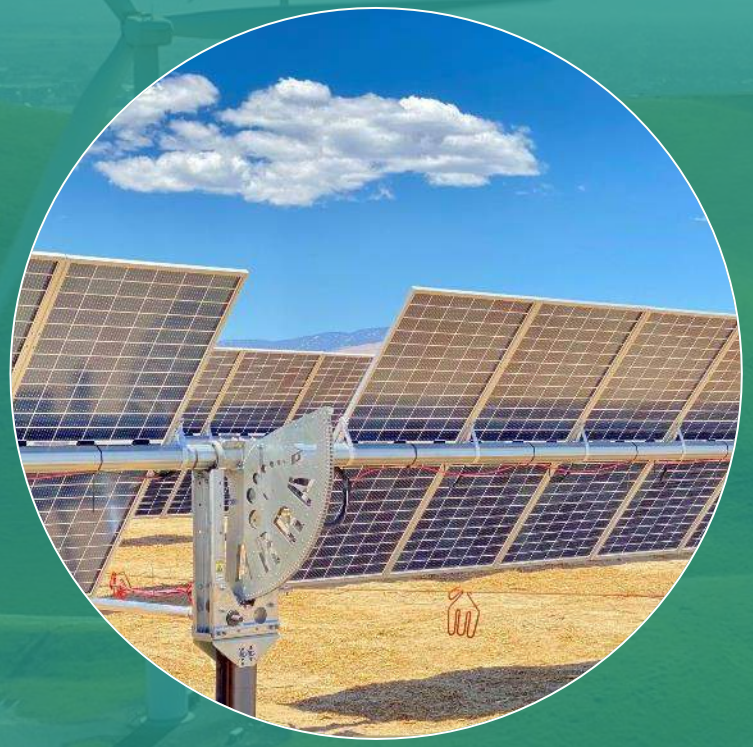
SVCE Policy and Strategy Workshops

The Next Chapter in Decarbonization

June 10, 2022

SILICON VALLEY CLEAN ENERGY



Intro: Why We're Here

Intro: Policy and Strategy Workshops

Welcome to SVCE's 5 Year Policy and Strategy Workshop Series!

Workshop Goals:

- Educate the Board and SVCE Community on key trends in energy and climate
- Identify SVCE's role within the California energy policy and market ecosystem
- Explore challenges and opportunities resulting from changing market and regulatory conditions
- Prime the Board for future decisions on SVCE policies and priorities





Today's Agenda

Day 1: Energy 101 + The Changing Grid

Intro (10 Minutes)

- About the Workshops
- Why We're Here: The Changing Grid

Energy 101 (15 Minutes)

- Energy Basics
- SVCE and the Grid

The Changing Grid (30 Minutes)

- Renewables and Storage
- Resource Retirements and Reliability
- Demand Side Innovation

SVCE Integrated Resource Plan Update (5 Minutes)

Recap and Discussion (30 Minutes)

Refresher: Energy Basics

TRIVIA QUIZ #1: Power Users

Which of these appliances uses the most power (watts)?

A) 30 LED Light Bulbs

B) Desktop Computer

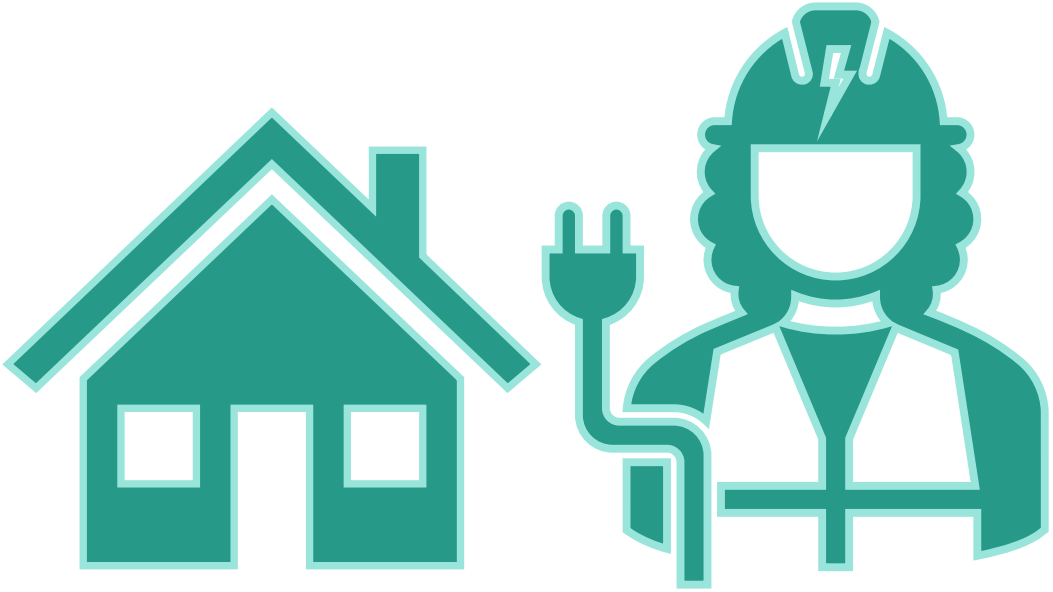
C) Heat Pump Water Heater

D) L1 EV Charger

E) Pool Pump (Filter Pump)

F) Vacuum

G) Window Air Conditioner

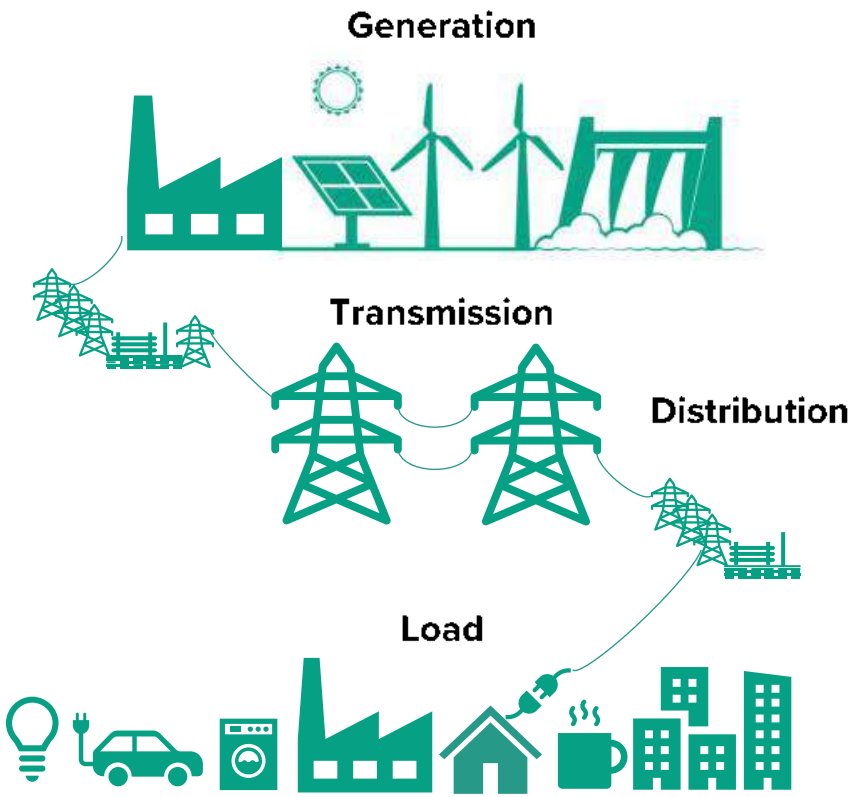


What is the Electric System?

The electric system powers our society 24/7 365.

The electric system is a complex machine built to provide reliable, stable *on demand* power to millions of customers.

- Energy is ***generated*** by ***power plants*** – hydroelectric, natural gas, coal, nuclear, and increasingly, renewables: solar and wind
- Energy is ***transmitted*** across the ***transmission and distribution system*** – poles, wires, transformers, substations, and other electrical equipment – from power plants to customers
- Energy is ***consumed*** by ***load*** – light bulbs, air conditioners, ovens, dryers, factory motors, water pumps, electric cars, and thousands of other electrical end uses powering society



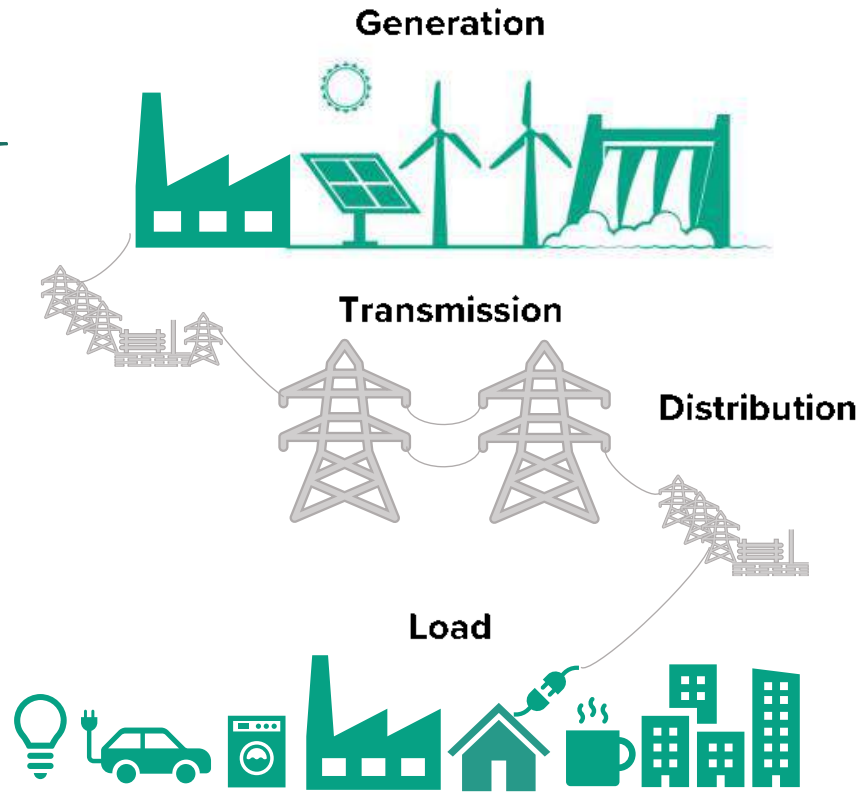
What is the Electric System?

SVCE's role on the grid is focused on buying clean energy for its customers.

SVCE Clean Energy Portfolio

PG&E Grid

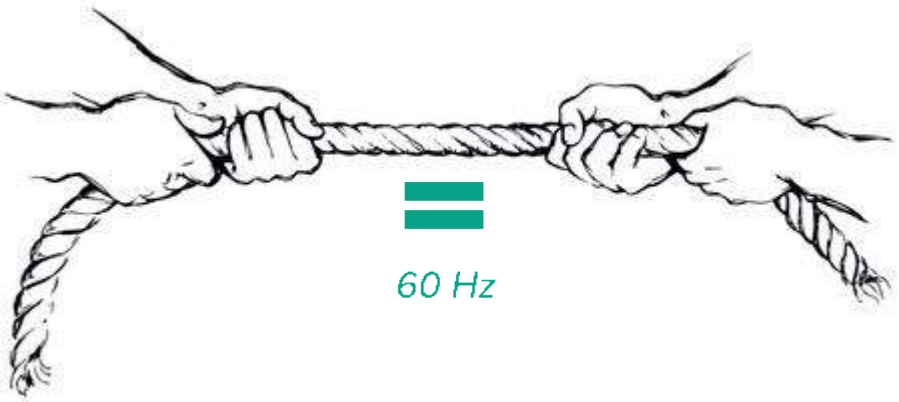
SVCE Customers



Balance: The Fundamental Rule of the Grid

Supply and demand must be balanced in real time every moment of the day.

Overfrequency:
If supply exceeds demand, frequency can exceed safe limits (>60hz)



Underfrequency:
If demand exceeds supply, frequency can fall below safe limits (<60hz)

Key Takeaways:

- Grid operators require flexible resources to balance grid.
- Grid must be built to meet peak demand
- Today we largely balance the grid utilizing the supply side; demand side management hold potential value

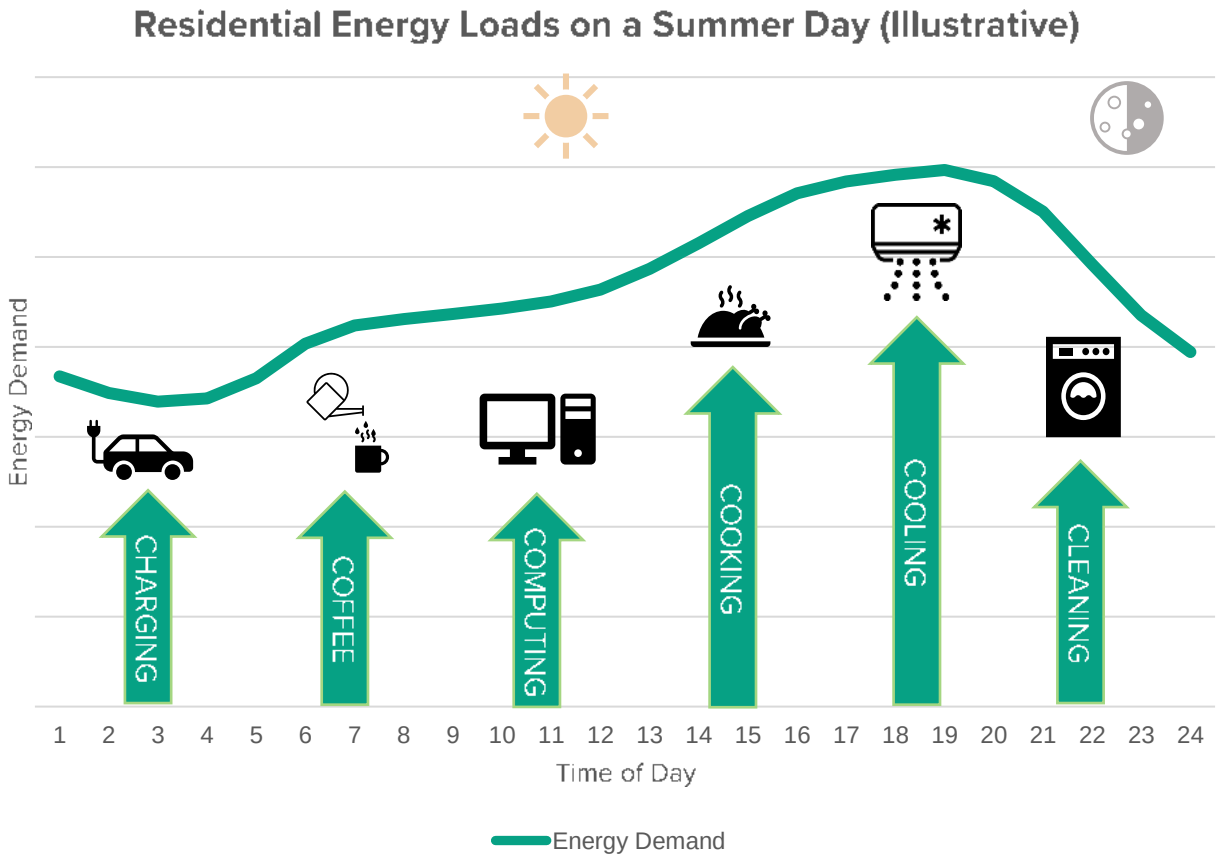
Learn more: *Understanding Inertia Without the Spin, NREL, 2020*

The Cycle of Energy Demand

Electricity demand has both daily and seasonal cycles.

Customer electricity use changes throughout the day and throughout the year, with higher usage during evenings and summer months.

- Electricity demand typically has a morning and evening peak
- "Peak loads" typically occur during summer evenings as customers return home to turn on air conditions and other appliances
- Changing when and how customers use energy is challenging, but can have significant environmental and economic benefits

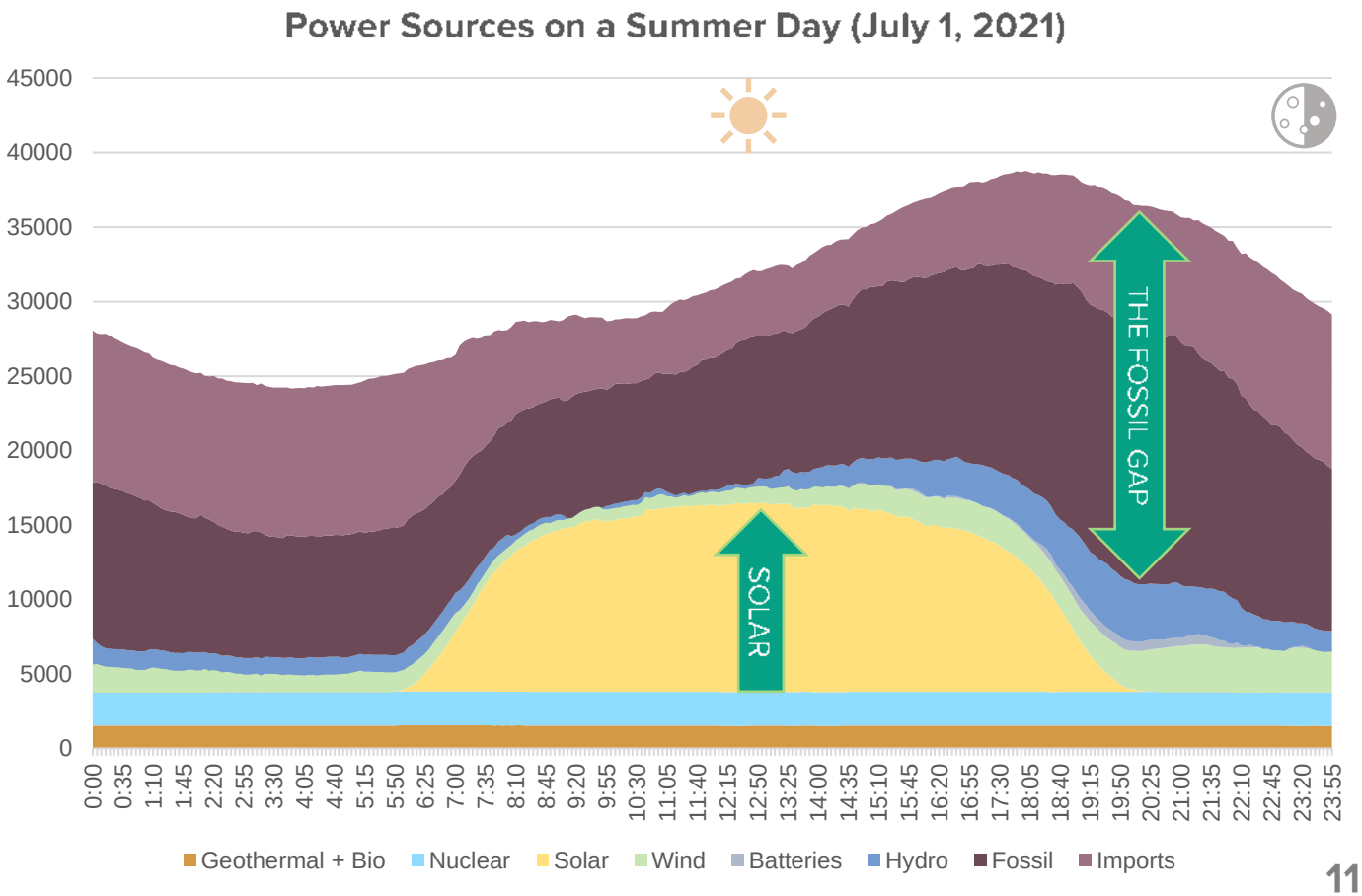


The Cycle of Energy Supply

Increasingly, energy supply also changes across days and seasons.

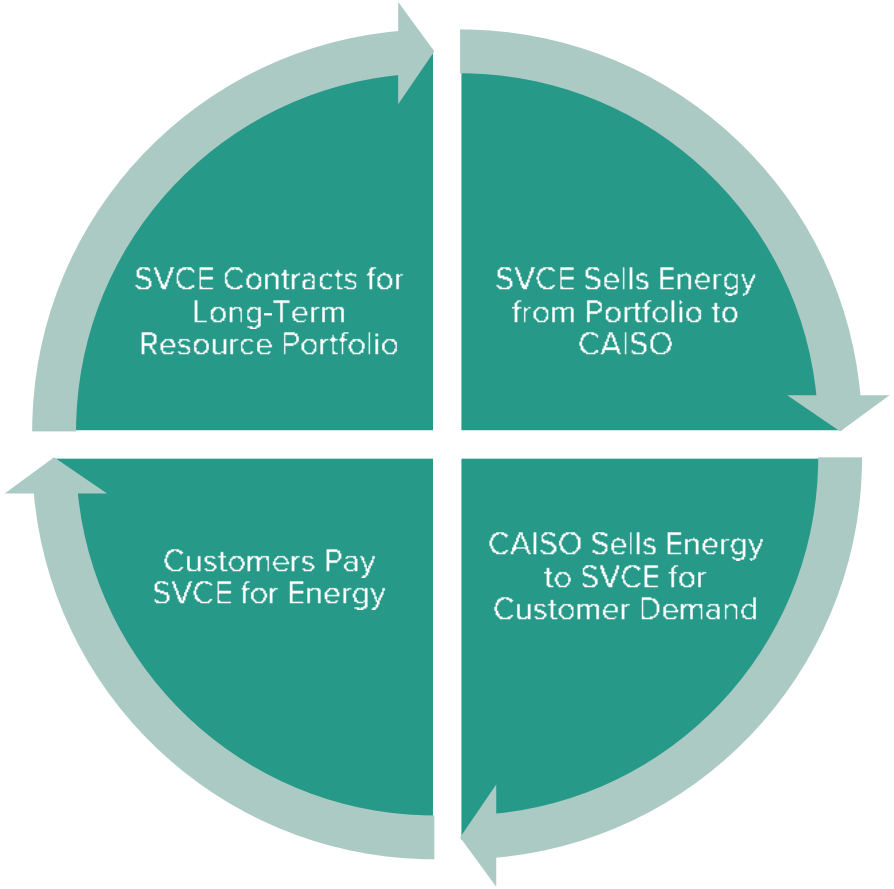
Clean energy resources have unique, weather-dependent operating characteristics.

- Solar energy is predictably available during solar hours, but is offline for peak hours
- Wind energy is often available during peak and overnight hours, but varies considerably between days and seasons
- Determining how resources fit together to form a holistic, reliable portfolio is critical



SVCE and the CAISO Market

CAISO is the energy market through which SVCE buys and sells energy.



The Energy Market Cycle

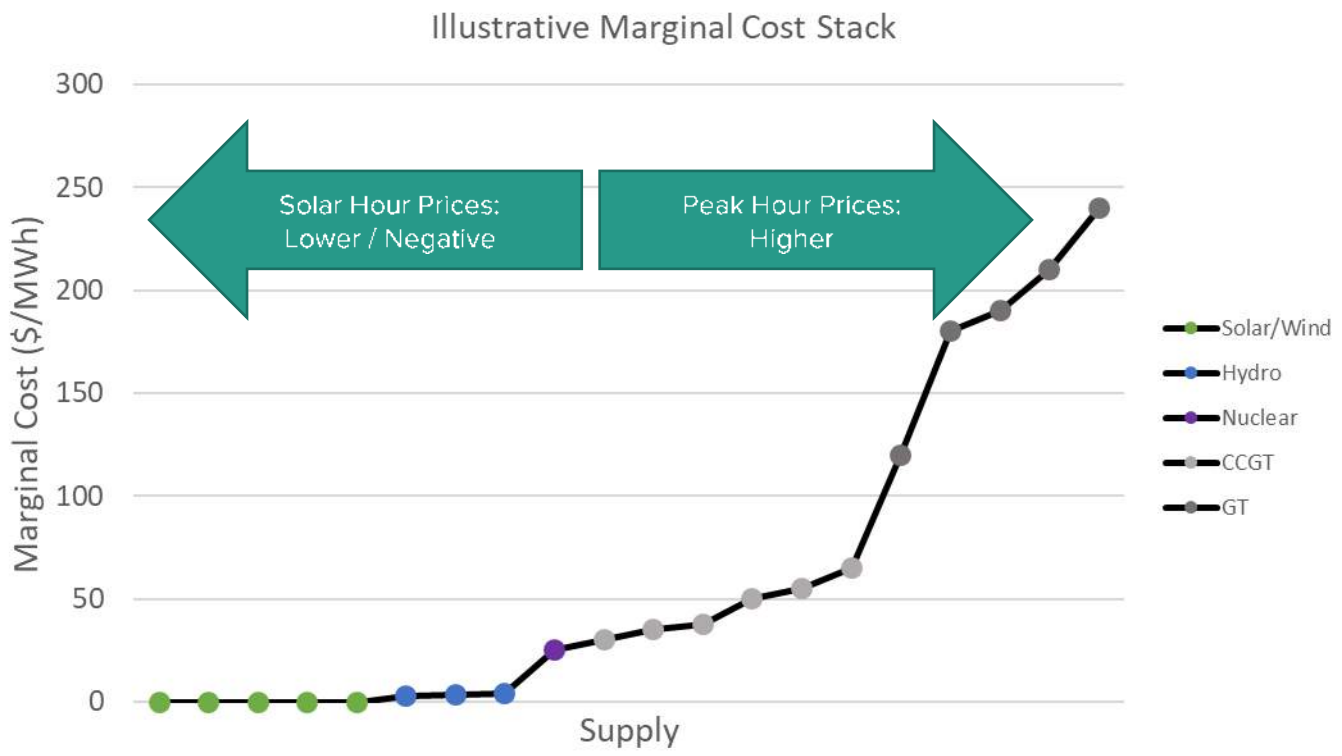
- SVCE (and all other suppliers) bid their energy resources into the CAISO market
- The CAISO selects the most economic portfolio of resources needed for reliability, which changes continuously throughout the day and year
- CAISO sells energy to SVCE to reliably serve SVCE's customers' needs
- SVCE collects costs for energy from customers through bills
- SVCE uses revenues to buy long-term energy resources

The price SVCE pays for resources may not be the same as the value it gets when those resources are sold into CAISO
In turn, the value of SVCE's portfolio may not be the same as

Energy Market Overview

A primary function of the CAISO is to operate the energy markets economically and reliably

Energy market prices are set by the most expensive unit needed for reliability at any given moment.



Key Takeaways:

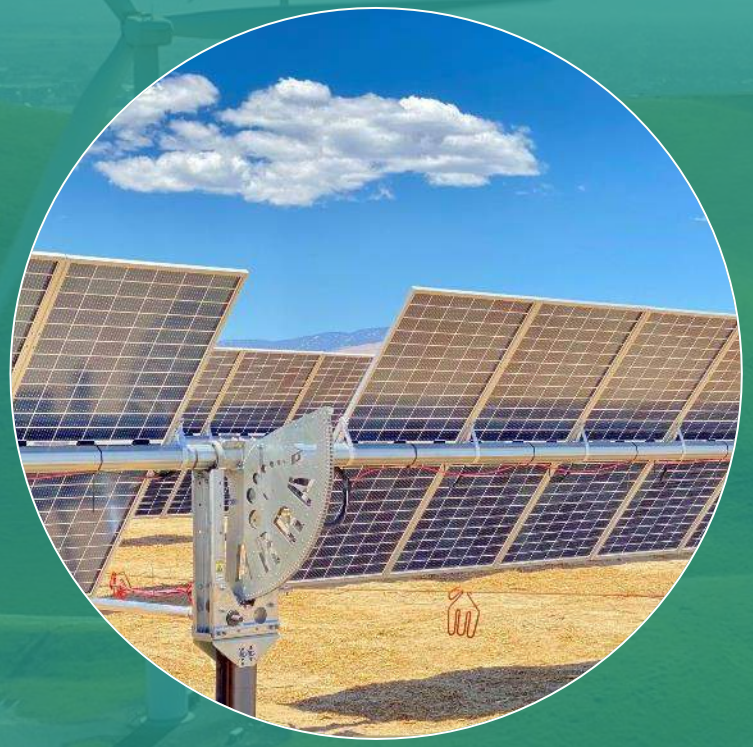
- For **supply** (power plants), when your resources are available matters – *sell high (evenings)*
- For **demand** (LSEs with load), when your customers use energy matters – *buy low (solar hours, overnight)*
- **SVCE is both a supplier and an LSE**, and must manage both sides of the portfolio efficiently

SVCE and the Grid: Key Takeaways

- **Supply and Demand Fluctuate, but Must Always be in Balance:** Daily and seasonal cycles impact how much energy customers use, as well as how much energy is available – particularly from weather-dependent renewable resources.

- **SVCE is One Player in a Larger Ecosystem:** SVCE buys and sells all of its energy through a centralized market operated by CAISO (quasi-state agency) on infrastructure owned and operated by PG&E.

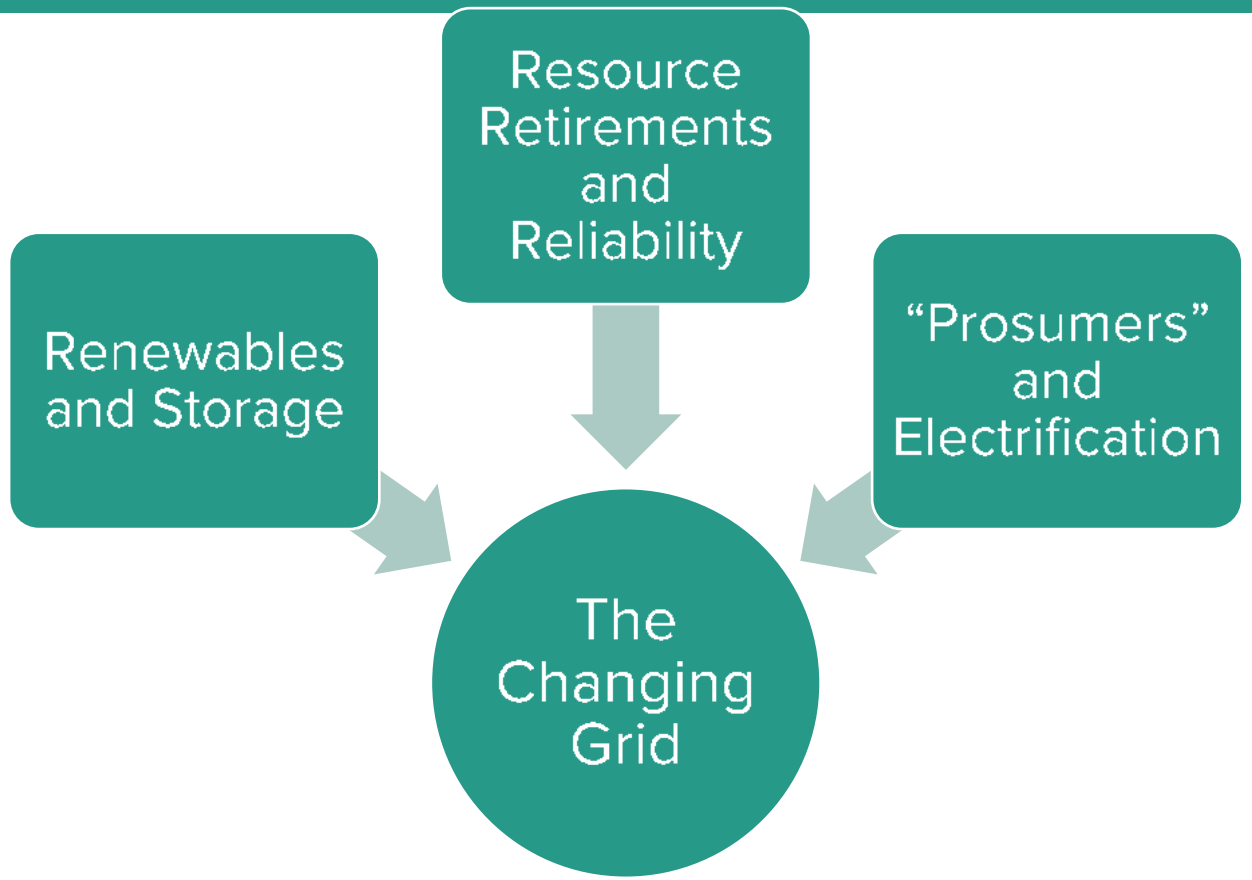
- **Addressing the The Fossil Gap:** While solar, wind, and storage are making a major dent in grid emissions, a majority of energy is still served by fossil resources (including imports) – moving forward, the focus will be on decarbonizing evening and overnight energy needs.



The Changing Grid

Understanding the Transition

The Changing Grid: Three Key Trends

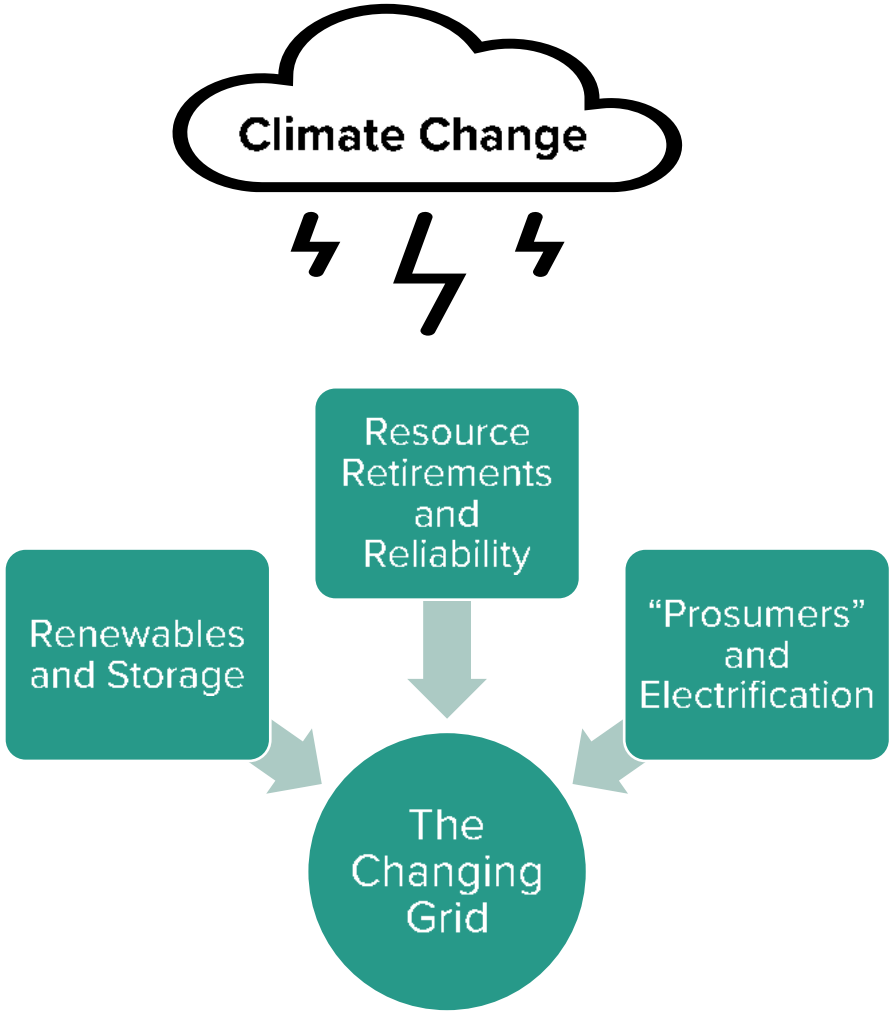


The Power Grid is undergoing massive change along three dimensions:

- Solar, wind, and storage are growing rapidly
- Conventional reliability resources are retiring across the West
- Electrification is increasing customer demand, while distributed resources are changing how much and when customers need energy from the grid

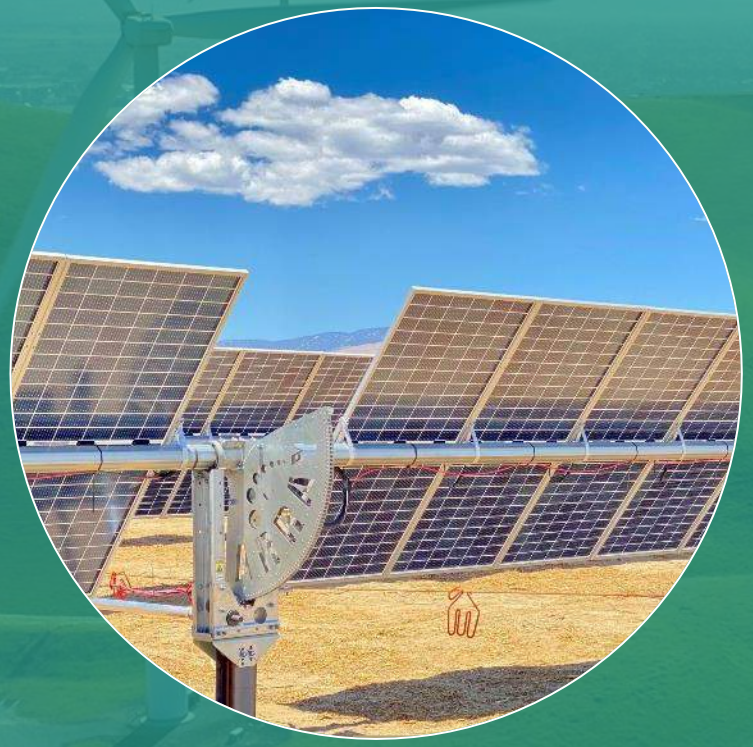
Each of these trends has important implications for SVCE and state policy. How can SVCE leverage opportunities and mitigate risk in this dynamic environment?

Climate Change: An Important Overlay

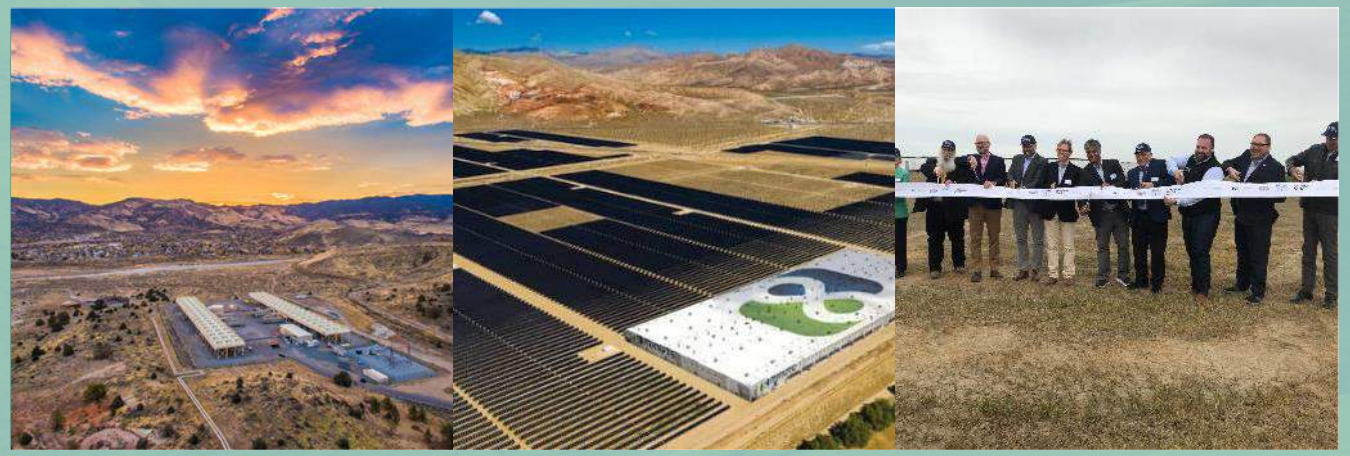


The effects of climate change – including drought, extreme weather, and wildfires – forms a critical overlay on the energy system transition.

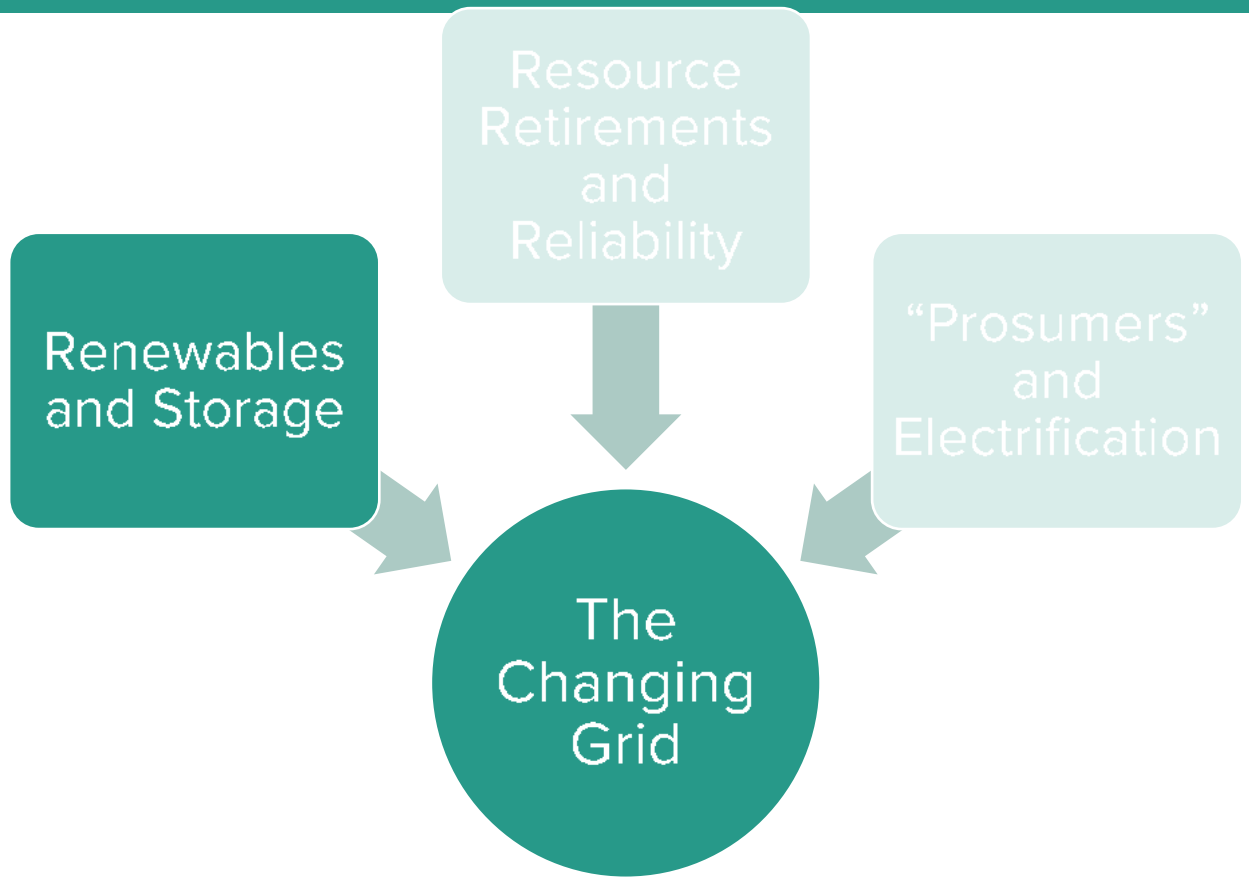
- Climate change impacts the potential output of both traditional and renewable resources and elements of the transmission and distribution grid
- Climate change increases the risk of prolonged, regional drought – impacting both in-state and regional hydro supplies and removing a key carbon-free resource
- Climate change increases the risk of extreme heat – which increases electricity demand during summer peaks
- Climate change increases the risk of wildfires which can result in Public Safety Power Shutoffs (PSPS) events often during periods of extreme demand



The Changing Grid: Renewables and Storage



Renewables and Storage



The massive growth in renewables and storage is a key driver of grid change:

- Nearly 10,000 megawatts of utility-scale solar - nearly 15% of total system capacity - have been added to the CAISO grid in the past decade
- ~20,000 megawatts of storage are projected to come online in the next decade
- Solar, wind, and storage are having a massive impact on emissions reductions
- They are also fundamentally reshaping the economics of the electric sector in both predicted and unexpected ways

How does the growth in solar, wind, and storage impact the grid? How does it impact SVCE? How can it inform SVCE's future strategies?

TRIVIA QUIZ #2: Renewable Energy

After solar and wind, which renewable energy technology provided California the most electricity in 2020?

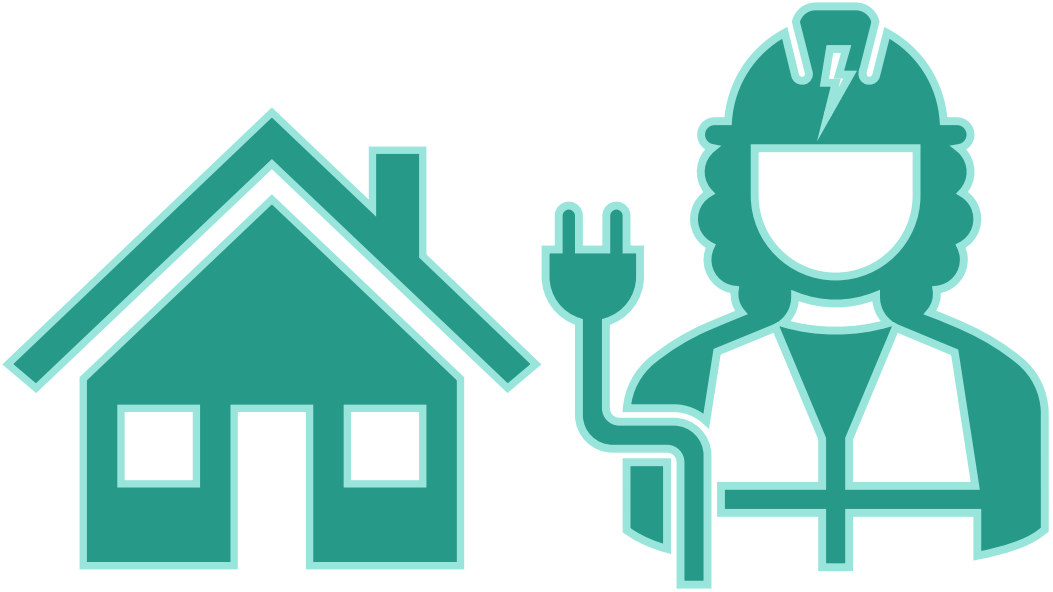
A) Bio (Biomass / Biogas)

B) Hydrogen

C) Renewable Natural Gas

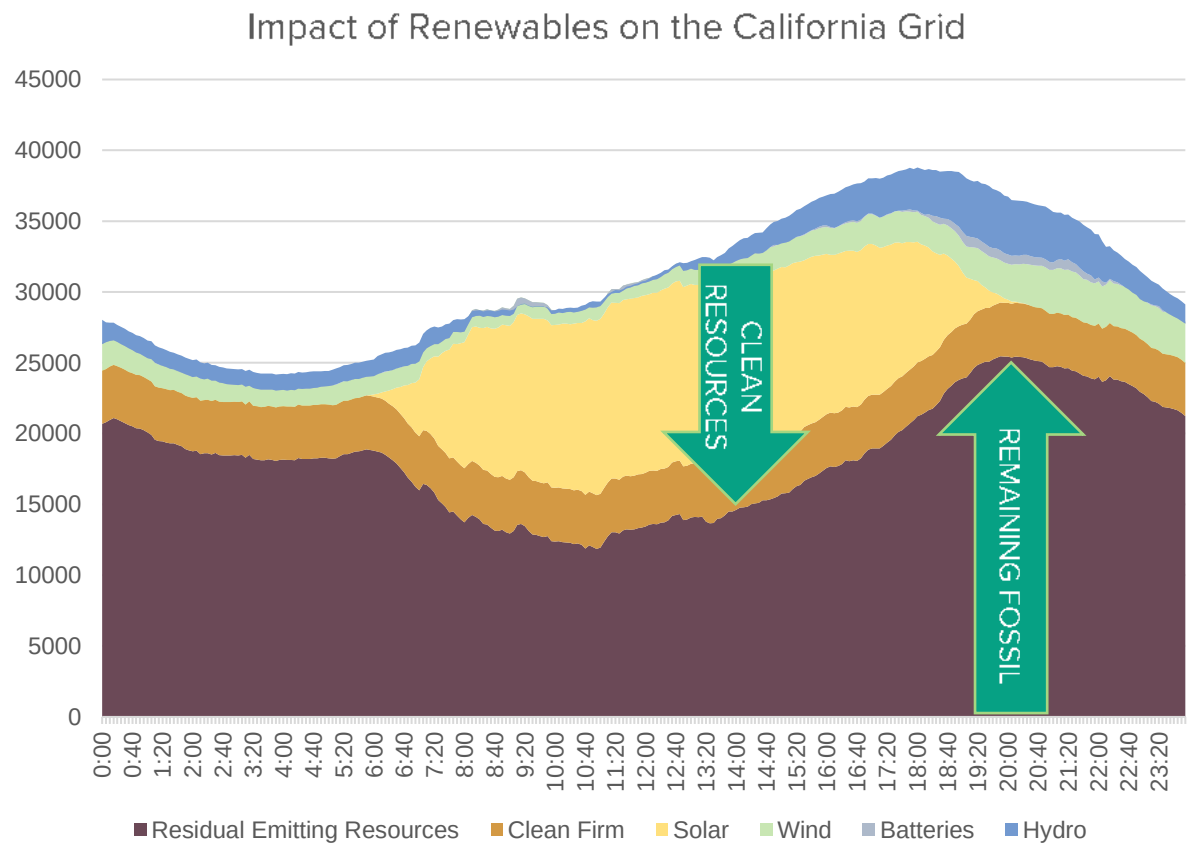
D) Geothermal

E) Small Hydro*



*In California, large hydro (over 30MW) is considered non-renewable

Renewables and Emissions



The massive growth in renewables and storage is a key driver of grid change:

- Renewable energy represented 33% of California's energy sales, led by 13% from solar and 11% from wind
- Renewable energy will grow to 60% by 2030 – with 100% of sources to be carbon-free by 2045
- California's emphasis on solar and wind has made a huge impact, but leaves significant clean energy gaps during peak and overnight hours

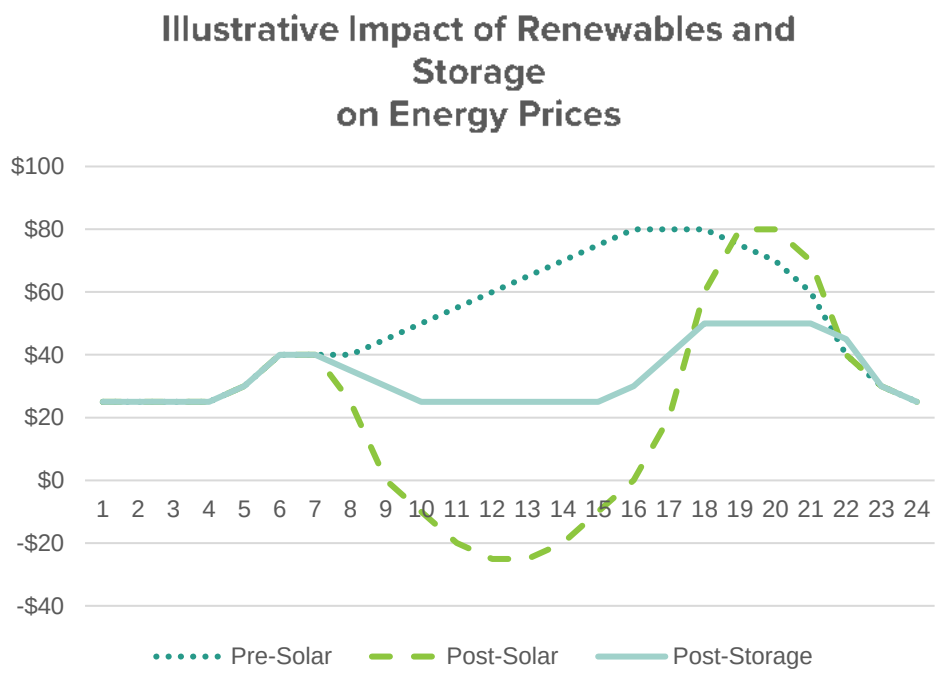
What is the best strategy for California to fill its non-renewable energy gaps?

Resource Attributes

Each resource provides a unique set of attributes but no resource provides the ideal mix of clean, firm, flexible and affordable energy.

Resource	Clean	Firm	Flexible	Energy Source	Affordable
Solar/Wind	✓	✗	✗	✓	$
Storage	— Depends on Source Energy	—	✓	✗ Energy net loss ~15%	$
Solar + Storage	✓	—	✓	✓	$
Fossil	✗	✓	✓	✓	$ $
Geothermal	✓	✓	— Potentially	✓	$ $
Biomass	— Cleaner than fossil	✓	— Potentially	✓	$ $
Hydrogen	— Depends on Source Energy	✓	✓	✗	$ $ $

Renewables and the Markets



Renewables and storage are fundamentally reshaping markets for energy and capacity:

- Solar – a "zero marginal cost resource" – is significantly reshaping energy prices on sunny days
- In contrast, peak hour prices are rising – reflecting the need of gas resources to recoup their operating costs over fewer hours
- Storage is expected to significantly "flatten" prices between mid-day and evening periods
- Flattened prices reduce the revenue case for storage as flattened prices eliminate arbitrage opportunities

How should California decarbonize energy needs during evening and overnight hours?

Preferred Resources: Strategic Issues

SVCE has made significant progress in creating a portfolio of carbon free resources but the next phase for renewable development will have new challenges

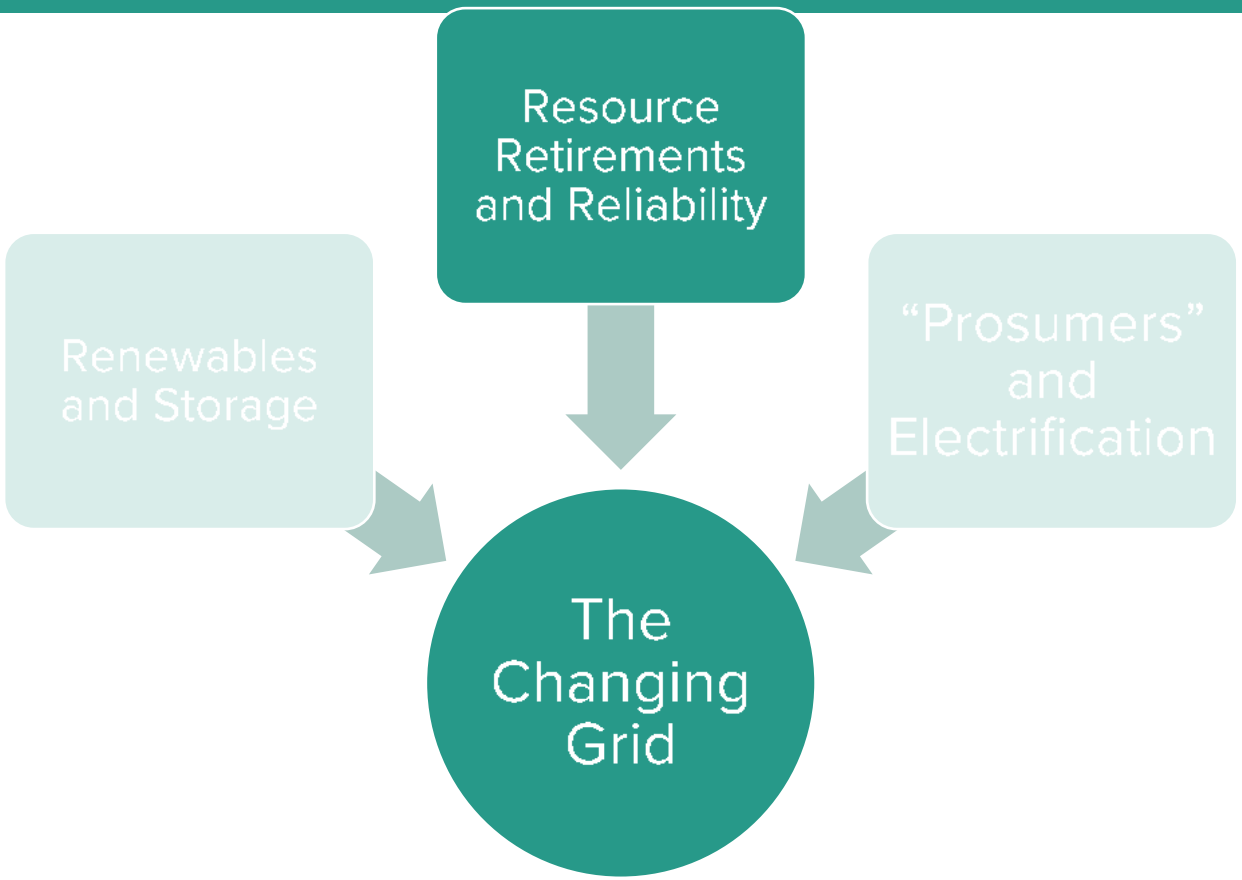
- **The Renewables Revolution:** Clean energy resources are growing rapidly on the system – fundamentally changing the operations and economics of the electric system:
  - How should SVCE plan for these changes

- **Integration Will be Critical:** Renewable energy resources have tremendous potential to reduce emissions, but need storage, transmission, and flexible load for effective integration:
  - How can SVCE support renewable integration, including storage, firm resources, and load flexibility?

- **Need for Continued Innovation:** To reach 2045 goals, complementary resources will be needed – storage, geothermal, regional and offshore wind, hydrogen, and other technologies will be critical:
  - How can SVCE support the development and commercialization of emerging technologies?

The Changing Grid: Resource Retirements and Reliability

Resource Retirements and Reliability



Much of California's conventional generating fleet is reaching retirement age:

- California's natural gas, hydro, and nuclear fleet is readying for retirement – with similar trends occurring throughout the western market
- These retirements are straining both the reliability and economics of the system, resulting in rotating outages and extreme market prices
- Policymakers are deeply concerned with the potential for upcoming resource retirements in 2024 to further strain grid reliability

How do conventional resource retirements impact the grid? How do they impact SVCE? How can SVCE support a managed transition away from natural gas?

TRIVIA QUIZ #3: The End of Gas

Since 2000, what percentage of California's in-state natural gas fleet has been retired?

A) 100%

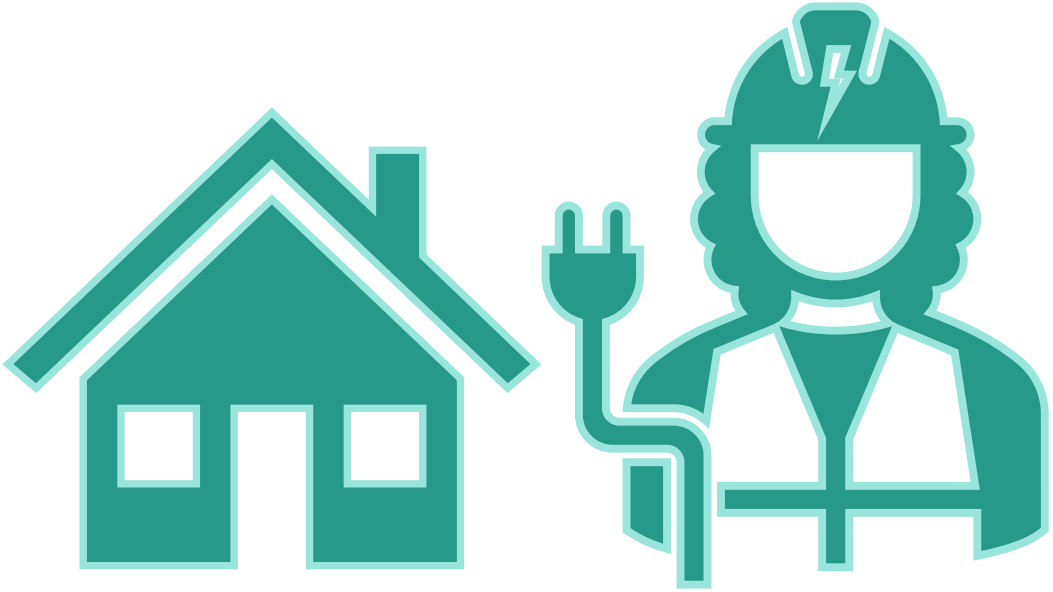
B) 85%

C) 65%

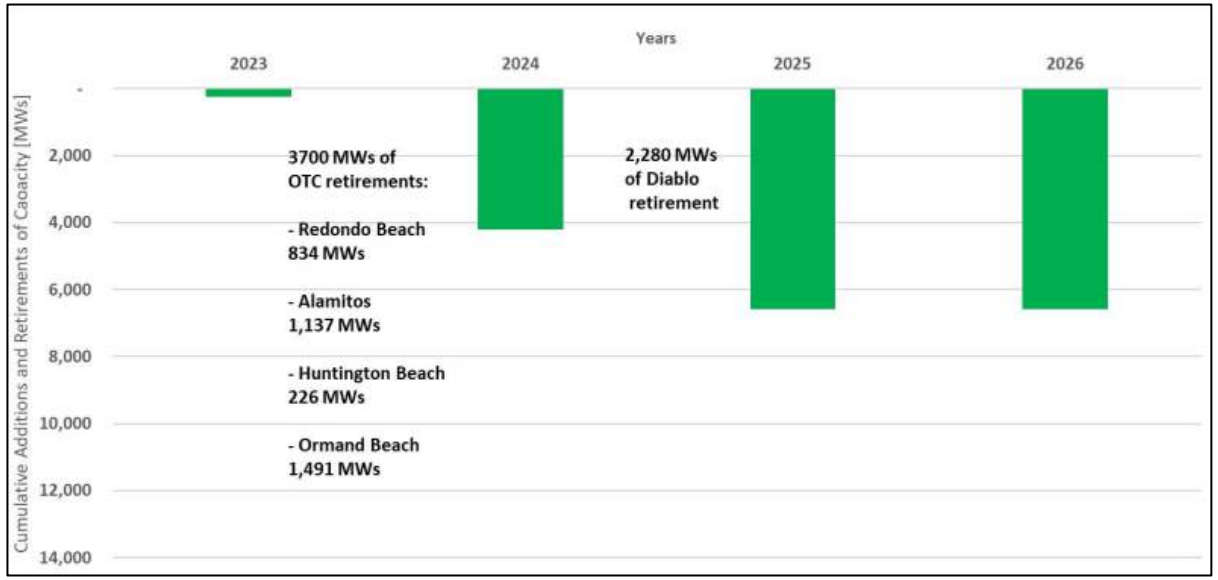
D) 35%

E) 15%

F) 0%



Resource Retirements



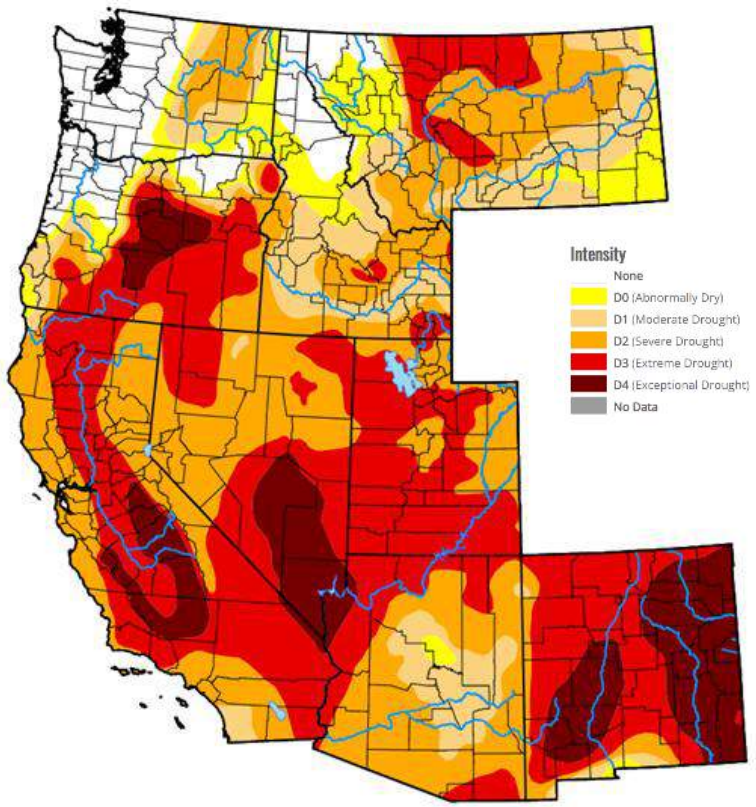
Upcoming Power Plant Retirements

The massive growth in renewables and storage is a key driver of grid change:

- From 2010 to 2020, 11GW of natural gas and nuclear resources retired in California
- An additional 6.2 gigawatts of firm resources are expected to retire in the next three years
- In addition, several thousand megawatts of conventional gas and coal on the broader western grid will retire – impacting the ability of California's trading partners to supply energy when needed

How do conventional resource retirements impact SVCE? What can SVCE do to mitigate the risk of reliability concerns or extreme market prices?

Drought Risk



Western Drought Conditions, May 2022

In addition to fossil and nuclear retirements, there is growing concern that the hydro fleet will have reduced capacity due to drought:

- Hydro resources – both in-state and across the west – are critical for serving energy and reliability needs in California
- Prolonged drought, made more likely by climate change, risks reducing hydroelectric capacity or even taking resources out of service entirely
- Regional hydro resources which were long available to California for import are now needed by their own states for reliability
- Understanding reliability risks and drought is a critical area of analysis for state regulators

To what degree can California count on hydroelectrical resources to meet its current and future energy, reliability, and decarbonization needs?

Policy Impacts

Reliability is the current “hot topic” in the policy realm driving changes in the regulatory space

IRP

CPUC has ordered nearly 15,000 MW of new capacity.
All CPUC jurisdictional LSEs have been required to procure, regardless of portfolio need.

RA

CPUC is requiring LSEs show adequate capacity to meet their load’s resource requirements each hour of the day starting in 2025.
Current policy has LSEs show only for peak hour.

Future Risks

CPUC / CAISO/ CEC may change resource counting rules and resource requirements, including for imports and hydro to account for impact of climate change. Other resources such as solar+storage hybrids may also receive different resource crediting

SVCE must manage regulatory risk when making portfolio decisions.

Retirements: Strategic Issues

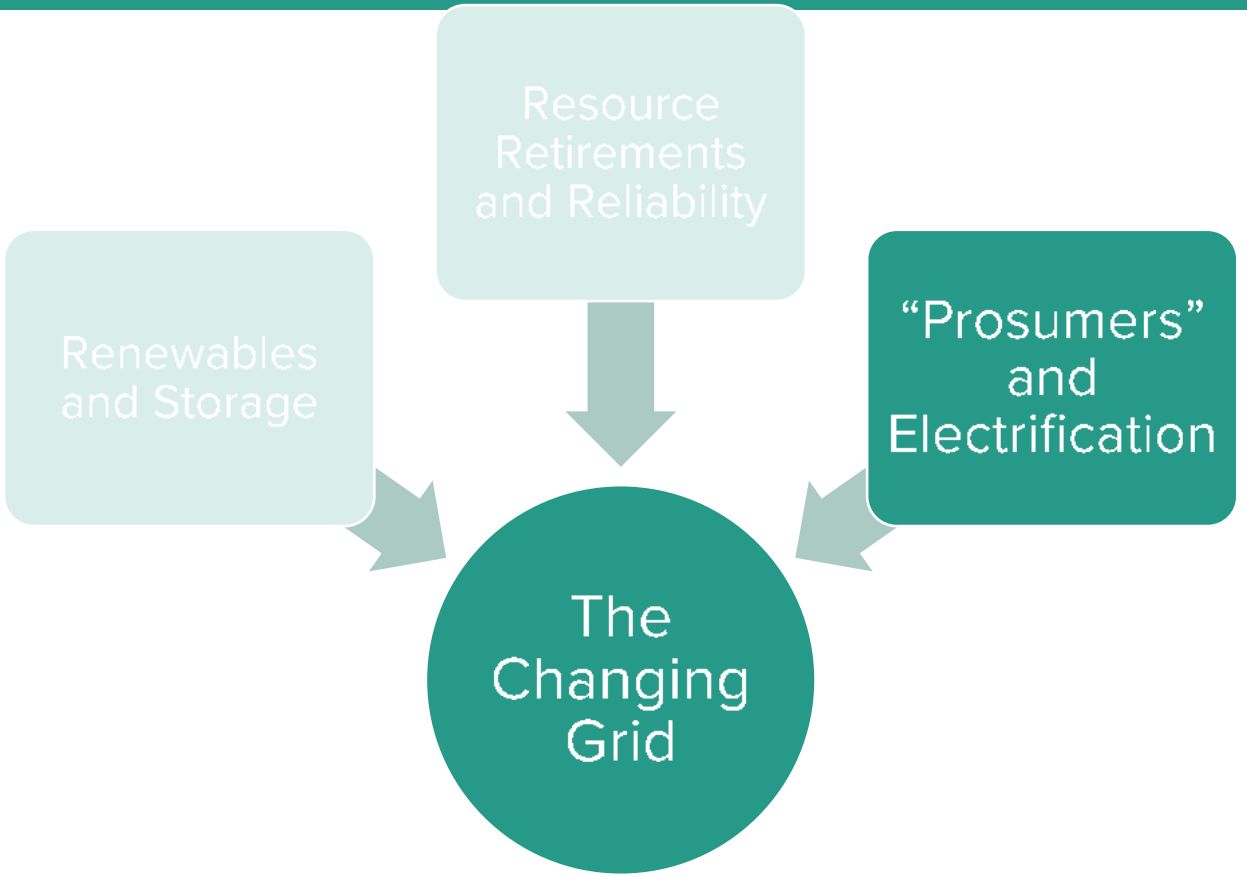
SVCE is contracting for Geothermal and LDS – including exploring new LDS technologies – but such firm, clean resources will continue to grow in importance

- **The Role of Natural Gas:** Resource retirements of legacy resources have highlighted the critical reliability function of existing natural gas resources:
  - How can SVCE support the development of firm and flexible resources which can displace the grid's reliance on natural gas and other fossil resources during evening and overnight periods?

- **Hydroelectricity and Drought:** The changing climate, growing demand, and policy concerns create complicate the role of large hydro in the clean energy transition:
  - How should SVCE adapt its planning to mitigate reliance on hydroelectric resources?

The Changing Grid: Prosumers and Electrification

Prosumers and Electrification



Rooftop solar, back-up storage, heat pumps, and electric vehicles are fundamentally changing how consumers use and purchase energy:

- California now has over a million electric vehicles and solar homes – with millions more in years to come
- Electrifying heat – both space and water heating – will be a key part of the decarbonization of remaining building emissions
- Electrification is likely to significantly increase demand on the electric system, with a wide range of implications for SVCE
- Encouraging customers to "shape" new electric demands to high-renewable periods will be critical in mitigating emissions impacts

How can SVCE support its customers' electrification transition? How can SVCE ensure electrification supports, rather than hinders, reducing emissions on the electric grid?

TRIVIA QUIZ #4: Clean Cars

Electric vehicles produces less carbon dioxide than gasoline cars, unless the energy source is…

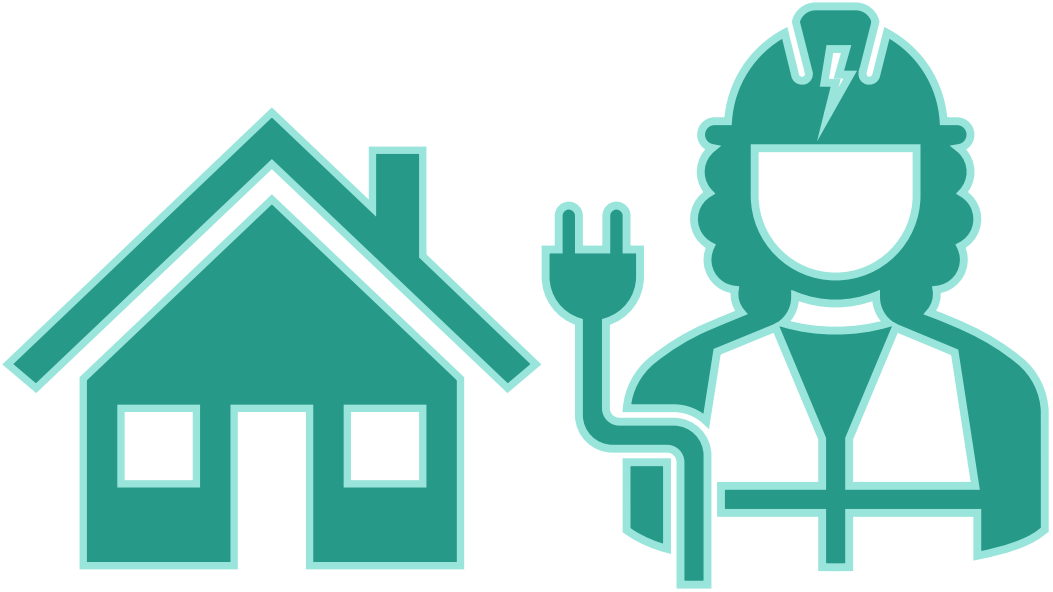
A) The US Grid

B) A Natural Gas Power Plant

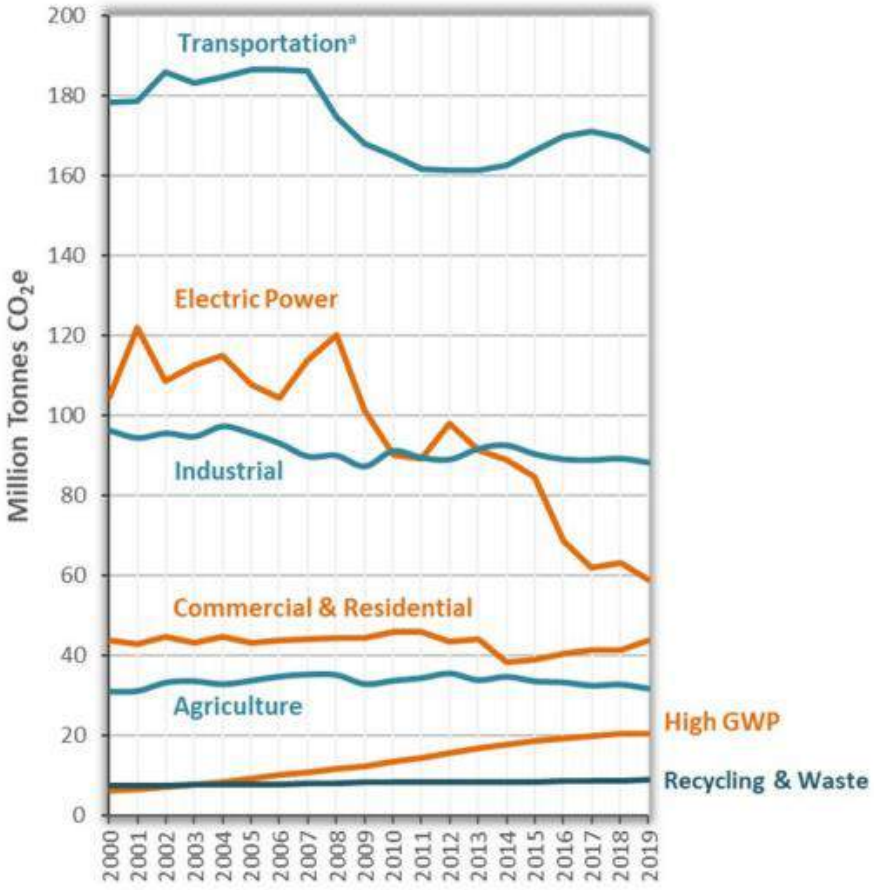
C) The California Grid

D) Coal Power

E) Biomass



Addressing Emissions Across the Economy



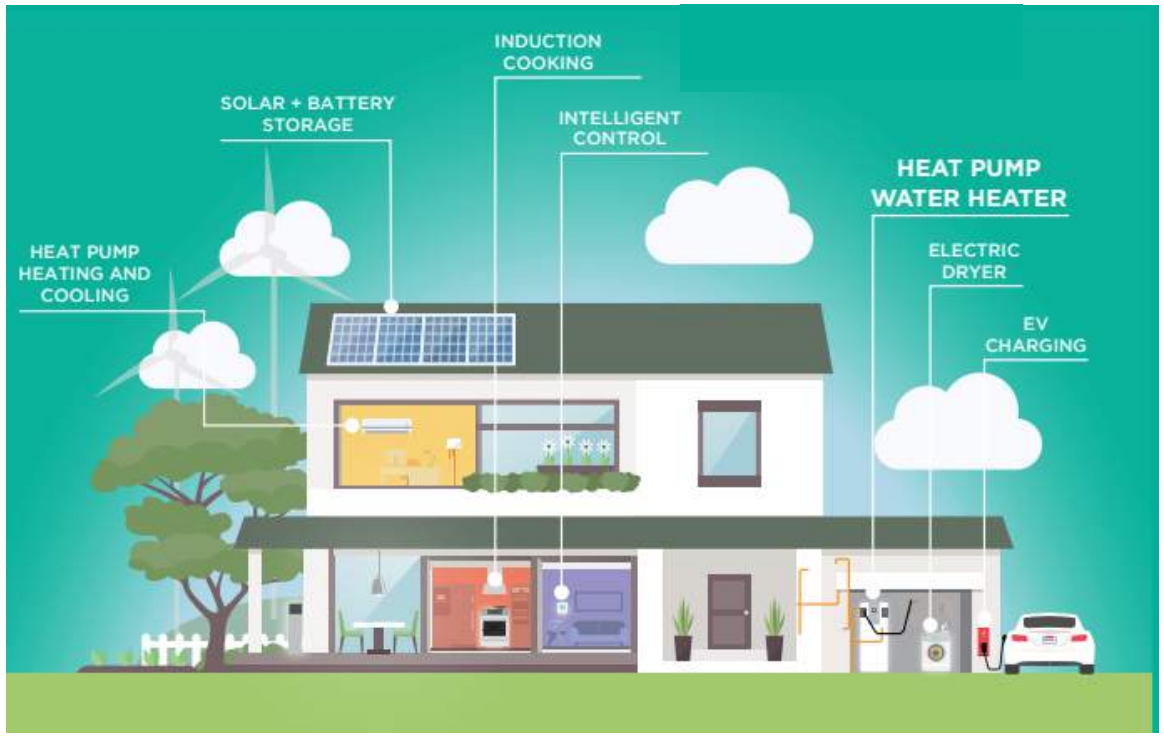
California Emissions Trends, 2000-2019

Source: CARB, "California Greenhouse Gas Emissions for 2000 to 2019 Trends of Emissions and Other Indicators"

- California's efforts to address greenhouse gas emissions have been most effective in the electric sector
- Harder to decarbonize sectors such as transportation, buildings, and agriculture have remained generally stagnant despite state-wide efforts
- New strategies and funding will be necessary to bend the curve to achieve long-term goals

How can SVCE influence the trajectory of decarbonization in Silicon Valley and beyond?

Electrify Everything!



Electrification is required to address residential energy demand and lower building emissions:

- Electric vehicle options and adoption are rapidly expanding but ~35% of emissions in the SVCE territory are estimated to come from vehicles
- Electric space and water heating is becoming mainstream but still represent ~25% of SVCE territory emissions
- Induction cooktops, which are faster and more precise than gas, are gaining in popularity but many customers continue to prefer gas cooking

How can SVCE support residential electrification and electric vehicle adoption? How can SVCE ensure new electric demands are served with reliable and renewable energy?

Regional Leadership In Efficiency

Emissions are driven by infrastructure choices, infrastructure is driven by policy.

- A better building code keeps cost of construction low, prevents pollution, and utilizes the grid's clean energy.
- Without electrification, heating will remain a major driver of emissions in Silicon Valley – the majority of space and water heating is achieved through natural gas combustion.
- SVCE led a regional effort to adopt efficiency and electrification building code standards above and beyond the state requirements ("reach codes")
- SVCE's efforts were cited and replicated by the California Energy Commission in the most recent building code update

All-Electric Adopters

- Santa Clara County
- Mountain View
- Morgan Hill
- Los Gatos
- Cupertino
- Sunnyvale
- State of California (Proposed)

Rooftop Solar and Storage

An SVCE Solar Home

Rooftop solar is far and away the most common type of distributed generation:

- 25,000 SVCE customers have installed rooftop solar.
- Customers generate electricity during the day and import electricity from the grid as needed.
- 2,600 SVCE customers have installed both rooftop solar and storage, which helps shift customer energy production from low-value solar hours to high-value evening hours
- SVCE is actively seeking policy and technical strategies to use more customer energy resources for its environmental and reliability policy obligations

How can SVCE encourage customers with solar and storage to operate their systems for maximum grid reliability benefits?

Efficiency and Demand Response

A Nest Smart Thermostat

The most efficient kilowatt-hour is the one you never have to use:

- Energy efficiency remains a key pillar of California's decarbonization strategy, and has avoided 33% of California's expected energy growth*
- Increasingly, demand-side management is about *when* customers use energy – demand response programs help shift customer demand away from stressed evening periods
- SVCE is supporting demand response programs through targeted solicitations from aggregators and direct customer incentives

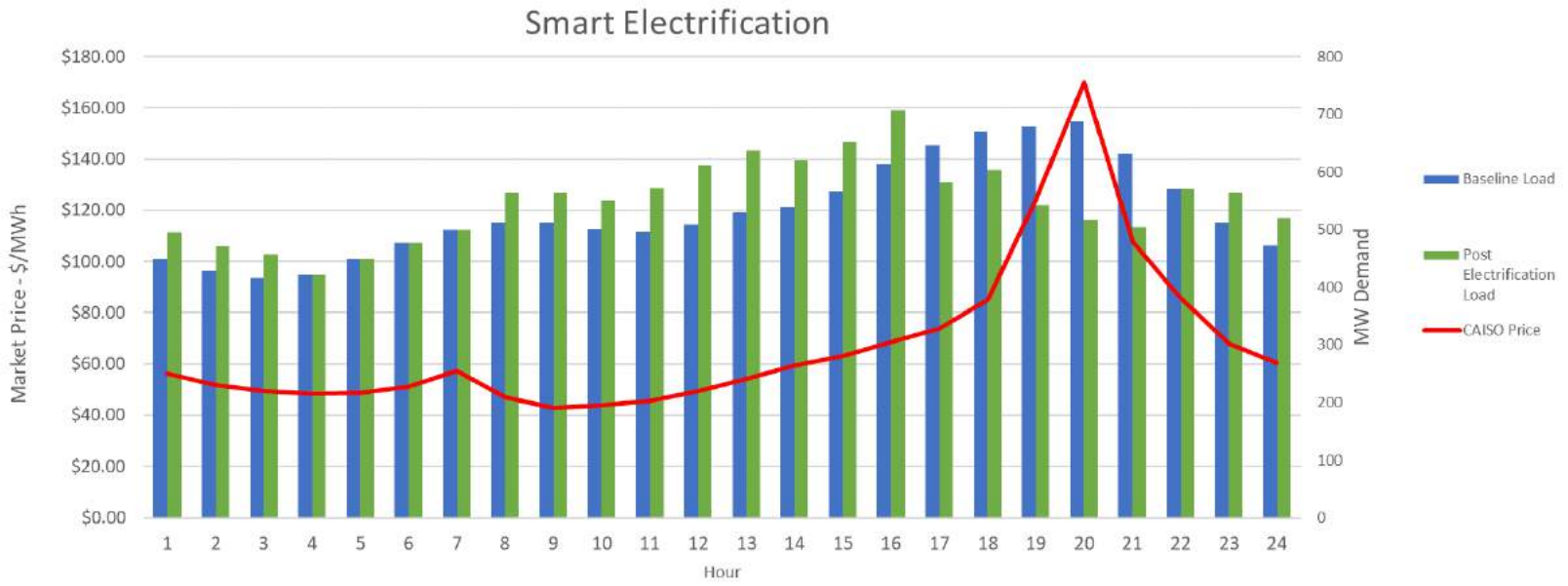
What does it take to get customers interested in shifting their behavior? How can SVCE better engage the community to participate in efficiency and demand response?

* Sourced from https://www.cpuc.ca.gov/energyefficiency/

Prosumer Value Streams

There are several benefits to electrification and DERs:

- Lower emissions than fossil-based alternatives
- Electrification increase SVCE's demand – spreading fixed costs and creating additional revenues for reinvestment in programs and customer savings
- DERs decrease demand from grid, *potentially* reducing total system costs
- "Smart" Electrification/ DER implementation also creates potential to shape demand – improving economics for all customers



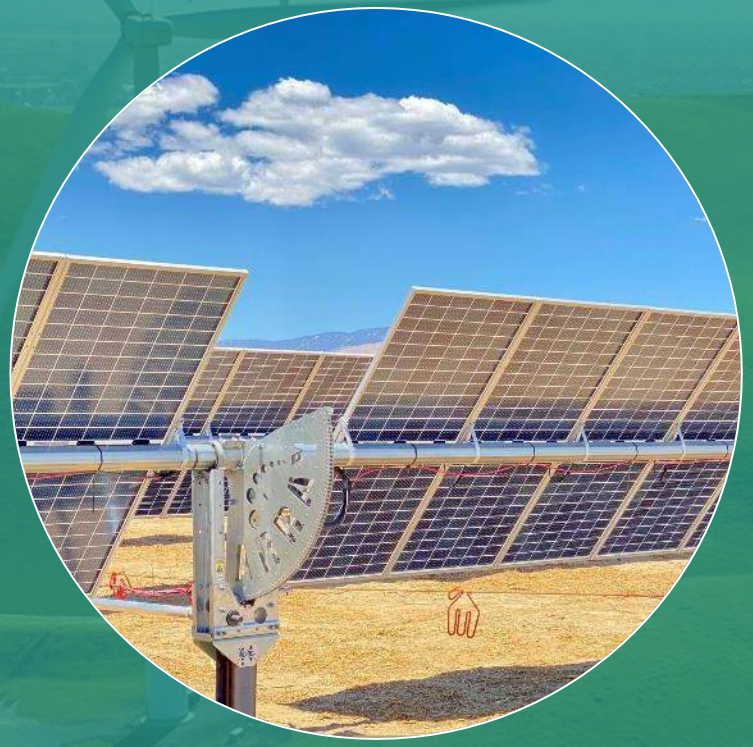
- Total Load Up
- Total Cost Down
- Energy shifted to high renewable/ low-cost hours via smart EV charging and smart appliances

Prosumers: Strategic Issues

- **Evolving Demand:** Rooftop solar and electrification will fundamentally reshape SVCE's load profiles with competing effects; how consumers choose to use their resources can have significantly different impacts.
  - How can SVCE support and encourage customers to charge vehicles and use batteries in a manner that best supports grid reliability and decarbonization?

- **Early Adoption and Equity:** New technology adoption is often skewed heavily towards wealthy communities, which may have significant equity impacts due to subsidies and stranded costs.
  - How can SVCE support policies and programs that ensure equity is prioritized for distributed generation and the transition away from the natural gas system?

- **Prioritizing Efforts:** The vast majority of SVCE's clean energy investments are focused on developing grid-scale renewables and storage, consistent with state and local policy.
  - How do we balance between clean energy investments in the electric sector and decarbonizing other sectors?

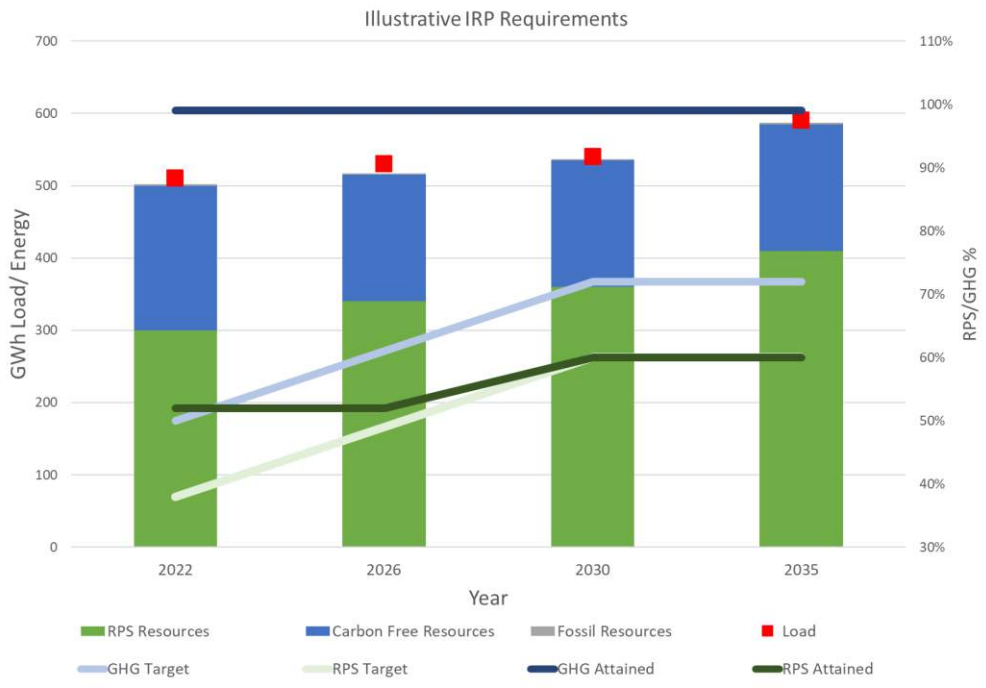


Integrated Resource Plan

IRP Overview

The CPUC addresses system planning issues in the Integrated Resource Planning proceeding

- Every two years LSEs file their individual IRP to report how they will meet
  - Energy obligations
  - GHG target
  - RA needs
  - RPS needs
- LSEs also discuss key planning issues, including programs and procurement efforts
- CPUC "stiches" together plan and runs models and analysis to ensure system reliability and climate targets will be met
- The CPUC will order new capacity if:
  - System plan does not meet system requirements
  - CPUC does not trust LSEs to procure to plans/ emergency reliability concerns
  - CPUC would like specific resources built (e.g. LDS or offshore wind)



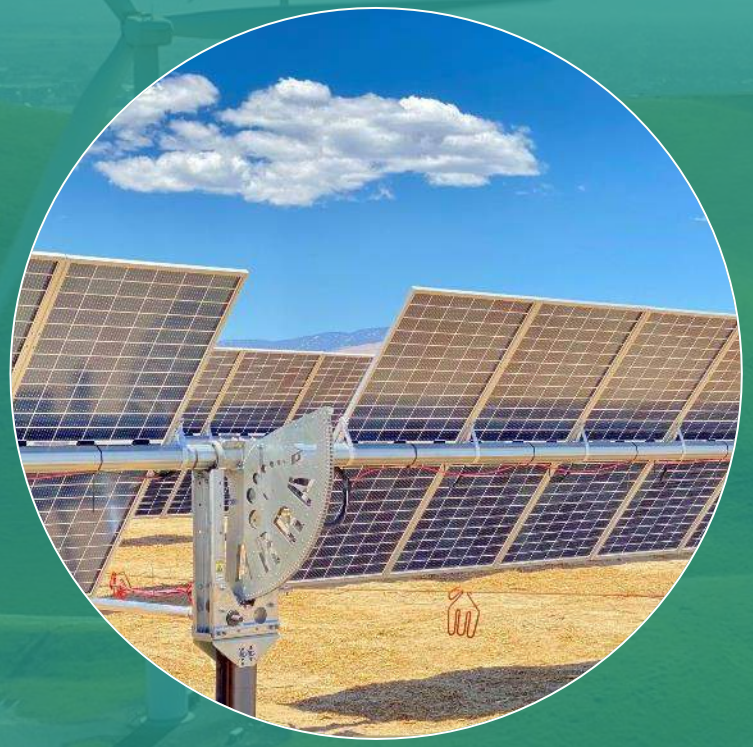
2022 Cycle

SVCE will file its next IRP on November 1, 2022.

- Two required portfolios:
  - 30 MMT target by 2035 (SVCE share: 420,000 tonnes)
  - 25 MMT target by 2035 (SVCE share: 340,000 tonnes)

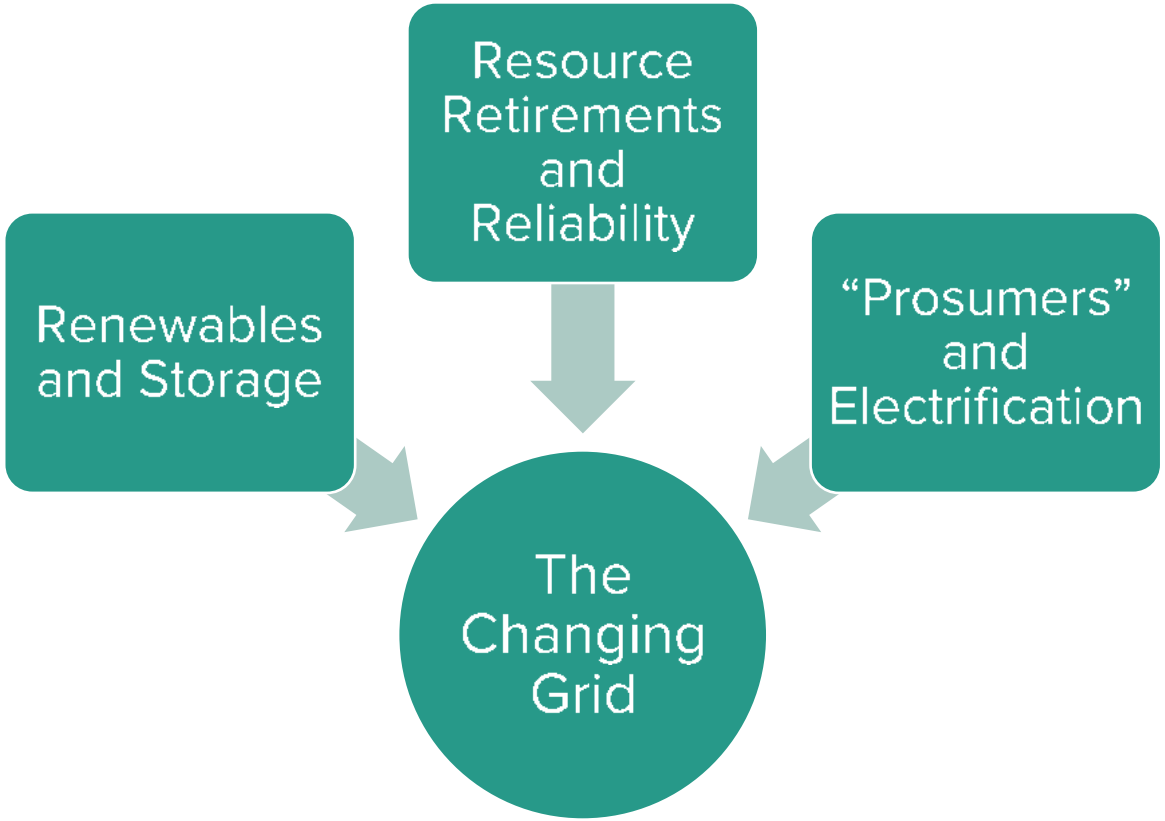
- SVCE has the option, but not the obligation, to provide additional preferred portfolios
- Final requirements to be released 6/15, including requirements for reliability showing
- SVCE expects that CPUC will order additional procurement – likely including offshore wind – at the conclusion of the 2022 cycle

Is there strategic value in providing additional portfolios? Are resources better allocated to other projects and priorities?



Workshop 1: Recap and Strategic Discussion

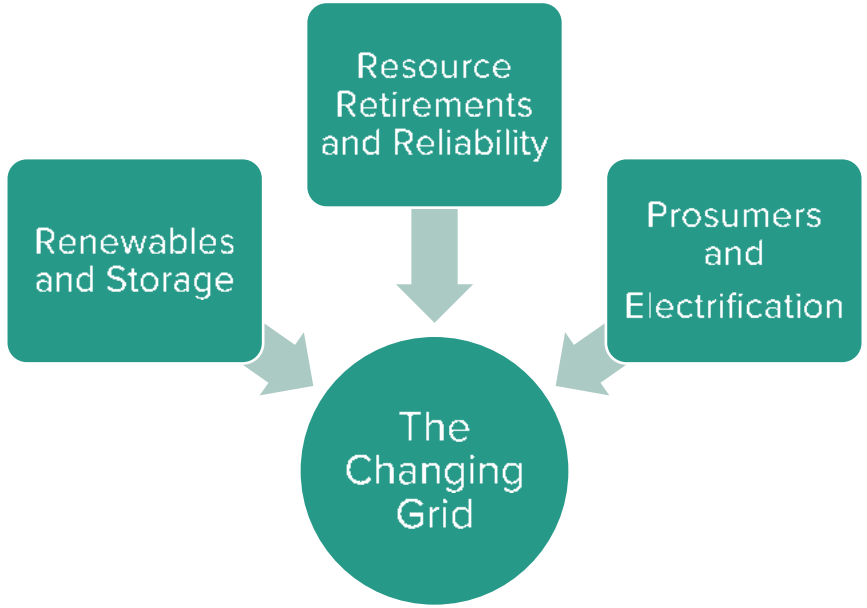
Refresh: The Changing Grid



The Power Grid is undergoing massive change along four dimensions:

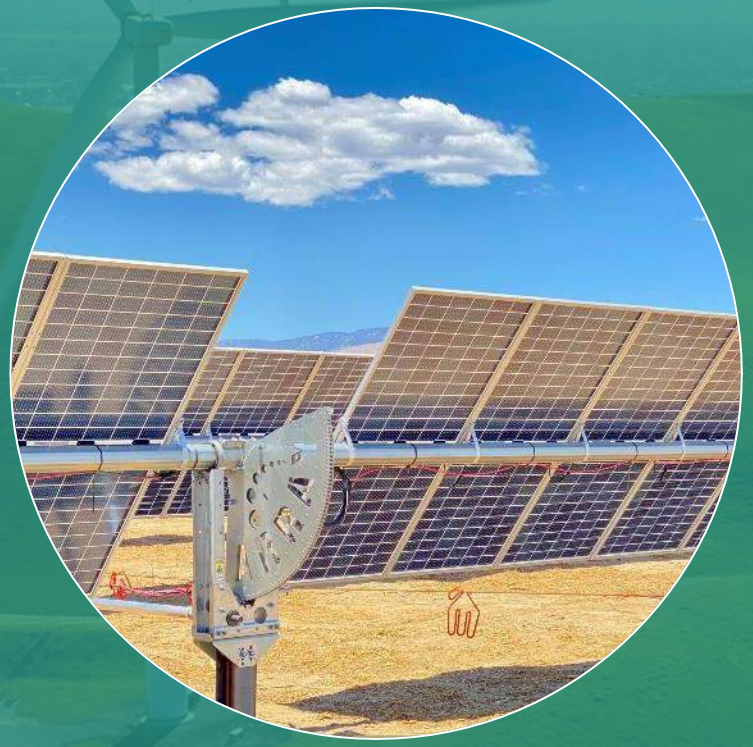
- Solar, wind, and storage are growing rapidly
- Conventional reliability resources are retiring across the West
- Electrification is increasing customer demand
- Distributed resources are changing how some customers interact with the grid

The Changing Grid: Four Key Questions



- **Clean Grid:** How to develop an integrated, diverse portfolio of clean energy resources to decarbonize the grid?
- **Reliable Grid:** How to develop clean energy resources that can support reliability and displace the need for natural gas?
- **Low-Carbon Roads and Buildings:** How to support decarbonization across the entire economy, including homes, businesses, transportation, and industry?
- **Customer Choice:** How to support customer adoption of emerging distributed technologies (e.g. solar, smart thermostats) in alignment with SVCE's climate and equity goals?

Strategy Workshop #2 will explore these and other questions in greater depth. Please reach out to Girish with questions or discussion topics in the interim.

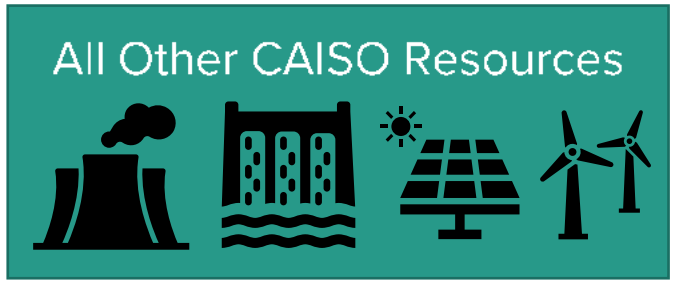


Appendix

SVCE & The Market

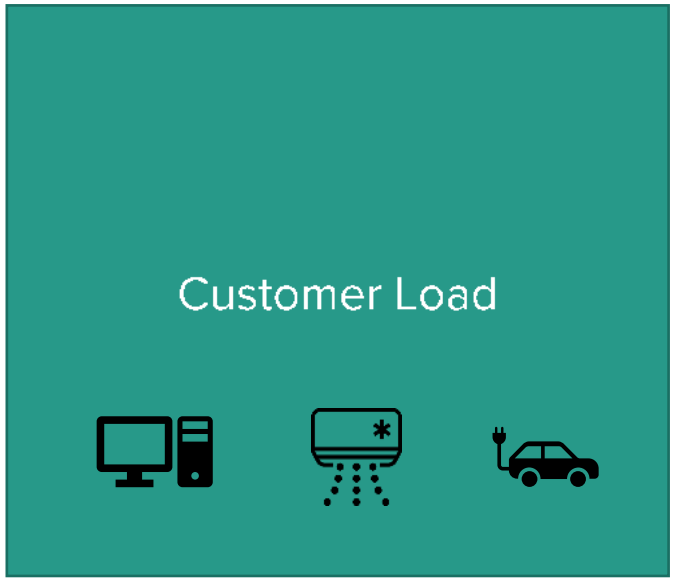
24/7/365, SVCE's resources and load are "cleared" in CAISO markets.

SVCE (and all other suppliers) bid energy and other grid products into the market



The CAISO clears bids and balances the grid in real time and pays suppliers for their product

SVCE buys energy on behalf of its customers and pays the CAISO for the product



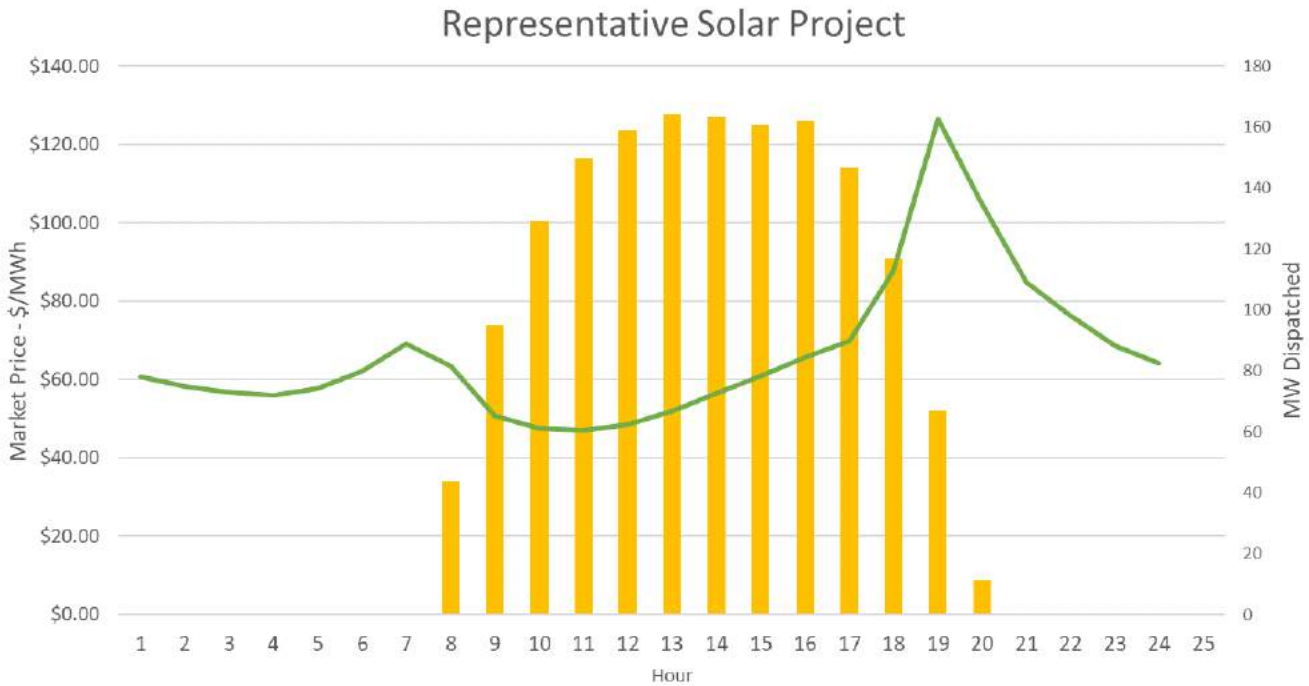
SVCE is both a supplier and source of demand for the CAISO market

SVCE as an Energy Supplier

SVCE acts as a supplier to the CAISO market through its solar, storage, and other PPAs

Selling to CAISO, SVCE is Paid: Price (Hourly Price) x Production in Each Hour

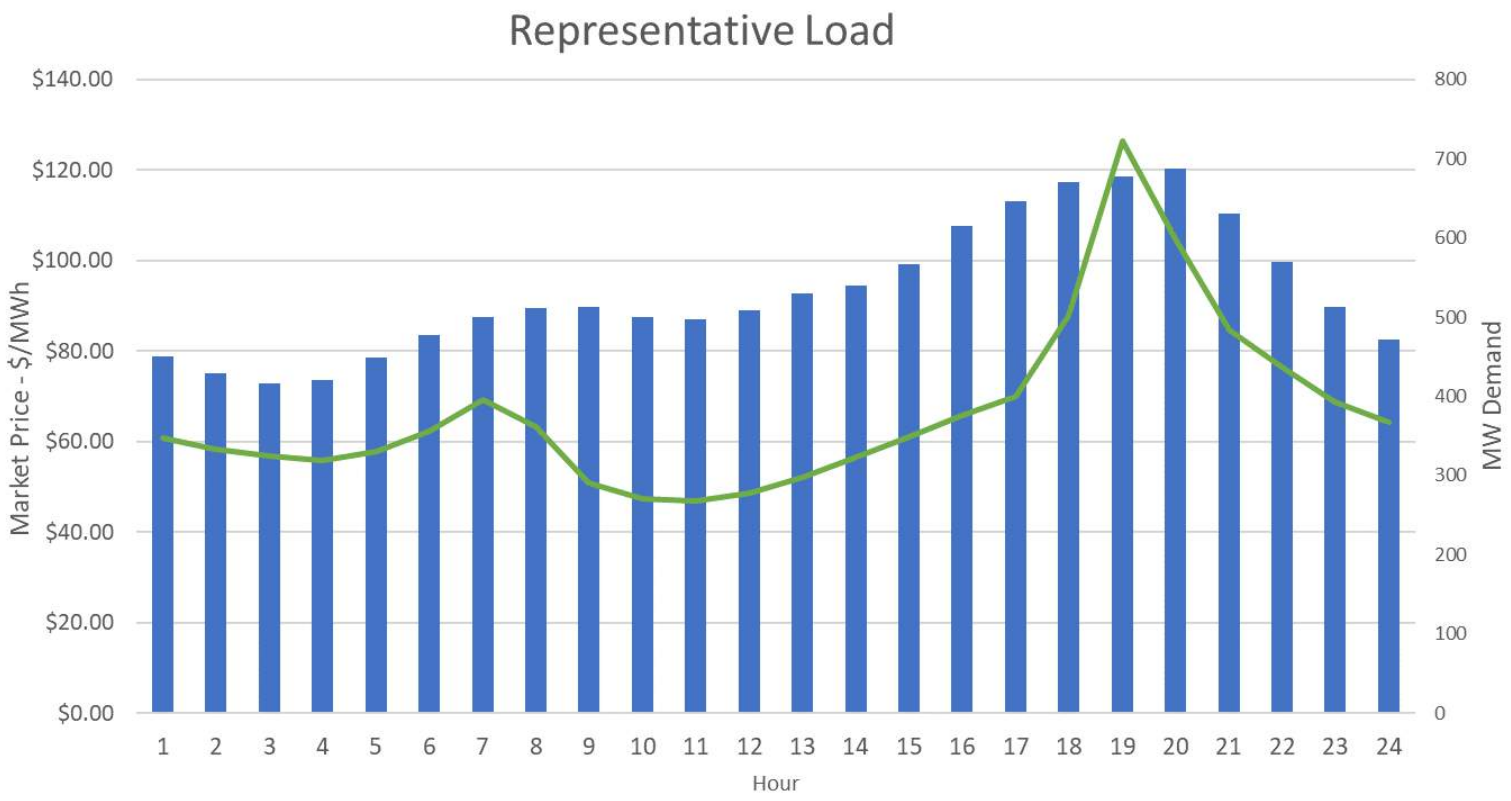
Buying from Generators, SVCE Pays: Price (Fixed Price) x Production in Each Hour



Example:
In hour 12, the market price is $48.65 and the output of the solar unit is 158 MW.
If the Solar PPA is $30/MWh, the supplier receives a profit of $2,946 for that hour ($18.65/MWh * 158).

SVCE as an Energy Purchaser

SVCE must also purchase energy on behalf of our customers



Example:
In hour 18, the market price is $87.86 and the customer demand is 670 MW.
The LSE will owe the CAISO $58,952 to cover customer demand for that hour.

Note: Significant energy savings can be realized by shifting load to mid-day or over-night hours.

Hourly GHG Accounting

If an LSE with an 100% clean portfolio leans on the grid for energy in some hours, they are given an emissions allocation under IRP accounting rules

Hour	LSE Load (a)	LSE GHG-free Supply (b)	LSE Net Open Position (c) = (a) * (b)	System Emissions (Co2/MWh) (d)	LSE GHG Allocation, (e)=(c * d)
3:00 pm	500	550	-50	0.42	21
4:00 pm	550	545	5	0.41	-2
5:00 pm	650	800	-150	0.42	64
6:00 pm	750	700	-50	0.44	22
7:00 pm	850	600	-250	0.43	107
8:00 pm	825	400	-425	0.44	189
Total					400