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Siting Utility-Scale Concentrating Solar Power Projects

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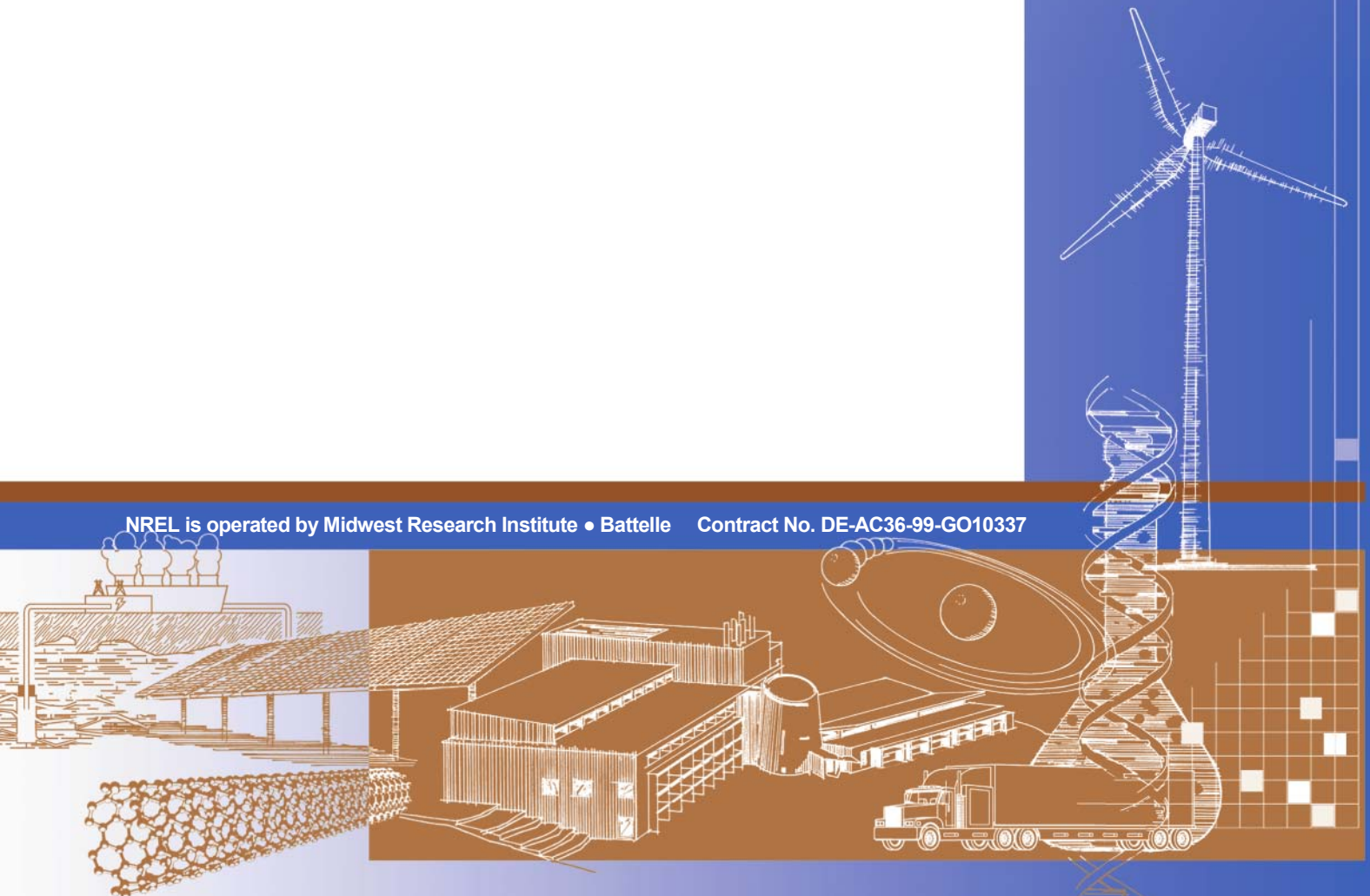

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ABSTRACT

In 2002, Congress asked the U.S. Department of Energy to "develop and scope out an initiative to fulfill the goal of having 1,000 megawatts (MW) of new parabolic trough, power tower, and dish engine solar capacity supplying the southwestern United States [i]". In this paper, we present a review of the solar resource for Arizona, California, Nevada, and New Mexico. These four states have the greatest number of "premium" solar sites in the country and each has a renewable portfolio standard (RPS). We present information on the generation potential of the solar resources in these states. We also present regions within New Mexico that may be ideally suited for developing large-scale concentrating solar power (CSP) plants because of their proximity to load and their access to unconstrained transmission.

1. Objectives

The objective of the siting effort is to identify economically viable locations for siting concentrating solar power (CSP) plants in the U.S. Southwest. The viability of a site is determined in part by the level of direct normal solar radiation, area topography, access to unconstrained transmission, and proximity to load centers. The potential for economically viable power generation, combined with additional regional benefits such as job creation [ii] and pollution mitigation, can provide state energy officials, utility stakeholders, and policy makers with the information necessary to make informed decisions regarding the development of their solar resource.

2. Technical Approach

The direct-normal solar energy resources in the southwestern United States, shown in Fig. 1, are among the best in the world. The direct-normal resource shown in the figure was derived from a new, high-resolution solar resource data set that was developed with satellite data and correlated to good ground station data. Annual solar direct-normal incident estimates are provided on a grid of 0.1 degree in both latitude and longitude (nominally, 10 km). These estimates were created with the Perez irradiance model [iii].

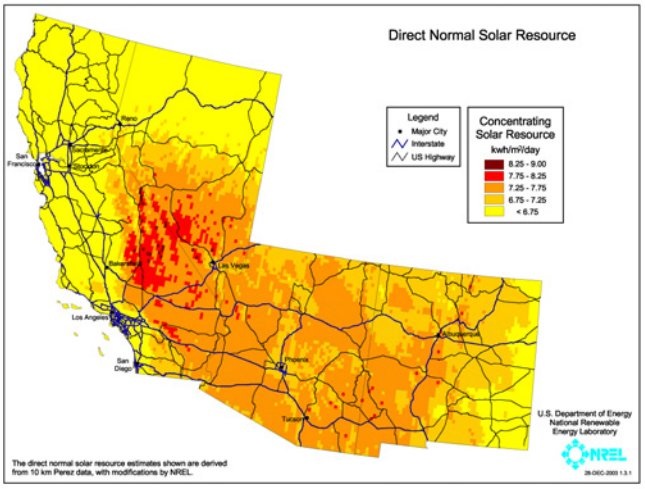

Figure 1. Direct-normal solar radiation in the southwestern United States.

Not all the land area shown in Fig. 1 is suitable for large-scale CSP plants, because such plants require relatively large tracks of nearly level open land with economically attractive solar resources. Geographical information system (GIS) data were applied on land type (urban, agriculture, etc.); ownership (private, state, federal); and topography.

The terrain available for CSP development was conservatively estimated with a progression of GIS filters as follows:

- Lands with less than 6.75 kWh/m^2/day of average annual direct-normal resource were eliminated to identify only those areas with the highest economic potential.
- Lands with land types and ownership that were incompatible with commercial development were eliminated. These included national parks, national preserves, wilderness areas, wildlife refuges, water, and urban areas.
- Lands with slope greater than 1% and with contiguous areas smaller than 10 km^2 were eliminated to identify lands with the greatest potential for low-cost development.

The United States is divided into a number of transmission control regions. The largest is the Western Electricity Coordinating Council (WECC) grid, which covers the western third of the United States. When siting a new solar power plant, experts would need to consider how it fits into the transmission system, taking into account transmission constraints and proximity to load centers.

3. Results and Accomplishments

Figure 2 depicts the available land area once the filters described previously were applied.

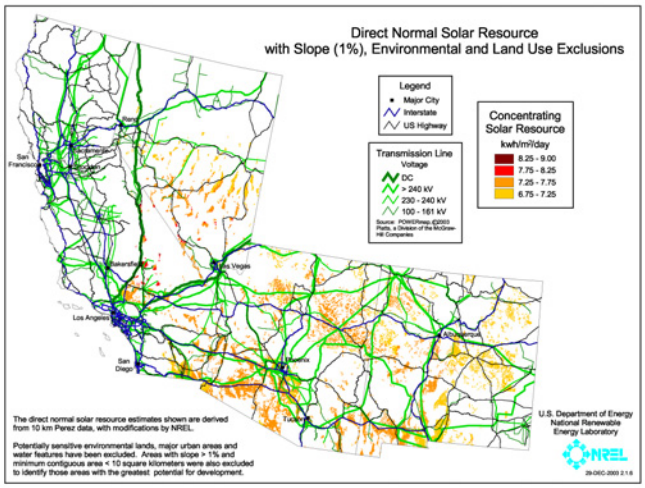

Figure 2. Most favorable utility-scale sites based on conservative filter criteria.

The resulting land area and associated CSP generation capacity are given in Table 1.

Table 1. Suitable Land for CSP Plants and Associated Generation Potential

	Available Area (mi^2)	Capacity (MW)
Arizona	25,527	3,267,456
California	6,421	821,888
Nevada	5,807	743,296
New Mexico	23,640	3,025,920
Total	**61,395**	**7,858,560**

The data in Table 1 show that, even if we consider only the high-value resources, there is potential for more than 7 million MW of solar generation capacity in the Southwest. Currently, there are about 100,000 MW of generation capacity in these four states. Each state has enough land illuminated by the highest solar radiation levels, such that only a small segment would be enough to generate its current electricity needs.

Potential locations for siting of large-scale CSP plants have been identified for the States of New Mexico, Arizona, Nevada, and California. As described earlier, these locations were identified based on the filter criteria in addition to availability of transmission and proximity to load centers. Figure 3 provides an example of potential siting opportunities for the State of New Mexico based on these considerations. Similar analysis has been completed for the three remaining states and can be provided upon request.

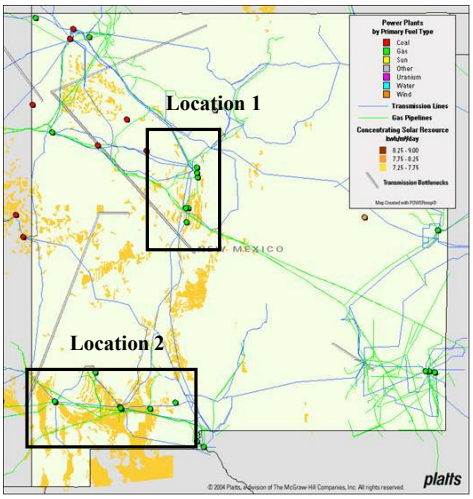

Figure 3. Potential locations for siting of 50 MW or larger CSP plant in New Mexico.

4. Conclusions

The solar energy resource in the southwestern United States is enormous and largely untapped. As demonstrated in Table 1, there is no shortage of economically suitable land. At its June 2004 meeting, the Western Governors Association (WGA) recognized the 1,000 MW CSP Initiative as one of its projects and formed a regional task force to coordinate the efforts of the interested states, which include New Mexico, Nevada, California, Arizona, Colorado, and Utah. Nevada has already contracted 50 MW of trough power that is likely to become part of the initiative. New Mexico has formed a CSP task force to develop a plan for deploying a 50 MW or larger plant. Under the leadership of the WGA, other states are expected to start exploring ways in which they, too, can support the deployment of large-scale CSP power projects.

ACKNOWLEDGEMENTS

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[i] *DOE Fiscal Year 2002 Energy and Water Development Appropriation.*

[ii] Schwer, R. K.; Riddel, M., "Potential Economic Impact of Constructing and Operating Solar Power Generation Facilities in Nevada," 28 pp.; NREL Report No. SR-550-35037.

[iii] Perez, R.; Ineichen, R.; Moore, K.; Kmiecik, M.; Chain, C.; George, R.; Voignola, F. (2002); "A New Operational Satellite-to-Irradiance Model," Solar Energy 73, 5 pp. 307-317.

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[i] *DOE Fiscal Year 2002 Energy and Water Development Appropriation.*