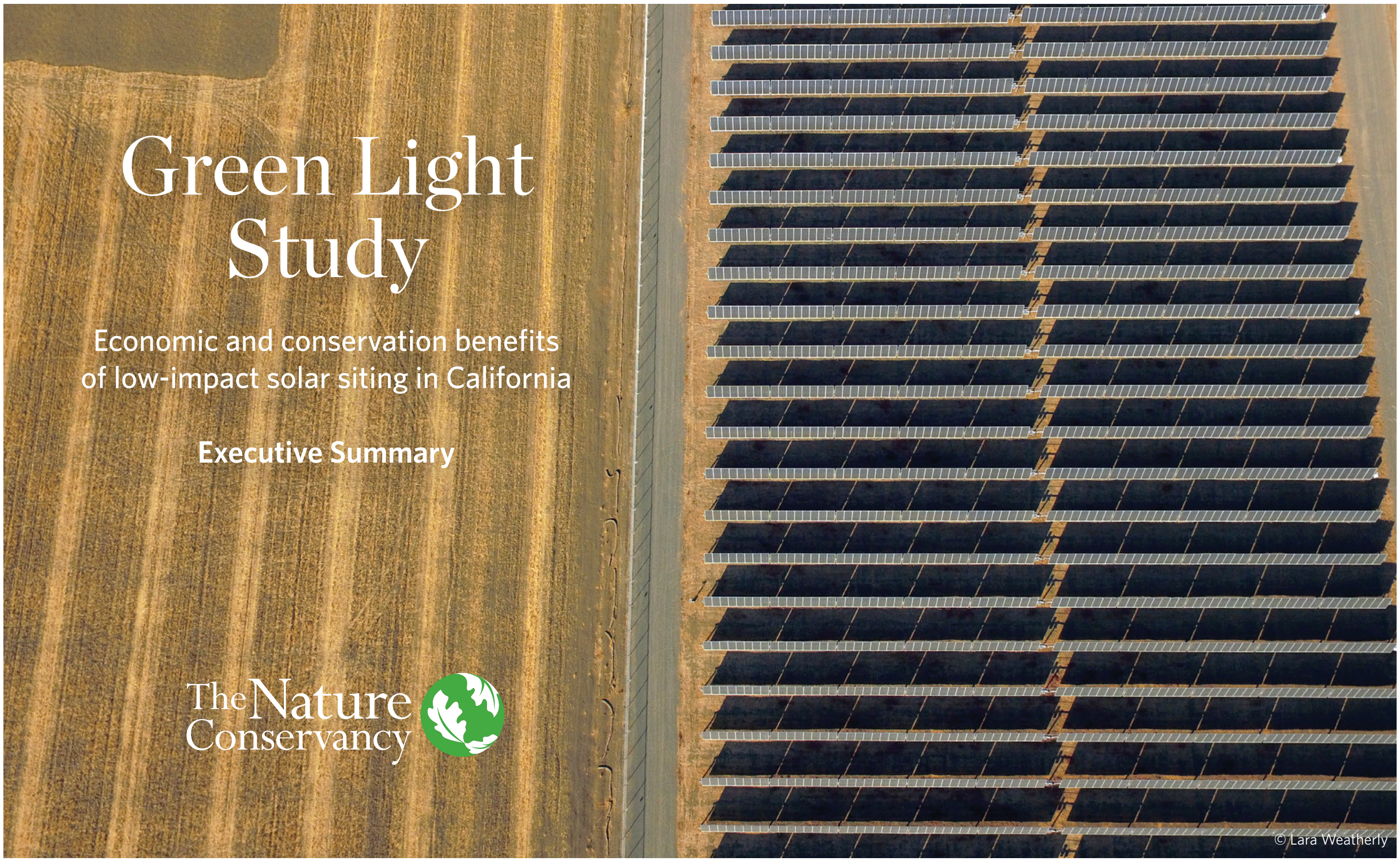

Green Light Study

Economic and conservation benefits of low-impact solar siting in California

Executive Summary

The Nature Conservancy

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The *Green Light Study* builds the business case for low-impact, utility-scale solar energy development in California by highlighting the multiple benefits—efficiency, affordability, and nature conservation—of siting solar on land characterized by low biodiversity value.

With the passage of California Senate Bill 100 (SB100) in 2018, the California legislature set the most ambitious energy goal in the nation, committing to 100% clean energy by 2045. This commitment will require significant amounts of new renewable energy infrastructure, built expeditiously, and could result in a large development footprint. For example, in California, estimates range from 600 square miles to 1,700 square miles for new utility-scale solar energy, depending on how much clean energy comes in from out of state. However, The Nature Conservancy's recent report, *Power of Place: Land Conservation and Clean Energy Pathways for California,*[1] found that California can significantly ramp up renewable energy and limit impacts to natural and agricultural lands by integrating conservation information up front.

Over the past decade, California has invested in proactive landscape-scale planning for solar that integrates conservation information and directs development to places of low biodiversity value.[2] The benefits to nature of an approach that integrates conservation data into energy planning have been well-documented.[3] The *Green Light Study* is the first study to quantify the economic benefits of this approach using a selection of utility-scale solar energy projects in California.

The trends documented in the *Green Light Study* indicate that building solar energy facilities in areas of lower biodiversity value could help California maintain the pace and scale of renewable energy development needed to address the urgent challenge of climate change while also protecting the state's important lands and waters and minimizing costs.

[1] Wu, G.C.; Leslie, E.; Allen, D.; Sawyerr, O.; Cameron, D.; Brand, E.; Cohen, B.; Ochoa, M.; Olson, A. *Power of Place: Land Conservation and Clean Energy Pathways for California,* 2019.

[2] Bureau of Land Management's Western Solar Plan, 2012; California Desert Renewable Energy Conservation Plan, 2016; Pearce, D.; Strittholt, J.; Watt, T.; Elkind, E. University of California, Berkeley and Conservation Biology Institute's Identification of Least-Conflict Solar PV Development in California's San Joaquin Valley, 2016.

[3] Kiesecker J. M.; Copeland H. E.; McKenney B. A.; Pocewicz A.; Doherty K. E. Energy by Design: Making Mitigation Work for Conservation and Development. In *Energy Development and Wildlife Conservation in Western North America;* Naugle, D. E., Ed.; Island Press: Washington, DC, 2011.

Key Concepts

ECOLOGICAL IMPACTS
The suite of impacts to biodiversity and ecological systems that result from the development of solar energy projects.

BIODIVERSITY VALUE
The degree of diversity of plants and animals, and habitat for multiple species, provided by a site. Areas of high biodiversity value have been prioritized for conservation, based on analyses completed by The Nature Conservancy.

ECONOMIC BENEFITS AND COSTS
The benefits and costs that accrue to developers (and, as a result, energy buyers) with budgetary implications. These benefits have direct implications for the financial bottom line.

LOW-IMPACT SITING
The siting of renewable energy projects in areas that have been identified as having low biodiversity value based on analyses of the Mojave and Sonoran Deserts and the San Joaquin Valley by The Nature Conservancy and other environmental stakeholders.

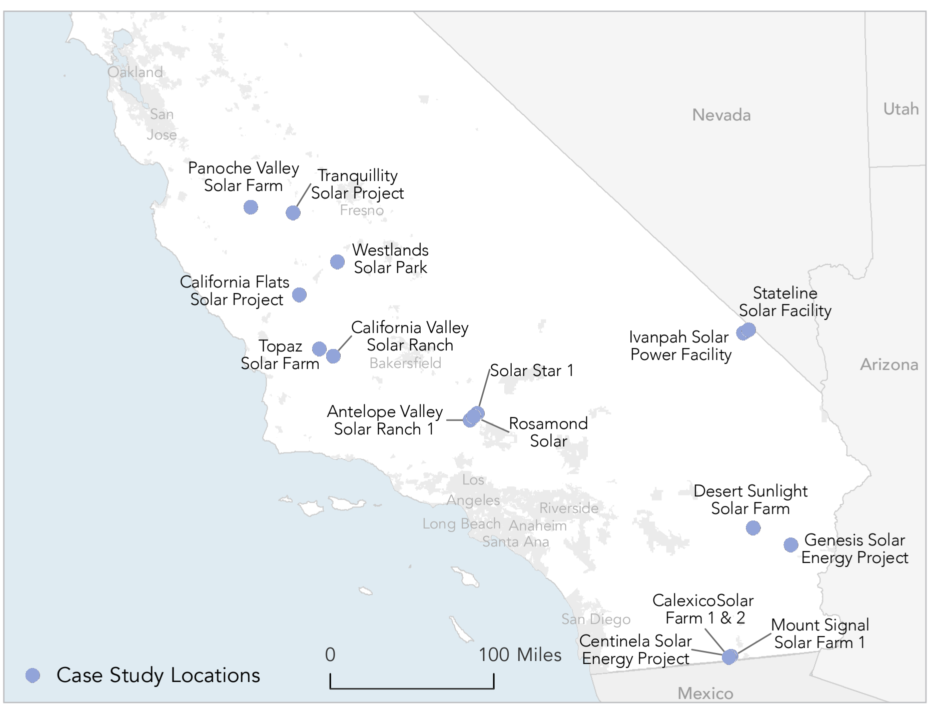
Methods

To explore costs associated with the biodiversity value of the site selected for a given solar facility, The Nature Conservancy in California (TNC), in partnership with ECONorthwest and San Jose State University, conducted the *Green Light Study* of solar energy projects in California.

Sixteen utility-scale solar case studies were selected from a database of 622 solar projects and represent 41% of installed capacity as of June 2018. All the projects except one were over 100 megawatts in size and were either completed or in process at the time of their selection in June 2018, had accessible environmental review documentation, and were located in either the San Joaquin Valley or the desert region of southern California where TNC had access to science-based conservation assessments.

Biodiversity value was assigned to the solar case study project locations using four prior land use and ecological assessments for three California geographies (the Mojave Desert, Sonoran Desert, and San Joaquin Valley). Half (eight) of the projects selected as case studies were built on lands that, prior to development, were characterized as high biodiversity value. The other half (eight) were built on lands characterized as low biodiversity value.

We evaluated trends across three main variables for each of the case study projects: permitting timeframe, compensatory mitigation ratios, and mitigation costs. Where available, we used compensatory mitigation and habitat management cost data specific to the individual case study. In the majority of cases, where case study-specific cost data were not available, we used representative unit costs from other comparable solar projects to estimate mitigation and habitat management costs for each case study. These costs were summed for all solar projects and categorized by biodiversity value, revealing how the difference in costs per acre related to biodiversity value.



Solar energy project case study locations. Source: California Energy Commission (CEC) (2016); ECONorthwest.

Results

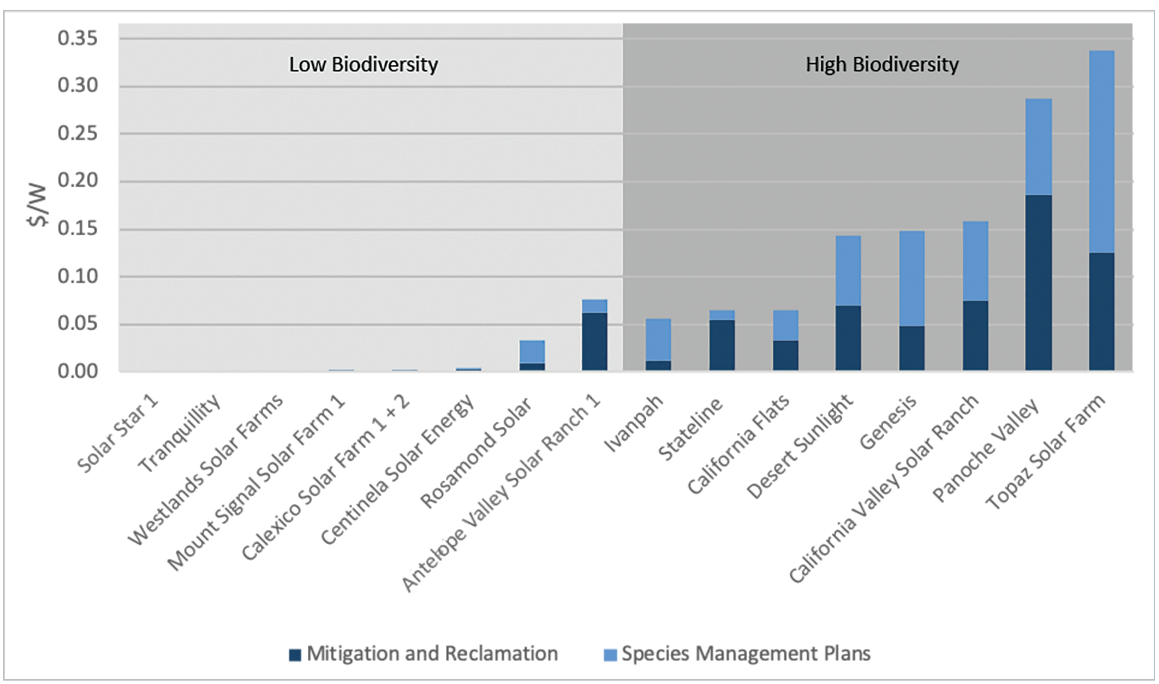
The *Green Light Study* indicates that low-impact siting of utility-scale solar energy benefits from:

- **Permitting timelines more than two and a half times shorter.** Projects sited on lands of low biodiversity value take, on average, 13 months from project announcement to permit issuance compared to 35 months for solar projects located on lands of high biodiversity value.

- **Substantially lower land acquisition requirements to mitigate impacts to habitat.** On average, over 20 times more land is required as compensatory mitigation for projects that impact high biodiversity value areas (average mitigation ratio: 2.95:1) compared to those that impact low biodiversity value areas (average mitigation ratio: 0.13:1).

- **Mitigation and habitat management costs that are more than eight times lower.** Solar projects sited on high biodiversity lands are estimated to have average mitigation and management costs of $0.16 per watt, whereas those sited on low biodiversity lands have average habitat mitigation and management costs of $0.02 per watt. This does not include costs associated with project delays and land acquisition for mitigation.

As a result, total project costs are estimated to be 6-14% higher for solar projects sited on high biodiversity lands.



Estimated Mitigation and Management Cost by Case Study Project ($/W) Source: Analysis of case studies.

Discussion

The *Green Light Study* highlights cost savings and efficiency trends associated with low-impact siting of solar energy in California. The longer average permitting timelines observed for case study projects sited in areas of high biodiversity value may translate into overall decline in project profitability. Lengthy time delays can also introduce uncertainty into projects for investors and purchasers of renewable energy.

Case study project sites in high biodiversity value areas tend to require greater compensatory mitigation, resulting in higher costs for overall mitigation and species management plans. Assuming an average installed solar energy price of $2.47/watt,[3] this cost savings of $0.14/watt represents 5.6% of total installed costs, not counting permitting delays and land acquisition costs. Furthermore, if total installed solar energy project pricing declines to $1/watt, low-impact solar siting could provide a 14% overall cost saving.

[3] *Utility-Scale Solar: Empirical Trends in Project Technology, Cost, Performance, and PPA Pricing in the United States,* 2018 Edition, Lawrence Berkeley National Laboratory.

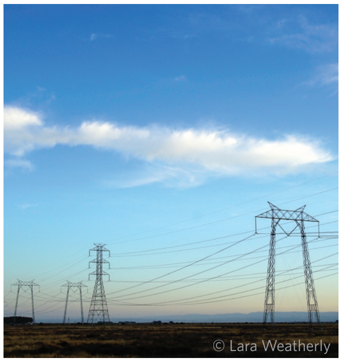
Recommendations

The following recommendations identify actions to expand on this study and to realize the cost savings and efficiency benefits of low-impact solar energy development in California:

1. **Conduct a comprehensive study of the economic benefits of low-impact clean energy that builds on the *Green Light Study* findings.** While the results from these case studies are compelling, a larger sample size is required to validate the findings. As California's energy and air resources agencies look to implement the landmark SB100 legislation, we recommend conducting a robust study of the multiple benefits of low-impact clean energy development. It is essential to fully understand the economic drivers and challenges to clean energy siting so that California can remove obstacles and further incentivize low-impact clean energy development.

2. **Prioritize grid investments in areas of low biodiversity value.** California will be making grid investments to enable new zero-carbon generation to meet SB100 goals. Those investments are best spent in areas of low biodiversity value where efficiencies (e.g. permit timelines, mitigation ratios, savings) observed in the case studies can be realized. This will require an investment in proactive planning that integrates conservation data up front to identify low-impact places for new clean energy facilities and that aligns transmission planning with identification of low-impact places.

3. **Strengthen procurement policies and programs to drive a market for low-impact solar energy.** The findings from the case studies indicate that purchasers of clean electricity will benefit from certainty in permitting timelines and pricing by choosing to purchase low-impact clean energy projects. For these reasons, purchasers of electricity should integrate environmental criteria into their procurement decision-making process to ensure they are contracting with projects in places of lower biodiversity value, thereby driving a market for low-impact clean energy.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