



Silicon Valley Clean Energy and Google's innovative 24/7 carbon-free energy agreement embraces electrification and community collaboration in advancing a clean energy future.



Silicon Valley Clean Energy and Google share common goals for clean, carbon-free electricity on the grid, and switching from fossil fuels to clean electricity in buildings and transportation. Headquartered in Mountain View, California, Google is a long-time corporate leader in renewable energy procurement and is committed to operating its business on carbon-free energy (CFE) – at all hours and in every location by 2030. Silicon Valley Clean Energy (SVCE) is a public community choice energy agency formed in 2016 by thirteen Silicon Valley jurisdictions to provide clean, carbon-free electricity at competitive rates and electrification programs to reduce community-wide carbon emissions.

Shared Motivations

As innovative, Silicon Valley-based organizations, SVCE and Google have joined forces to create a fundamentally new 24/7 carbon-free energy service for Google's offices in Mountain View and Sunnyvale. SVCE will match carbon-free electricity with Google's local demand for at least 92% of all hours in the year – from a tailored portfolio of renewable energy resources meeting additionality requirements. On the demand side of the equation, Google will flex its building electric loads to further improve CFE and cost performance. And in this same spirit, Google is committing to ongoing electrification investments at their local facilities.

Taken together, the new services advances decarbonization locally and on the grid, provides a scalable model for others to follow, and demonstrates the power of community collaboration in accelerating the transition to a clean energy future.

Google's History of Clean Energy Leadership

Google has been carbon neutral since 2007 through a combination of high-quality carbon offsets and renewable energy purchases that have brought its net operational emissions to zero.

In 2017, Google became the first major company to match 100% of its annual electricity consumption with renewable sources. Today, Google is one of the world's largest corporate purchasers of clean energy, responsible for more than 7 gigawatts of new capacity across roughly 60 wind and solar projects.

Yet while Google buys as much renewable energy in total as it uses over a year, there are still times and places when the wind does not blow, or the sun does not shine. During those hours, Google's data centers and office buildings often rely on carbon-based electricity.

Since
2007

Carbon Neutrality Offsetting Emissions

Google purchased enough high-quality carbon offsets and renewable energy to bring its net operational emissions to zero.

Since
2017

100% Renewable Energy Reducing Emissions

Google has matched its global, annual electricity use with wind and solar purchases. However, facilities rely on carbon-based power in some places and times.

By
2030

24/7 Carbon-Free Energy Eliminating Electricity Emissions

Google intends to match its operational electricity use with nearby (on the same regional grid) carbon-free energy sources in every hour of every year.

24/7 carbon-free energy means having clean electricity available for every hour on every grid—completely eliminating carbon emissions associated with Google's electricity use. Google is now in the final and most ambitious phase of its energy journey: by 2030, Google intends to run on carbon-free energy everywhere, and at all times.

An Advanced 'Building Energy Footprint' in Silicon Valley

Google's Bay View campus features first-of-its-kind dragonscale solar skin, equipped with 50,000 solar panels on the roof, and North America's largest geothermal pile system beneath the building to provide heating and cooling throughout the year.



Google's energy use in Silicon Valley is primarily from commercial office buildings at its headquarters and surrounding campuses. By contrast, much of Google's energy use globally comes from data centers, and Google is also pursuing 24/7 CFE for each of its data center sites as well.

Data centers are more energy-intensive than office buildings, and they consume a consistent amount of power hour-to-hour. Commercial buildings, with loads that have peak periods and are less predictable, represent a more typical energy use case. In the U.S., commercial buildings account for 35% of electricity consumption, and 16% of all carbon emissions.

Optimally serving Google's facilities with carbon-free energy measured on a 24/7 basis involves innovation in both energy supply and energy demand. A growing number of Google's buildings in the area incorporate the latest in smart all-electric building design, with features that allow Google to flex energy demand by shifting loads to align with periods of lower grid emissions.

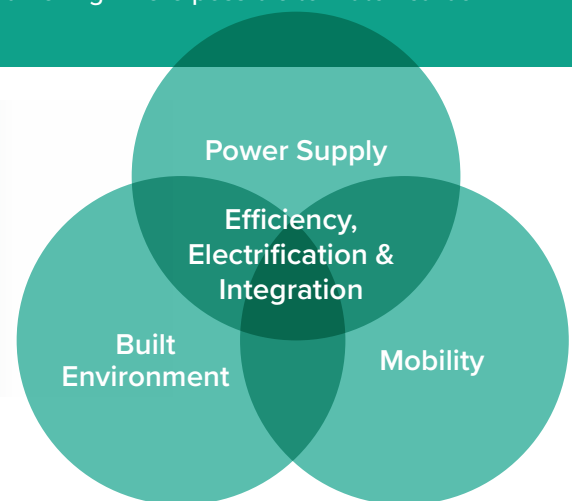
Ground source heat exchange and thermal storage technology enable Google facilities to shift heating and cooling demands by acting as a "thermal battery." Solar and battery storage generate renewable energy onsite which can be intelligently controlled to offset electricity usage during peak grid-emission periods. In the Bay Area, Google is approaching its target of providing EV charging for 10% of all parking spaces and is looking to take advantage of load management technology to flex real-time power supply to better align with carbon-free energy.

This will enable SVCE's 24/7 CFE service with Google to operate from two directions – providing hourly carbon-free electricity supply from a tailored energy portfolio, and encouraging dynamic load flexing where possible to match carbon-free electricity supply.

Silicon Valley Clean Energy – a Mission to 'Decarbonize'

Silicon Valley Clean Energy (SVCE), a public community choice energy agency, was formed in 2016 by thirteen neighboring communities. The organization was given a very specific mission – to fight climate change by providing clean, carbon-free power at competitive rates, and innovative community programs for fuel-switching from fossil fuels to clean electricity in buildings and transportation.

SVCE is guided by an overarching strategy to achieve deep decarbonization in the community



SVCE now serves more than 270,000 business and residential customers, including many of the world's top technology companies. SVCE's member communities and customers are taking major steps to reduce emissions and fight climate change – including broad adoption of all-electric "reach codes" for new building construction, and the highest ownership rates of electric vehicles in the U.S.

SVCE is investing in numerous community programs for decarbonization, including building electrification, electric vehicle charging, energy storage, and related awareness-building and education.



Silicon Valley Clean Energy's Move from 'Carbon-free' to '24/7 Carbon-free'

Since the organization's launch, SVCE's power portfolio has been carbon-free as measured on an annual basis, sourced exclusively from renewable and carbon-free resources.

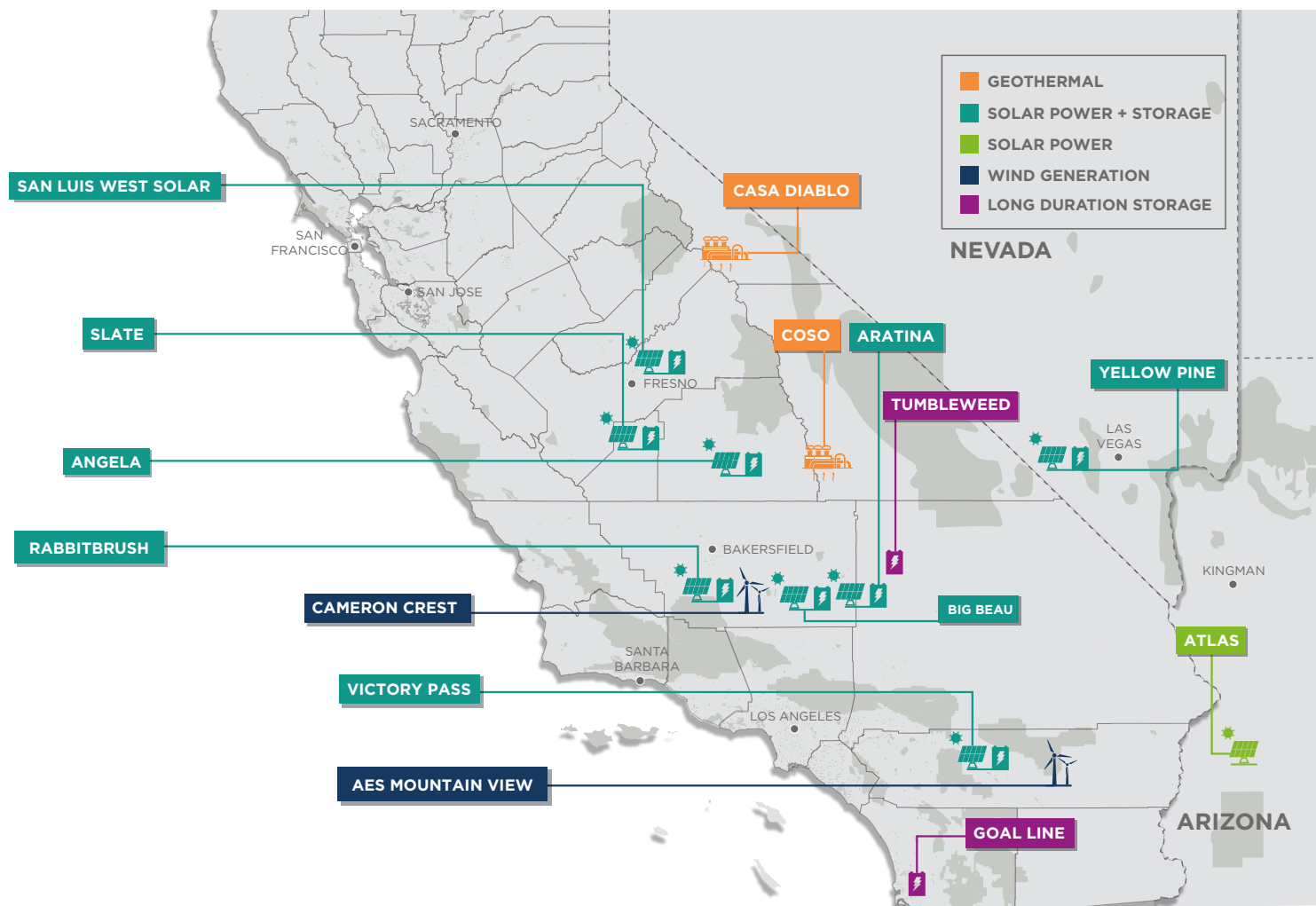
SVCE understands that expanding renewables on the California grid while reducing reliance on fossil fuels requires building a portfolio of complementary generation technologies that can deliver energy well-matched with varying hourly demands throughout the year.

With this in mind, SVCE has committed over \$1.8 billion to renewable energy facilities well-suited to the challenges of delivering clean energy on a 24/7 basis. These include the largest solar + battery storage plant in the U.S. operating as of early 2022, and other solar + storage, geothermal, wind, and long-duration storage contracts.

Now, SVCE is taking the next step in providing carbon-free energy, launching a customer-facing service with Google that plans, commits, and tracks delivery of energy on a 24/7 hourly carbon-free basis.



SVCE Power Generation Locations



Challenges for 24/7 Carbon-Free Energy in California

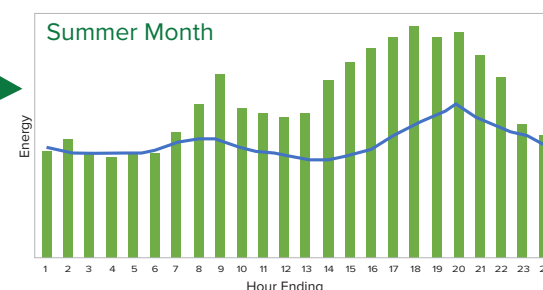
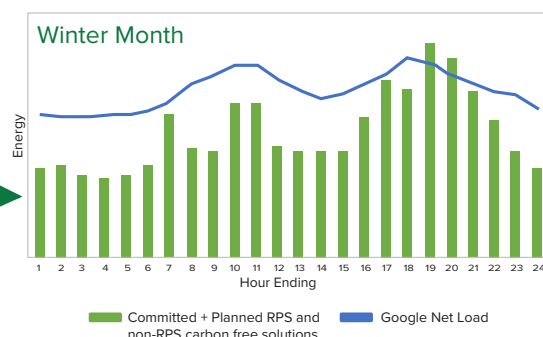
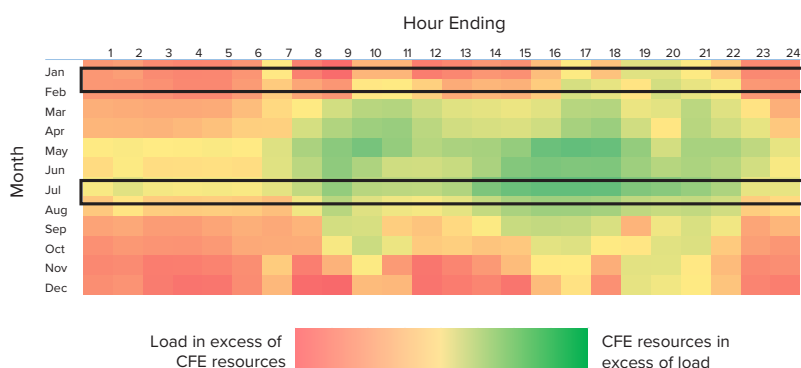
– and at SVCE

Senate Bill 100, California's landmark policy signed in 2018, requires that renewable and zero-carbon energy resources supply 100 percent of electric retail sales to customers by 2045. By national standards, the California grid is already relatively clean, sourced with approximately 55% renewable or other carbon-free resources, and 45% from fossil fuel-fired generation.

Yet the further expansion of renewables on the California grid will require new approaches. Currently, a proliferation of solar energy and a lack of complementary renewables and grid storage requires rapid ramping of fossil fuel generation on the grid in the late afternoon, as the sun sets and energy use peaks. In addition, reliance on intermittent resources such as solar and wind can result in grid reliability challenges.

SVCE generates or buys renewable and carbon-free power equal to its total electricity demand on an annual basis, so its portfolio mix is cleaner than the overall California grid. SVCE's commitment to deploying storage with solar, and other complementary resources means SVCE's overall energy mix is on track to reach an estimated 80% CFE score by 2025, based on modeling of generation using standard resource profiles. In the industry today, most renewable supply resources are accounted for on an annual basis, so hourly results must be modeled. More precise CFE scoring requires hourly generation data, which is not yet generally available via renewables registries.

Heat map for standard SVCE energy mix, showing relative carbon-free electricity (CFE) generation by hour and month.



Charts showing Google load and CFE supply for a representative day in January and June.

As shown above, SVCE's standard carbon-free energy mix would match Google's load as measured on an annual basis, yet daily and seasonal variations of renewable resource generation still result in mismatches between supply and demand during many hours of the year – often over-supplied during the sunniest hours of the day, and under-supplied on winter nights.

Building a true 24/7 carbon-free electricity portfolio that can greatly reduce or eliminate reliance on fossil fuels requires a variety of supply and storage resources that can match hourly demand – and new ways of accounting for supply and demand on an hourly basis. New portfolio investments should be directed to resources that can address key hours of under-supply, and utilize energy generated during over-supply hours.

Key Goals for a New 24/7 CFE Service

Working together, Google and SVCE envisioned a new carbon-free electric service that brings additional clean energy to the grid, promotes electrification, and serves as a leading example for the community, commercial customers, and electricity providers. SVCE's agreement with Google addresses the following overarching goals:

- 1 Operationalize new 24/7 electricity supply and delivery service**
A commercial 24/7 electricity service, anchored around specific CFE performance goals, must utilize new methods and capabilities for renewable supply modeling, procurement, portfolio tracking, and reporting on an hourly basis – relative to forecast and actual hourly electricity loads. The service should provide customers with operational leverage, sourcing flexibility, and good overall economics.
- 2 Integrate flexible ‘all-electric’ building and transportation loads**
To further encourage electrification at customer facilities and improve cost and CFE performance, a 24/7 CFE service should take advantage of opportunities to flex a customer's electric load toward hours where carbon-free energy is the most plentiful and lowest cost.
- 3 Advance clean electrification in the community, and beyond**
Electricity providers and large commercial energy users are essential players in our clean energy transition – locally, and globally. A comprehensive 24/7 CFE service should support investment in building and transportation electrification at local customer facilities and via programs available to community members. Such a service accelerates the move toward electrification and a carbon-free grid and serves as a replicable model for other energy providers, customers, and policymakers.

How does the new 24x7 service work?

To serve Google's facilities over the next 10+ years, SVCE will manage a dedicated power portfolio comprised of wind, solar + battery storage, geothermal and other resources sourced by both Google and SVCE. In combination, these resources will be well-matched on an hourly basis with Google's load profile. SVCE is using probabilistic models to analyze current and forecasted hourly energy demand, and alternative California-based power portfolios to determine what combination and sizing of resources will provide a 92+% hourly CFE score, at the best-blended cost.

Ongoing collaboration between SVCE and Google is important for load forecasting and evaluating future sourcing tradeoffs, as market and regulatory factors in California continue to influence power prices and the economics of new energy projects.

Critical to 24/7 CFE accounting, generation from dedicated CFE portfolio resources will be tracked on an hourly basis, relative to hourly energy demands. Trends in hourly CFE scoring identify hours where additional renewable supply is needed, and where opportunities are best for shaping demand.

Hourly CFE Score (i) =

$$\frac{\text{MWh}_{\text{Gen}_i} + [(\text{MWh}_{\text{Load}_i} - \text{MWh}_{\text{Gen}_i}) \times \text{Forecasted Hourly Grid CFE Score}]}{\text{MWh}_{\text{Load}_i}}$$

In hours where dedicated renewable supply is less than demand, a grid CFE score is applied to the shortfall. Hourly results are averaged on a load-weighted basis over the year to produce an annual 24/7 CFE score.

Service costs are based on dynamic CAISO market prices, rather than traditional time-of-use pricing. The 24/7 CFE service supports active demand management, providing for the integration of day-ahead price signals with Google's flexible all-electric building and transportation systems, including thermal and battery storage, EV charging networks, and smart HVAC. In California, high energy prices on the grid are strongly correlated with fossil-fuel use – so effectively flexing demand improves the economics and CFE performance.

Long-term purchase agreements in the dedicated portfolio help to hedge these service costs. For hours where portfolio generation exceeds demand, SVCE helps manage cost risk by selling or purchasing surplus RECs. To simplify utility bill administration, Google facilities personnel pay a standard generation rate across all accounts, reset annually based on forecasted costs, and trued up based on actual hourly costs from the preceding year.

As with all SVCE customers, a percentage (set annually) of energy revenue received from Google is invested in community electrification and decarbonization programs.



A 24/7 carbon-free energy service that empowers customers, communities, and the grid

Throughout California and around the world, communities, businesses, and governmental agencies have committed to fighting climate change through large-scale reductions in carbon emissions. Silicon Valley Clean Energy's 24/7 carbon-free energy service with Google shows how a community-based energy agency and a leading global energy customer can come together to take on this challenge, creating a service with multiple benefits:

For the Customer



- Delivers 24/7 CFE as an integrated service, with new planning, procurement and operational processes, and performance metrics
- Encourages demand-side management to flex building electricity loads toward hours when electricity supply is the cleanest and lowest-cost

For the Community



- Leverages a long-term customer commitment to local emissions reduction through ongoing investment in innovative building and vehicle electrification at customer campuses, and via related incentive programs available to the local community

For the Grid



- Further reduces grid carbon emissions by channeling new investment toward renewables that generate during hours most reliant on fossil fuels

Encouraging Demand-Side Management

Current time-of-use (TOU) electricity rates are designed to reflect increased pricing from 4-9 pm in response to California's "duck curve" load profile, when demand is high but solar energy is dwindling. Generally sorted into three major pricing blocks throughout the day (peak, partial-peak, and off-peak), TOU rate structures lack the nuance needed to reflect dynamic grid emissions throughout the day.

By utilizing significantly more price increments than a standard TOU rate, 24/7 hourly pricing creates the opportunity to control "smart" devices and building systems by using a dynamic price signal to align behavior with grid emissions.

Working together, SVCE and Google have established a 24/7 CFE service model with important benefits – that can be replicated and scaled by energy providers, large energy customers and communities to accelerate our transition to a clean energy future.