California
Solar Development Analysis

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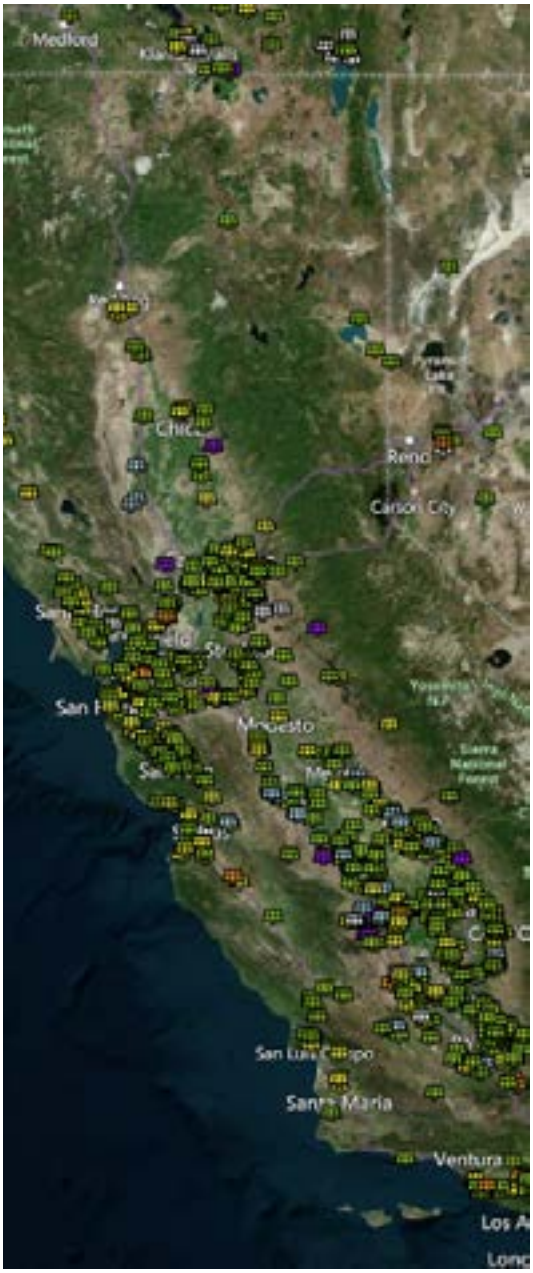
ANALYSIS

The state of solar development in California can be evaluated by key factors such as federal and local regulations, incentives, grid interconnection and integration. The current state of development activity in California is growing and can be seen in this analysis summarizing all facets of solar energy project development.

We will break down the various federal and state incentives available to solar energy developers in California and how to access them.

LandGate provides key data to the top developers and financiers in the country. To learn more about access to this platform, or to talk about how to apply the information below to your business, book time with a member of our dedicated energy markets team.

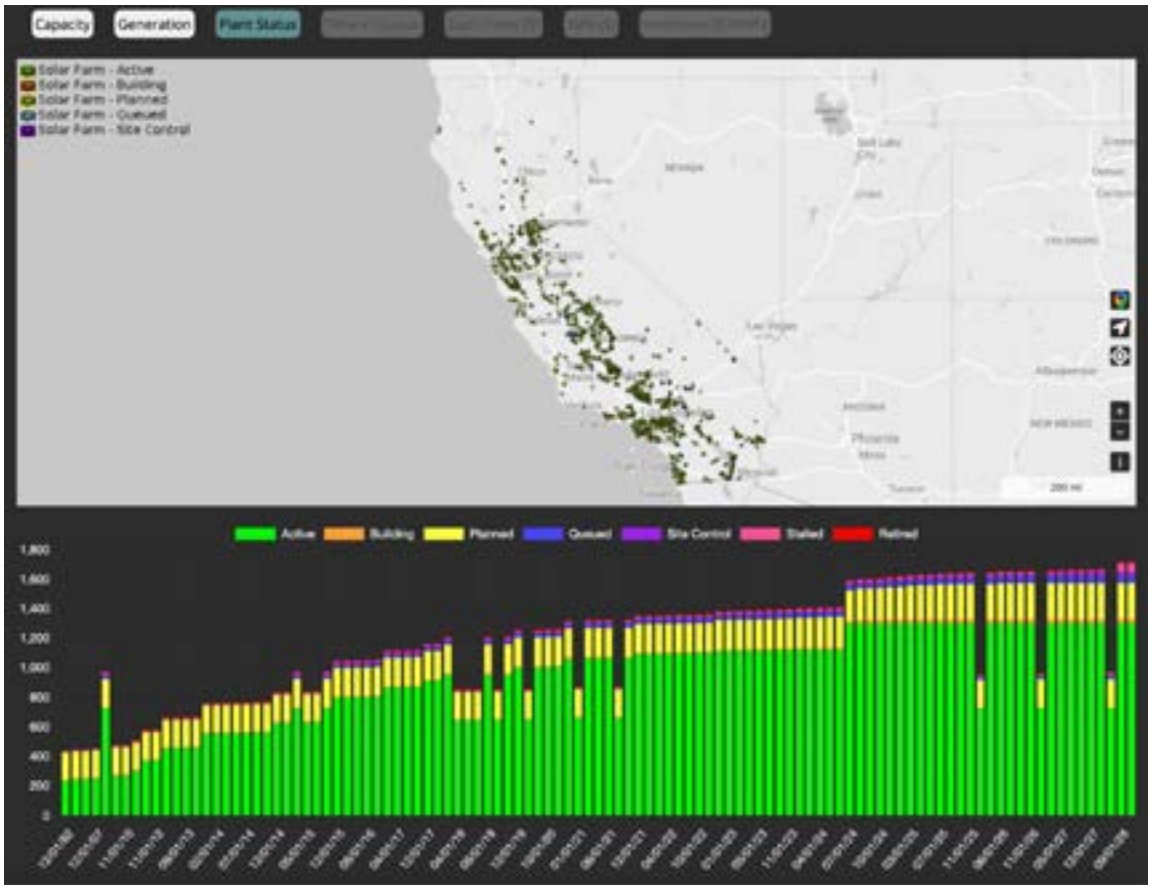


California Solar Energy
ACTIVITY

Status	CA Solar Farm Count	CA Solar Farm Capacity (MWac)	CA Solar Farm Generation (MWh)
Operating	1,302	23,128.38	1,446,628
Under Construction	30	491.70	198,405 (est.)
Planned	244	7,705.83	2,975,619 (est.)
Queued Projects	119	28,493.55	2,071,239 (est.)
Site Control (Lease Options)	31	4,386	1,586,320 (est.)

*est is the estimated peak total electricity generation that those solar farms will produce once operational

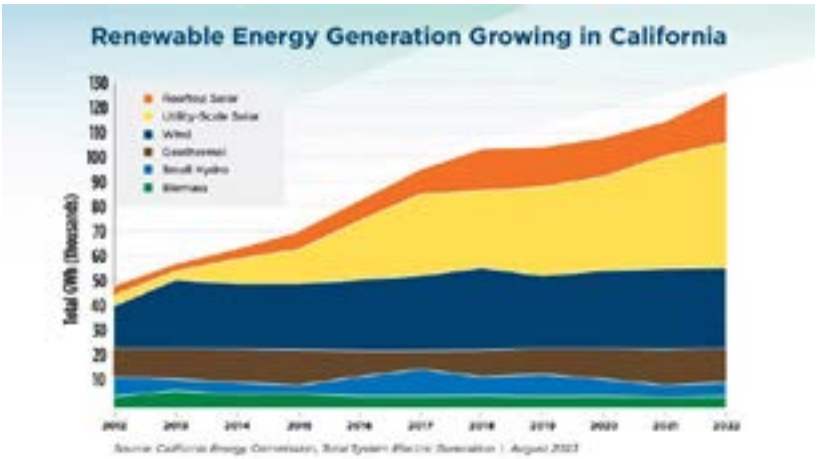
California has a well-established pipeline for utility-scale solar development with 7,705 MW capacity for 244 planned projects, 28,493 MW capacity for 119 queued projects, and 4,386 MW capacity for 31 site control projects. Overall, if all planned, queued, and site control farms go into operating status, California will expand its capacity by 40 GW. In California, the average solar farm size is 171 acres, producing 17.8 MW of electricity under ideal conditions. So a solar farm in California needs an average of 9.6 acres per 1 MW of capacity.

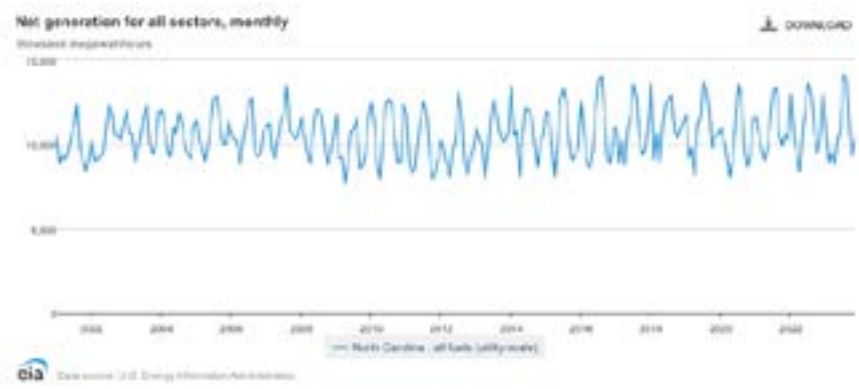


Over the past two decades, California's energy landscape has experienced a remarkable transformation, moving decisively from traditional energy sources to renewable ones. In 2000, the state relied heavily on conventional energy, but the rise of solar power has played a significant role in the shift towards a sustainable energy mix. As of July 2024, solar energy contributed to over 30% of the state's electricity, reflecting substantial growth in this sector. Notably, California leads the nation in installed solar capacity, with 23,000 MW, enough to power over 21 million homes. The state's robust solar market has attracted $105.3 billion in investment and created over 78,000 jobs, highlighting the economic benefits alongside environmental gains.

Due to recent policy changes, such as the transition from net metering to net billing, the state's solar industry continues to adapt and thrive. Major installations like the 527.8 MW Mount Signal Solar Farm and corporate projects by companies like Apple underline the extensive development in the sector.

California stands as the second largest state, after Texas, in total electricity generation from renewable resources. It is the nation's top producer of electricity from solar energy and geothermal resources. Solar energy is the largest source of California's renewable electricity generation, with significant solar resources in the southeastern deserts where all of its solar thermal facilities and several of its largest solar PV plants are located. However, there are solar PV facilities throughout the state.





In the context of the U.S. Energy Information Administration (EIA), "net generation" refers to the total electricity produced by an energy source, excluding the power used in the generation process. The EIA gathers and publishes net generation data for various energy sources, such as solar (shown above) providing valuable insights into the U.S. energy production landscape and aiding energy-related decision-making and policy planning.

Utility-Scale
SOLAR

Utility-scale solar refers to solar farms often created and managed by utilities, independent power producers, or energy firms. These projects aim to produce electricity on a large scale and deliver it directly into the distribution grid. These solar farms generally have **more than 10 MW** in capacity. Below is a breakdown of the different types of solar farms and their development statuses.

Utility-Scale

The state of California is regulated by the California Independent System Operator **(CAISO).**

Projects Queued for Development in California

SPP Generator Interconnection Queue

Number of Solar Farms	Capacity (MWac)	Solar Farm Generation (MWh)
134	8,966.09	8,966.09
10	1,452	1,452

A project in queue means that the project enters the interconnection queue of that region waiting for regulatory approval. During this period, the analysis of possible engineering and land factors is conducted to determine the feasibility of the project to be constructed and connected to the grid. The average amount of time it takes for a farm to go from queue to operational in California is **~ 4 years.** As per the projected in-service dates for the current projects in queue, California will most likely add **17 GW** of Utility Scale farms by the end of 2025.

How do developers screen and run due diligence for those solar farm projects in queues?

Factors to take into consideration:

- Electricity generation
- Electricity commodity prices (LMP, incentives, PPA)
- Capital costs
- Operating costs
- Timing
- Risks

Using the factors above and a standard solar panel size, the buildable acreage and a land coverage ratio (encompassing row spacing and maintenance spacing) we calculate the maximum number of panels that could fit on the parcel. This helps us estimate the capacity the project lease will add to the grid and calculates a Market Value of the solar project.

Solar PowerVal enables similar capabilities to evaluate land parcels for solar development and get an independent economic report for solar projects of all statuses. This tool allows developers and project financiers to fast-track the process of submitting a feasibility study to the queue for approval through independently produced Engineering & Economic analytics and Solar 8760 reports or evaluate projects and parcels for origination and M&A.

Some of the more prominent utilities in the state of California include the Pacific Gas & Electric Company (PG&E) and Southern California Edison (SCE). These two largest utilities represent over 80% of electricity production for the state of California.

California’s growing emphasis on solar energy aligns with state policies, federal tax incentives, and decreasing costs of solar

technology, which have collectively driven this expansion. However, challenges such as interconnection delays, supply chain issues, and high soft costs remain. Addressing these will be crucial to sustain future growth.

Overall, California demonstrates a robust trajectory towards enhancing its solar energy capacity, reflecting strategic efforts to diversify its energy sources and promote sustainability.

Highlights: Notable Utility-Scale Solar Projects in California

Project	Capacity	Description
Topaz Solar Farm 	585.9 MW	• Owned and operated by BHE Renewables • Year of commercial operation: 2013 • Has more than eight million modules • 4,700 acres • Provides enough electricity to power more than 160,000 average California households
Slate Hybrid 	440.3 MW	• Owned and operated by MN8 Energy • Year of commercial operation: 2021 • One of the largest PV + battery storage projects in the U.S.

SOUTHERN CALIFORNIA EDISON

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Project	Capacity	Description
Daggett Solar Farm 	444 MW	• Owned and operated by Clearway Energy • Year of commercial operation: 2023 • Project has generated $210 million in local spending; will pay the county up to $10.9 million in Sales and Use Taxes
Arlington Energy Center II 	365 MW	• Owned and operated by NextEra Energy Resources • Expected year of commercial operation: 2022 • Consists of 233 MW PV coupled with 132 MW/528 MWh of battery storage • Uses solar photovoltaic modules for energy generation, inverters for power conversion, and typical electrical equipment to collect the produced energy

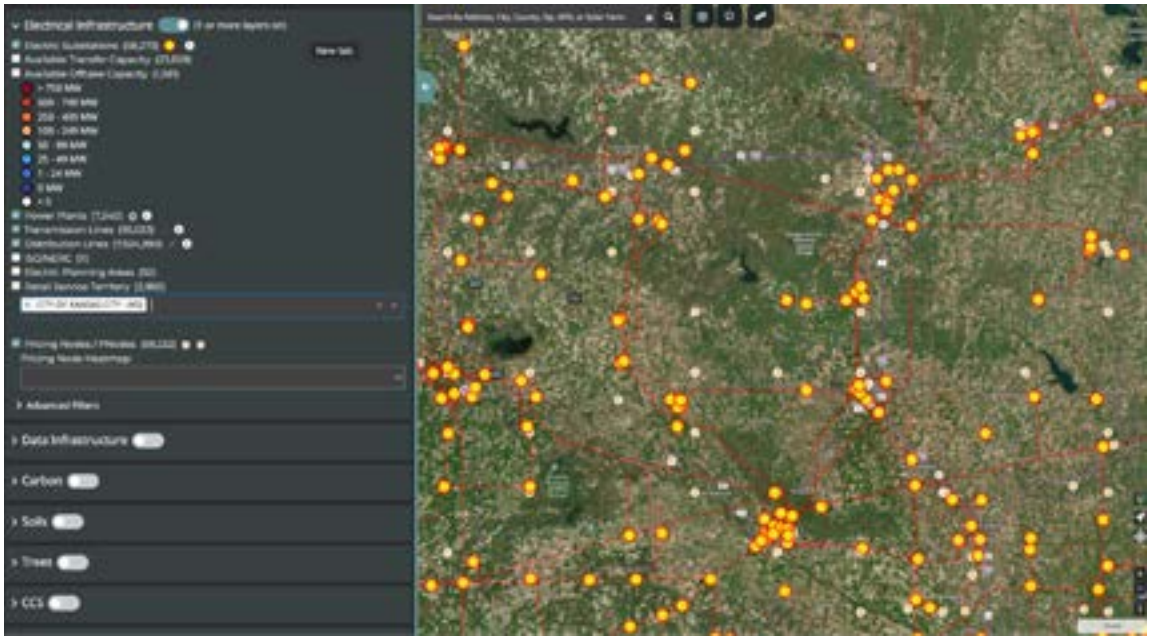
How is a Utility-Scale solar project submitted to the queue to connect to the electric grid?

Typically, the queue submission process within an ISO or Utility area follows similar steps.

The solar developer needs to complete and submit an official interconnection request form provided by the ISO or utility, that captures essential project details and starts the interconnection process. Project specifications should include details like name, location (latitude and longitude), point of interconnection, capacity, expected energy production, environmental impact, technology layout- inverters, solar panels, system layout through a Feasibility study with an 8760 report to help initially assess the project's compatibility with the existing grid infrastructure. The Solar developer will also have to pay an initial payment to secure a position in the interconnection queue and contribute towards the cost of initial studies and evaluations conducted by the ISO/Utility. Post the submission of the form, reports and payment, the project is now effectively in the queue.

After the project has entered the queue, Injection reliability study and system impact study is conducted. These studies determine the exact impact of the project on existing infrastructure and identifies any potential network updates required to reliably interconnect the solar project to the grid. Once the study is completed, the developer gets a complete picture of the financial cost of the solar farm with regards to the complete CAPEX and Budget. This helps the decision making process of whether to move forward with the development of the solar project or withdraw the application from the queue. If the project seems viable to move forward the developer signs an interconnection agreement with the ISO/Utility and essentially looks to produce Economic and Financial reports for Bankers and Investors to help facilitate the construction of the solar project.

How is a Utility-Scale solar project connect to the electric grid?



These projects are interconnected through transmission lines that carry electricity from one point to another in an electric power system grid. These lines are used to transmit electrical power from power generation sources to distribution centers, which are then distributed to end-users. Through LandGate's accessible transmission line data, developers and landowners can evaluate land parcels based on segments & feeders, proximity to existing distribution lines and distribution hosting capacity.

Commercial, Community & Behind-the-Meter Solar Farms

Over the past few years, community solar projects in California have gained momentum, providing an accessible pathway to renewable energy for many residents. These projects allow individuals, particularly renters and those unable to install solar panels on their own properties, to subscribe to local solar installations and receive credits on their utility bills. The state's commitment to expanding community solar is evident through legislative efforts and various programs aimed at enhancing solar access.

One of the key initiatives is the Disadvantaged Community Green Tariff Program (DAC-GT), which enables low-income customers in disadvantaged areas to benefit from solar projects while receiving a 20% discount on their electricity bills. This program has recently expanded from 60 MW to 144 MW, expecting to benefit approximately 45,000 additional customers and facilitate 45 new solar projects. Another significant program, the Community Solar Green Tariff, will allow customers to subscribe to local solar projects and enjoy similar bill savings, with the involvement of local non-profits or government sponsors in organizing these efforts (CPUC) (CPUC).

Moreover, the passage of Assembly Bill 2316 marks a significant step forward in making solar energy more accessible. This bill mandates that at least 51% of subscribers to community solar projects must be low-income customers, ensuring equitable access and triggering federal tax incentives. The legislation also emphasizes pairing solar projects with energy storage to enhance grid reliability and provide continuous power even after sunset.

California
LMP Data

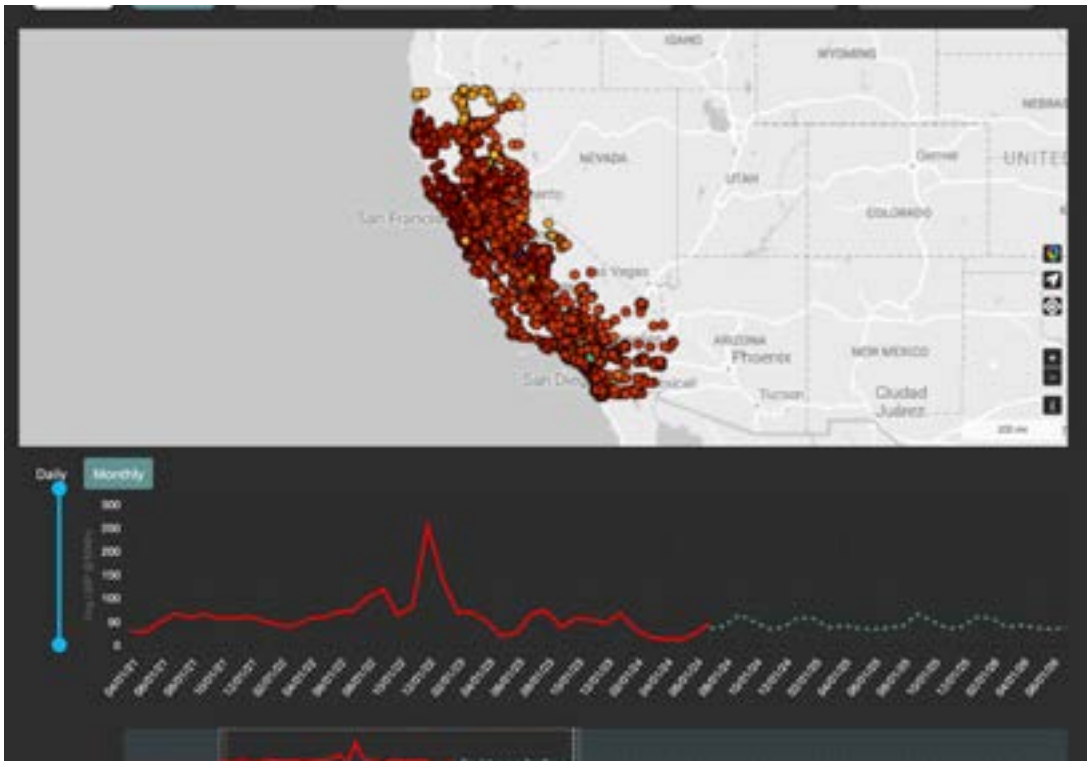
LMP (Locational Marginal Price) is a pricing mechanism used in wholesale/merchant energy markets to determine the cost of electricity at specific locations (node) within the grid. LMP considers a number of variables, including the cost of generating power, transmission constraints, grid congestion, losses, and load at certain nodes or locations within the electrical grid. The prices at which electricity is bought and sold in the market in real time or on an hourly basis are reflected in its calculation, which is done through market procedures.

California saw the average LMP price decrease by 31% in the past 3 years with an average price of $53.74 $/MWh in the year of 2024. This price is forecasted to decrease further by 33% in 2025 to $29.28. Similarly, consumer electricity purchase cost has also increased for the past few years in California. The current commercial electricity rate is 11.15 ¢/kWh which is a 13.4% increase compared to the commercial electricity rate of 9.83 ¢/kWh in 2020.

In California, higher Locational Marginal Prices (LMPs) within the energy market could present specific challenges for the state's electricity distribution system. Elevated LMPs may reflect congestion in certain areas of the grid, potentially indicating insufficient transmission infrastructure or imbalances in supply and demand. This congestion could lead to increased costs for consumers, as electricity providers may need to procure power from more expensive sources to meet demand. Additionally, high LMPs may impact the economic viability of renewable energy projects in the state, affecting California's transition towards cleaner energy sources.

California

LMP Scorecard



Merchant Energy Pricing: **Market: SPP (Southwest Power Pool)**	
Number of price nodes active:	**5,273**
Average LMP price as of 05/01/24: Average LMP for 2024 (including current and forecasted): $53.74	**$51.22**
Current commercial electricity rate	**11.15¢/kWh**
Percentage change in average LMP for 2025	**-34.0%**
Commercial electricity rate change since January 2020	**+13.4%**

Average LMP Prices: Historical & Forecasts

Year	Avg LMP Price ($/MWh)
2019	$33.06
2020	$34.08
2021	$47.27
2022	$58.17
2023	$56.19
2024 (est.)	$53.74
2025 (est.)	$50.22
2026 (est.)	$51.23

California
PPA Data

Utility-scale solar can be integrated into the grid and electricity can be sold at a predetermined price thanks to PPAs (Power Purchase Agreements) with utilities or power purchasers. Even if they are unable to put solar panels on their own homes, PPAs for community-scale solar projects allow local participants to profit from solar energy generation. The time and amount of power sales are governed by the PPA's terms, which guarantees a steady market for the solar installation.

The average Estimated Utility-Scale PPA price in California is $85.45 $/MWh. This demand influences PPA prices as developers strive to meet regulatory requirements while remaining profitable. Additionally, limited land availability poses challenges for large-scale renewable projects, increasing costs associated with land acquisition and development, thus impacting PPA prices.

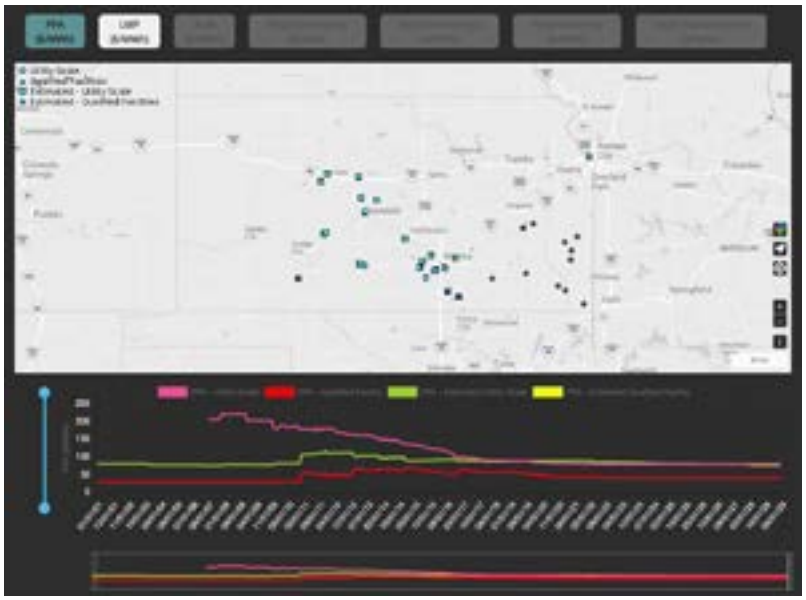
In California, Power Purchase Agreement (PPA) prices are influenced by a diverse array of factors. The state's energy mix, comprising coal, natural gas, nuclear, hydroelectric, and wind energy, along with the increasing competitiveness of renewable sources like wind power due to technological advancements, significantly impacts PPA rates. As California's energy landscape evolves, with a growing emphasis on renewables and technological innovation, the dynamics driving PPA prices continue to evolve, reflecting the complexities of the state's energy market.

Furthermore, California's low development costs have contributed to stable PPA prices. Advancements in solar technology have led to increased efficiency and lower manufacturing costs, making solar panels more affordable to install and maintain. These technological innovations have also improved the overall performance and reliability of solar systems, reducing operational expenses and enhancing long-term cost competitiveness.

Additionally, economies of scale and growing market maturity have contributed to stable PPA prices in California. As the solar industry expands and more projects come online, developers benefit from economies of scale in manufacturing, installation, and project development, driving down overall costs. Moreover, increased competition among solar developers and suppliers has spurred innovation and efficiency improvements throughout the value chain.

California

PPA Scorecard



Average PPA price last 12mos:	**$85.31**
Average Utility-Scale PPA price change in the last 3 years	**+0.16%**
Largest PPA buyers:	**Apple, Google, Meta, Amazon**

Average PPA Prices:

Year	Price ($/MWh)
2020	$83.45
2021	$84.23
2022	$85.31
2023	$85.45
2024	$85.45

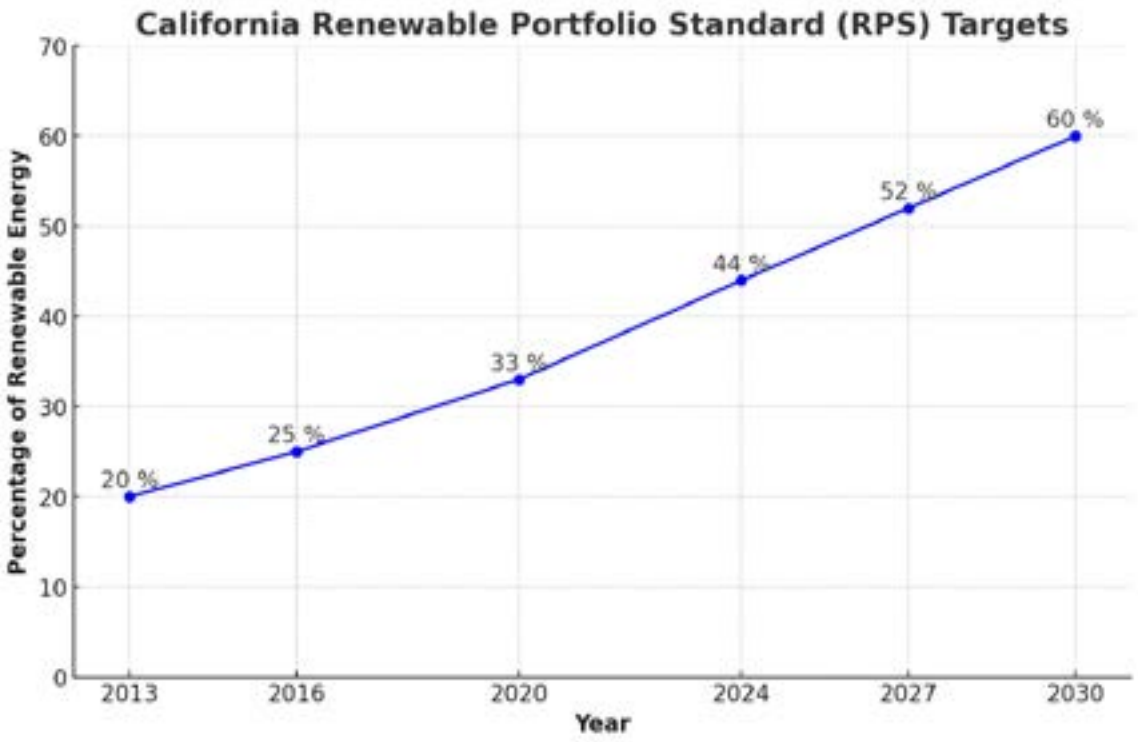
Federal & California State

Tax Incentives for Solar Developers

There are several federal and state incentives available for solar development in California, intended to encourage the use of solar energy by making solar power more affordable for businesses and organizations that install solar systems. These incentives can improve the financial viability of solar projects since they lower the initial costs and increase the return on investment. Solar project incentives aid in the switch to clean, renewable energy sources, which lower greenhouse gas emissions and slow climate change. Incentives aid in increasing the deployment of solar projects by making solar energy more financially appealing, replacing fossil fuel-based power and lowering the environmental effects related to traditional energy sources.

CA Solar Development Incentive	Type	About
Federal Solar Tax Credit, Solar Tax Credit (ITC)	Federal	The ITC allows for a 30% tax credit on the cost of solar system installation, applicable through 2032. Furthermore, solar panel installations are exempt from sales tax and any value-added property tax that may be levied from it.
Net Energy Metering	State	California allows for net metering, which means that when your solar panels produce more electricity than you use, the excess energy is sent back to the grid, and you earn credits that can offset future energy bills.
Property Tax Exemption	State	Solar panels in California are exempt from property taxes. This means that installing solar panels will not increase your property taxes, even though they increase the value of your home.
Property Assessed Clean Energy (PACE) Program	State	Eligible homeowners can obtain financing for solar panel installation through the Property Assessed Clean Energy (PACE) program. This program allows the homeowner to finance the installation and repay the loan via their property taxes.
Self-Generation Incentive Program (SGIP)	State	The California Public Utilities Commission's Self-Generation Incentive Program (SGIP) provides rebates to residents who install a solar battery in addition to their solar panels. The rebate amount depends on the battery's storage capacity and the resident's local utility company.

Renewable Portfolio Standard (RPS) Goal: California's Renewables Portfolio Standard (RPS) was initially set by legislation passed in 2002. Over time, amendments to the law have mandated that by 2030, and every year thereafter, 50% of California's electric utilities' retail sales must come from eligible renewable energy sources. The law includes interim targets for utilities to meet. Although Publicly Owned Municipal Utilities (POUs) are not regulated by the California Public Utilities Commission (CPUC), they are still impacted by the law, and their governing boards are responsible for setting procurement requirements.



With such a wealth of new data on the state of Solar Development in California, we imagine you might have questions about how to apply these trends, data, and tools to your own solar development efforts in California. Our dedicated energy markets team can help walk you through how to access and interpret this information in a way that is relevant to your business needs. Schedule time with our team here to talk one on one.

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