would be difficult to mitigate potential noise impacts to below the level of significance.

- **Use of Previously Disturbed Areas**—the proposed project site is a former airfield. The alternative sites do not appear to have contained recent uses, though the Cadiz site is adjacent to land currently in agricultural production.

Table 6.4-1 summarizes the comparisons between the proposed and alternative sites. The RSEP site and the McCoy site offer an advantage over the Cadiz site in that the latter would require construction of a 60-mile-long transmission line. The RSEP and Cadiz sites offer the advantage over the McCoy site in that they are privately owned. In addition, the RSEP site offers the advantage over both of the alternative sites in that it is a previously developed, brownfield site, rather than undeveloped, pristine desert land.

TABLE 6.4-1
Environmental and Project Development Constraints of the RSEP and Alternative Sites

Site or Alternative	RSEP Site	McCoy Site	Cadiz Site
Site control	Yes	No	No
Brownfield site	Yes	No	No
Privately owned	Yes	No	Yes
Land Use and zoning	Open Space – Rural Controlled Development Area zoning, utility uses permitted	Open Space – Rural Controlled Development Area zoning, utility uses permitted	• Agricultural zoning • General Plan Amendment for an Energy Facilities overlay required
California Department of Conservation Designation	None	None	None
Williamson Act Contract	No	No	No
Sensitive receptors nearby	Residences at 15 miles	Rural residence at 2 miles; residential clusters at 5 miles	Residences at 6 miles
Visual resources	No significant or protected viewsheds or designated scenic highways	No significant or protected viewsheds or designated scenic highways	No significant or protected viewsheds or designated scenic highways
Biological resources	• Impacts to desert tortoise and other species would be mitigated • Habitat quality low due to past disturbance	• Impacts to desert tortoise and other species would be mitigated • Removal of pristine desert habitat	• Impacts to desert tortoise and other species would be mitigated • Removal of pristine desert habitat • Greater habitat disturbance with 60-mile-long transmission line

TABLE 6.4-1
Environmental and Project Development Constraints of the RSEP and Alternative Sites

Site or Alternative	RSEP Site	McCoy Site	Cadiz Site
Cultural resources	• Previously used site, so prehistoric archaeological deposits may be disturbed • Rice Army Airfield historic site	• Unknown, but prehistoric archaeological properties likely	• Unknown, but prehistoric archaeological properties likely • Likely more disturbance of archaeological sites with 60-mile-long transmission line
Water resources	• Groundwater sufficient for project needs • No effects on basin water quality or other wells	Groundwater availability and potential for impacts unknown	Groundwater availability and potential for impacts unknown
Significant unmitigated impacts or costly mitigation?	No	Unknown	Unknown

In summary, the RSEP site best meets the project objectives because:

- It is a previously disturbed, brownfield site, rather than pristine desert. This minimizes effects on natural resources
- It is privately owned and does not require the use of large amounts of public land
- Transmission line requirements, at 10 miles, are modest, compared with the Cadiz site and other remote sites

6.5 Alternative Project Design Features

This section addresses alternatives to the following RSEP design features: electrical transmission line and cooling system alternatives. Natural gas and piped water are not design features required for the preferred alternative.

6.5.1 Electrical Transmission System Alternatives

All of the net power produced by the RSEP will be delivered to the electrical grid via a new 161-kV transmission line that will interconnect the project with Western's Parker-Blythe transmission line at a location approximately 10.0 miles southeast of the RSEP site.

An alternative to interconnection with the Parker-Blythe transmission line would be a connection from the RSEP site westward to the MWD 230-kV line via a new transmission line and the Iron Mountain Substation or a new substation. A number of routes between the RSEP site and the MWD line were identified; they range between 19 and 23 miles and would require easements, permits, and/or lease agreements from and with a number of sources, including BLM, California Department of Transportation, and the Arizona-California Railway. The shorter distance between the project site and interconnection site, as well as the

number of easements and permits likely to be required by the westward route, resulted in a connection to the Parker- Blythe line being the preferred option. In addition, it is not clear that MWD would allow an interconnection with the 230-kV line via Iron Mountain or a new substation or that this line would have capacity to accept additional power.

6.5.2 Cooling System Alternatives

The RSEP will rely on dry cooling technology, incorporating an air-cooled condenser (ACC) as part of the system that will condense steam back into a liquid state for reuse in the steam cycle. In a system with dry cooling, the ACC fans circulate ambient air across a heat transfer surface area, which cools and condenses steam carried inside the ACC tubes. The condensed steam drains into a condensate collection tank and a condensate pump transfers this water back into the boiler feedwater circuit. Typical water uses for a dry-cooled plant are steam-cycle makeup, quench water for boiler blowdown, and mirror washing water.

A wet cooling system, by contrast, would consist of a steam surface condenser, cooling tower, and circulating water pumping system. The surface condenser receives exhaust steam from the low-pressure section of the steam turbine and cooling water circulating within the condenser tubes causes the steam to condense back to water for reuse in the steam cycle. The surface condenser is a shell-and-tube heat exchanger with the steam condensing on the shell side and the circulating water flowing in one or more passes within the tubes. Heat is rejected by spraying the circulating water inside of a mechanical draft evaporative cooling tower. The consumptive water loss through evaporation and drift is significant. Makeup water volume is a function of total losses including evaporation, drift and blowdown (which limits concentration of solids due to evaporation).

The capital cost of the dry cooling system can be several times that of a wet cooling system. The dry cooling system also requires the plant to operate at a higher temperature, thereby lowering the efficiency of the power block by up to 15 percent compared to the wet cooling systems. However, use of dry cooling technology requires up to 90 percent less groundwater consumption compared with wet cooling in terms of acre feet per year. The project is located in a desert where water resources are limited and degraded. Therefore, dry cooling was selected.

6.6 Water Supply Alternatives

A search was conducted to identify possible alternative sources of water for the RSEP. This search included inquires to water and wastewater treatment and distribution facilities; agricultural irrigation and drainage districts; commercial and industrial operators; and other potential water supplies. Onsite groundwater from the lower alluvial aquifer was selected based on a variety of factors including reliability of source, availability, practicality, regulatory acceptability, environmental impacts, total groundwater demand, and cost.

Alternative water supply sources other than groundwater that were considered for the project and the reasons for their rejection include the following:

- Colorado River Aqueduct Canal Water: The Colorado River Aqueduct is located immediately north of the site. This canal conveys raw Colorado River water to MWD facilities in southern California. MWD is currently implementing water conservation efforts throughout the district to reduce its reliance on Colorado River water.

- Irrigation return flow from the Colorado River Valley: This source is accounted as Colorado River Water and water from the Colorado River is fully allocated. In addition, a pipeline of considerable length would be required, resulting in substantial cost to the project, ground disturbance, and reduction of net plant output due to pumping electrical loads.
- Treated wastewater from Blythe or Needles: Treated wastewater from these sources infiltrates into the Colorado River Aquifer and is accounted for as Colorado River Water under allocations to the City of Needles and the Palo Verde Irrigation District. Water from the Colorado River is fully allocated. In addition, with the exception of the McCoy site, a pipeline of considerable length would be required, resulting in substantial cost to the project, ground disturbance, and increased utility electrical demand due to pumping electrical loads.

Pumping groundwater from the upper alluvium above a depth of 600 feet below ground surface was also evaluated as a potential water supply alternative and was rejected for the following reasons.

- The upper alluvium below the water table consists primarily of fine-grained materials (silt and clay) that are not very permeable and do not yield large amounts of water to wells (i.e., have low transmissivity).
- Water supply quantities from the upper alluvium could theoretically be increased by addition of more production wells in the upper alluvium. Because of the low transmissivity of the upper alluvium, however, a relatively large number of wells would be required over a wide area. This large number of wells and the required lateral spacing would make production from the upper alluvium infeasible. In addition, pumping of groundwater from a low transmissivity zone would result in large amounts of drawdown because the lateral inflow of groundwater to replace what is pumped would occur slowly. Thus, the potential impact to nearby wells would be greater than pumping groundwater from deeper, more productive water-bearing zones.
- Analysis of groundwater sampled from well Rice #1, sampled in the upper portion of the aquifer, detected a total dissolved solids concentration of 2,370 to 3,540 milligrams per liter, indicating it is a relatively saline groundwater source. Use of this groundwater as a water supply would entail additional treatment expense, generate a large volume of waste from reject water and treatment residuals, necessitate larger evaporation ponds, and require more groundwater to be pumped to meet the project water demand.

6.7 Solar Technology Alternatives

The RSEP will utilize concentrating solar thermal technology with integral thermal storage configuration. Other designs considered for the RSEP included parabolic trough and photovoltaic solar technologies. These technologies are used in similar projects in California. Selection of concentrating solar thermal technology with integral thermal storage was made based primarily on the following criteria: minimization of water use, production of renewable energy without using fossil fuels, efficiency of operation and relatively low cost of power, and energy storage for generation during peak demand times when the energy source (the sun) is unavailable.

6.7.1 Central Tower CSP with Integral Thermal Storage

As described in Section 2.0, Project Description, the RSEP will utilize concentrating solar thermal technology with integral thermal storage that includes a central receiver tower, a tracking heliostat field, separate hot and cold salt storage tanks, and a conventional steam turbine generator (Rankine cycle), which is used to generate electricity.

In the RSEP system, sunlight is concentrated and directed from a large field of heliostats to a central receiver tower. A liquid salt heat transfer medium is pumped from the cold salt thermal storage tank through the tower to the receiver where it is heated to 1,050ºF. Hot salt is then collected in the hot salt tank, from which it is pumped through a steam generation system to create superheated steam. Cooled liquid salt exits the steam generation system at 550ºF and is returned to the cold salt storage tank for further solar heating.

The RSEP technology offers significant advantages over other forms of solar power in terms of efficiency and cost of power produced, and in the resultant stability and flexibility of generator operation inherent with liquid salt CSP systems. Because this technology uses liquid salt, a medium that can be heated to a very high temperature (approximately 1,050°F), the steam cycle is very efficient. Because the liquid salt can be stored with very little heat loss, this system allows power to be generated on demand, day or night, and regardless of short-term weather fluctuations.

6.7.2 Parabolic Trough

A parabolic trough system converts solar radiation into electricity indirectly by using sunlight to first heat a thermal fluid, typically synthetic oil, which is then used to generate steam that is used to power a turbine-generator to produce electricity. Parabolic trough CSP plants consist of horizontal, trough-shaped solar collectors arranged in parallel rows, normally aligned on a north-south horizontal axis. Each parabolic trough collector has a linear parabolic-shaped reflector that focuses the sun's direct beam radiation on a linear receiver tube, also referred to as a heat collection element, located at the focus of the parabola. The trough rotates east to west in order to track the sun throughout the day, heating the fluid circulating within the collector element. The hot fluid is collected in a tank and then pumped through a steam generation system to power the turbine-generator.

Parabolic trough systems generally cannot use liquid salt as a primary heat transfer medium given the relatively high freeze point of salt relative to oil (approximately 450°F for salt compared to below 100°F for oil). Given the linear arrangement with extensive, lengthy and diffuse piping networks, parabolic trough systems possess a low ratio of bulk liquid volume (e.g. heat) to pipe surface area (e.g. heat loss) which can result in rapid cool-down of the collector element and loss of fluid heat during even short duration cloud cover. The horizontal configuration also precludes gravity drainage in the event of loss of pumping power, posing a key operational challenge of salt-based CSP systems where, during interruption of electric power or fluid circulation, salt (if not promptly drained) will tend to solidify and create blockages inside the piping within short timeframes.

Parabolic trough plants can employ liquid salt as a means to resolve some of the limitations and operating challenges of oil. However, this can be accomplished only by installing a secondary heat exchange and storage system to transfer heat from the primary heat transfer

fluid (e.g. oil) into liquid salt which is then used as the heating medium for steam generation, thus resolving any fluctuation in primary fluid temperature (e.g. cloud cover).

The operating temperature range of most synthetic oils for parabolic trough applications is between a minimum around 60ºF and a maximum generally not higher than 750ºF. Therefore, employing a secondary loop with liquid salt cannot achieve any greater temperature than that of the primary fluid itself unless, for example, fossil fuels are employed for supplementary heating. The liquid salt process such as that used in the RSEP can operate at temperatures of up to 1,050°F without degradation, in marked contrast to the oil typically used for parabolic trough technology. Accordingly, the higher temperature tolerance of liquid salt allows steam to be produced at higher temperatures, which results in a more efficient steam cycle and a more cost effective generating system.

Parabolic trough plants equipped with an added, secondary salt storage system results in some loss of efficiency due to the extra stage of heat transfer necessary to integrate the two fluids. The added capital cost to install the secondary systems generally increases the price of electricity relative to that produced with a parabolic trough system not employing a liquid salt loop.

The technology selected for RSEP uses liquid salt directly together with thermal energy storage in substantial liquid volume in order to generate stable power at any time, under intermittent and prolonged cloud cover with constant and predictable generator output. Therefore, the RSEP design was chosen over the parabolic trough technology because of its greater cycle efficiency, greater cost-effectiveness including inherent energy thermal storage attribute, and the operational flexibility and stability it affords. Additionally, due to their relatively low operating temperature, the steam turbine-generator performance on parabolic trough systems is generally impacted much more significantly where dry cooling is employed in lieu of wet cooling of the turbine exhaust. By contrast, RSEP operates at much higher temperatures and can tolerate dry cooling with lower impact to the annual quantity of energy produced or to the resultant price of electricity.

6.7.3 Solar Photovoltaic

Solar photovoltaic (PV) power plants typically include modules of PV panels that absorb solar radiation and convert it into direct current (DC) electricity. This DC power is then converted into alternating current (AC) electricity for delivery to the electric grid system. In general, PV panels are currently installed in one of two ways. Fixed, stationary panels are a simple and very common PV application. Larger, more complex installations employ "tracking" devices that tilt the panels toward the sun for maximum efficiency. PV trackers use either single-axis (east-west) or dual-axis (east-west and north-south) axes in order to maximize the panels' absorption of sunlight during the day and throughout the year.

Solar PV technology is an electrical process using silicon-based semiconductors to convert sunlight (e.g., photons) directly into DC electricity flow. Multiple PV panels are wired together to increase the total system output. DC current flows through a device called an "inverter," which generates an alternating current that can be tied to the power distribution system for power delivery. PV technology does not involve thermal energy or the production of steam to drive turbines. In addition, a PV system is relatively simple to operate and maintain, using modest amounts of water to keep the panels clean. However, a

PV installation generally requires more land surface area to generate the same amount of electricity on an annual basis compared with either the parabolic trough or the central tower technology. In addition, due to strict dependence on solar irradiance to generate electron flow, PV systems produce highly intermittent electricity under routine conditions of haze and cloud cover. PV panel output can fluctuate by the minute with normal variations in the intensity of solar irradiance. For this reason, PV installations require additional electrical equipment to avoid grid instability, including batteries. Grid-tied PV systems can create instability that requires additional resources to compensate for normal, minute-by-minute variability in PV output.

PV technology was not selected because of its inherent technical limitations, chiefly, intermittency, which at the desired scale poses significant challenges to grid system stability. The technology selected for RSEP provides greater efficiency, inherent energy storage, operational control stability and flexibility, and greater cost-effectiveness for the annual quantity of energy produced.

6.7.4 Alternative Tower Configurations

In considering the various sizing configurations for the RSEP, a wide variety of factors were evaluated when establishing design parameters, including heliostat field size, tower size, receiver dimensions, thermal storage volume and the corresponding power output, as well as capital and operating costs. An economic optimization analysis was conducted to determine the project configuration parameters that resulted in the lowest cost of electricity production. The analysis concluded that the economy of scale advantages associated with the selected design will result in a lower price of electricity compared to a project with a lower tower and a smaller field. Similarly, a multiple-tower facility having several shorter towers with correspondingly smaller individual heliostat fields sized to yield comparable power output from a single, larger tower facility would also not result in the lowest cost of electricity.

The key drivers in the economic analysis include the overall project capital cost, the amount of solar energy collected, and the amount of electricity produced by any given project configuration. An economic analysis is the appropriate methodology for the design optimization due to the complex interrelationships between the variables considered. For example, the amount of solar energy that can be collected is related to the size of the heliostat field and number of heliostats deployed. Increasing the number of heliostats will result in a greater amount of total energy collected but will also result in a corresponding increase in the overall project capital cost, as well as an increase in the size of the heliostat field and a taller tower. The taller tower ensures that energy reflected from the heliostats in the outermost rows of the field will reach the solar receiver without being blocked or shaded by heliostats located closer to the tower. It is important to also note that the amount of solar energy reflected onto the receiver by a given heliostat diminishes the farther the heliostat is located from the receiver. Therefore, the cost-effectiveness of each additional row of heliostats will decrease as the field grows larger.

A project with a shorter tower would result in a smaller heliostat field and less solar energy collected. While there are capital cost savings associated with fewer heliostats, a shorter tower would use less concrete and require smaller steam turbine equipment, but less power would be generated by a project with this configuration. In general, projects with large

infrastructure costs such as the tower and steam turbine equipment are impacted greatly by economies of scale. In other words, the "fixed" costs of purchasing and installing major capital equipment such as tanks, piping systems, a steam turbine-generator, a transformer and generator tie-line, are such that incremental increases in size are achievable at lower incremental costs. In this context, economy of scale also means the average cost to produce electricity will decrease as the volume of output increases. Therefore, a shorter tower would be expected to result in an increase in the cost per unit of power generated.

To illustrate the price impact due to variations in tower height and field size, several cost and sensitivity analyses were performed using the Solar Advisory Model 2009 (SAM2009) model published by the U.S. Department of Energy's National Renewable Energy Laboratories (NREL). The SAM2009 model was used for this analysis because it is a publicly available model and protects the confidentiality of RSEP's pro forma information and proprietary technology specifications. The model's default parameters provide an optimal plant configuration and electricity cost for a 100 MW solar tower project. RSE adjusted the default parameters to be more representative of the RSEP, adjusting the plant output to 150 MW with dry cooling, and financial parameters (minimum debt service coverage ratio, debt/equity ratio, and PPA escalation rate). The impact to electricity price was evaluated as the tower height was reduced in 30-meter increments, as shown in Table 6.7-1, as well as one case where tower height was increased by 30 meters.

TABLE 6.7-1
Tower Height Analysis

				150 MWe Project		
Parameter	**Units**	**SAM2009 Default Parameters**	**Base**	**Shorter Tower Case 1**	**Shorter Tower Case 2**	**Taller Tower Case 3**
Nameplate Capacity	MWE	100	**150**	150	150	150
Cooling Mode	Wet/Dry	Wet	**Dry**	Dry	Dry	Dry
Tower Height*	Meters	194.4	**176**	146	116	206
Tower Height	Feet	638	**577**	479	380	676
Heliostats	No.	5,438	**5,438**	5,438	5,438	5,438
Mirror Area	M^2	783,566	**783,566**	783,566	783,566	783,566
Storage Volume	M^3	6,568	**9,852**	9,852	9,852	9,852
PPA Escalation	%	1.2	**2.5**	2.5	2.5	2.5
Debt Service Coverage Ratio		1.4	**1.6**	1.6	1.6	1.6
Debt Fraction	%	40	**60**	60	60	60
Annual Generation	MWh	311,084	**304,135**	274,932	259,707	310,210
	Differential (1st Yr PPA Price)		**Base**	**9.9%**	**29.0%**	**-1.1%**
	Differential (Net Output)		**Base**	-9.6%	-14.6%	2.0%

*The NREL model defines tower height as the optical tower height, or the elevation of the receiver above the plane of the heliostat pivot. When defined in this way, and for the purpose of this analysis, RSEP's "tower height" is equal to 176 meters or 577 feet.

As shown, a decrease in tower height from the base case (the nominal RSEP design) causes the price of electricity production to increase. Similarly, an increase in tower height of 30 meters from the base case would results in an increase in the price of electricity, demonstrating that added heliostats which are less efficient with increasing distance from the tower (to avoid shading and blocking), therefore, the higher capital costs for the project are not fully offset by the incremental contribution of more distant heliostats. These results indicate that the selected tower height is optimal for this project. It is also important to note that these relative price increases are only partially indicative since the total amount of electricity produced annually decreases with each incremental reduction in tower height. This analysis does not take into account the additional costs that would be required to maintain the equivalent annual energy of the RSEP objectives.

The price of renewable electricity is extremely important to ensure that state and federal government goals for overall climate change and renewable programs can be achieved at the lowest cost to the ratepayer. Renewable electricity is expensive relative to fossil fuel generation and therefore is already at a competitive disadvantage. In order to help achieve the goal of supplementing or displacing other conventional forms of power generation with sources of sustainable energy, it is critical that the project is optimized around the price of delivered electricity. Alternative configurations of field size and tower height would not achieve this core objective and therefore were rejected and not carried forward for further environmental evaluation and comparison to the proposed project.

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