ResponDER Business Requirements Document

Contents

1 Introduction

1.1 SVCE Project Objectives

SVCE's mission is to reduce dependence on fossil fuels by providing carbon-free, affordable and reliable electricity and innovative programs for its 13 communities in Santa Clara County.

The ResponDER project is part of SVCE's Innovation Onramp program looking at ways to improve energy resilience for its customers. In the project, Electron is designing a local SVCE-owned marketplace and a prototype to demonstrate functionality. [1]

SVCE and Electron defined four objectives for the marketplace to guide how market design should align with SVCE's broader organizational objectives.[2]

1. **Improve Customer Satisfaction:** SVCE should provide the mechanism for customers to achieve low carbon, reliable power at low cost.

2. **Reduce Cost:** SVCE can reduce energy procurement costs resulting from inaccurate forecasting or reduce Resource Adequacy capacity payments.

3. **Minimize Environmental Footprint:** SVCE has ambitious electrification and decarbonization goals. Its strategy is to develop a carbon-free power supply; electrify the built environment and mobility; and to promote energy efficiency and grid integration.[3]

4. **Ensure Scalability:** SVCE wishes to maximise available services for its consumers. An SVCE marketplace can provide the foundation for an ecosystem of solutions that complement existing and emerging markets or programs.

2 Executive Summary and Recommendations

Electron defined and prioritized market design options to help SVCE meet its objectives of improving customer satisfaction, reducing energy procurement costs, reducing hourly emissions, and ensuring market scalability. Eight market options were identified and reviewed. Six of these options were then explored for an in-depth assessment.

The eight identified options were created from different combinations of the following four factors:

1. The underlying value stream
2. The product traded

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[1] The work and analysis covered by this report were funded by SVCE through the Innovation Onramp Program. The report is not representative of SVCE's perspectives and views. SVCE is sharing these findings and documents to help other agencies and organizations learn from the pilot program.
The energy data used in the report's analysis is from Q4 2020.

[2] A full list of the objectives set out by SVCE is included in Appendix 8.1.

[3] https://www.svcleanenergy.org/wp-content/uploads/2018/12/SVCE-Decarb-Strategy-Programs-Roadmap_Dec-2018.pdf; p.1

3. The mechanism by which this product could be accessed
4. The position of the market within the existing California market landscape

The value streams were defined by reviewing SVCE priorities, opportunities for cost reduction, and opportunities to bring more financial value to consumers. Four value streams were identified: reduction in SVCE costs incurred through exposure on the wholesale markets; value derived from reducing peak demand; reducing hourly emissions; and facilitating access to CAISO markets. Capturing value in each of these markets can occur by trading capacity, energy, or green / renewable energy credits as products.

To generate the tradeable products, SVCE can leverage different market mechanisms. Three main mechanisms were reviewed: shedding load, shifting load, or attribute procurement. Shifting load is distinguished from shedding by a requirement to incentivize movement load between two specific times versus pure reduction of demand. In absence of procuring a physical resource, attribute procurement can also be used to account for carbon or environment attributes. Each market mechanism is not applicable across all value streams and was reflected in the analysis.

Finally, the operator or owner of the market was considered. In addition to the existing CAISO operated markets, two additional market structures were reviewed. First, a PG&E operated market in which PG&E might create a local mechanism to manage grid reliability and resiliency. The second is an SVCE-only market where SVCE operates a local market in collaboration or isolation with the existing CAISO markets.

Each market option was assessed against the following criteria: market surplus and liquidity; societal value; and SVCE's role in the marketplace, including the market's alignment with SVCE's own organizational goals. For each criterion, Electron scored the markets High, Medium or Low and assigned an overall score.

#	Value Stream	Market Mechanism	Product	Market Structure	Overall Assessment
1	Minimize Wholesale Exposure	Load Shedding	Energy	CAISO	
2	Minimize Wholesale Exposure	Load Shedding/ Shifting	Energy	SVCE-only	
3	Reduce Peak Demand (Resource Adequacy)	Load Shedding	Capacity	SVCE-only	
4	Reduce Peak Demand (Non-Wires Alternatives)	Load Shedding/ Shifting	Capacity	PG&E	
5	Reduce hourly emissions	Load Shifting	Energy	SVCE-only	
6	Reduce hourly emissions	Load Shedding	Energy	SVCE-only	
7	Reduce hourly emissions	REC Procurement	REC	SVCE-only	
8	Provide access to CAISO wholesale markets	Load Shedding	Energy; Ancillary Services	CAISO	

High	Medium	Low	TBD

Three market options scored 'High' overall:

- Market 2: SVCE-owned marketplace to minimize wholesale exposure through load shedding/ load shifting.
- Market 3: SVCE-owned marketplace to minimize Resource Adequacy payments through load shedding/ load shifting.
- Market 5: SVCE-owned marketplace to reduce hourly emissions by load shifting.

Markets 2 and 3 will help SVCE reduce its energy procurement costs. As SVCE-only markets, they allow SVCE to strengthen its relationships with its customers, whilst avoiding the added administration costs of integrating with existing CAISO and PG&E markets.

Market 3, reducing hourly emissions by load shedding, also scored highly for societal value and leveraging SVCE's relationship with its customers; however, determining the monetary value of the avoided carbon through load shifting requires further investigation with SVCE and its stakeholders.

Electron considered how each market option would interact with other markets and with existing price signals in SVCE's region. A key period of activity for each of the high-scoring markets is likely to be during peak hours, generally defined as 4 – 9 PM. At this time, SVCE internal analysis indicates that value can be gained through reducing wholesale exposure at the same time as a reduction in peak load, assistance with addressing ramping periods, and reduced carbon consumption. A single event to incentivize load shedding or load shifting can therefore leverage multiple value streams.

Electron therefore recommends that SVCE create a single market structure that will allow it to run market events to incentivize DERs to shed or shift load in response to price and system conditions. SVCE can tailor the price signal it sends to participants depending on the value stream it wishes to access. Where a single DER action provides multiple sources of value, SVCE can stack payment in a single price signal.

3 Glossary

Day Ahead Market (DA Market) – CAISO-run market where participants secure energy the day before the operating day.

Demand Response (DR) - An opportunity for consumers to play a significant role in the operation of the electric grid by reducing electricity usage during peak periods in response to time-based rates or other f financial incentives.

Distributed Energy Resource (DER)- A small-scale physical or virtual energy resource (e.g EV charger, smart thermostat, behind the meter solar/ storage) that operates locally and is connected within the distribution system.

Integrated Energy Policy Report – Biennial report prepared by the California Energy Commission that assesses and forecasts all aspects of energy industry supply, production, transportation, delivery and distribution, demand and prices.

Load – An end use device or customer that receives power from an energy delivery system.

Non-Wires Solution – Alternative methods to upgrade transmission and distribution infrastructure. NWS use energy storage, demand response and energy efficiency, amongst other tools, to reduce constraints on the grid.

Power Purchase Agreement (PPA) – A contract used to purchase the energy, capacity and attributes from a renewable resource project.

Resource Adequacy (RA) - Under its Resource Adequacy (RA) program, the California Public Utilities Commission (CPUC) requires load-serving entities to demonstrate in both monthly and annual filings that they have purchased capacity commitments of no less than 115% of their peak loads.

Real Time Market (RT Market) – CAISO-run market where participants procure energy up to 75 minutes before the operating hour.

Renewable Energy Certificate (REC) - A REC is the property right to the environmental benefits associated with generating renewable electricity. For instance, homeowners who generate solar electricity are credited with 1 solar REC for every MWh of electricity they produce. Utilities obligated to fulfill an RPS requirement can purchase these RECs on the open market.

4 The role of local markets in SVCE's region

This section sets out why new local markets are a key feature of decarbonizing energy systems. It explains why implementing a local marketplace can help SVCE meet its objectives.

California's transition away from fossil fuels has resulted in the emergence of renewable generation and Distributed Energy Resources (DERs), changing the nature of its energy system. Increased amounts of decarbonized solar and wind generation and the adoption of consumer-owned DERs results in shifting market structures to introduce new products, procurement strategies, and asset optimization approaches.

As a Community Choice Aggregator (CCA), SVCE is responsible for procuring renewable energy on behalf of retail electricity customers in its geographic area. As a CCA with high renewable targets, SVCE is procuring an increasing volume of renewables for its portfolio.

- Solar generation: Solar generation accounted for 13% of California's supply in 2019[4], up from 7% in 2015[5]. Five of SVCE's seven current long-term PPAs are solar plus storage generation[6].
- Wind: Wind accounted for 8% of California's energy generation in 2019[7], up from 5% in 2015[8]. SVCE has stated in its IRP that its future RPS-eligible PPAs and short-term contracts are assumed to be 30% wind[9].

[4] http://www.caiso.com/Documents/2019AnnualReportonMarketIssuesandPerformance.pdf; p.31
[5] http://www.caiso.com/Documents/2015AnnualReportonMarketIssuesandPerformance.pdf; p.35
[6] IRP; p.6
[7] http://www.caiso.com/Documents/2019AnnualReportonMarketIssuesandPerformance.pdf; p.42
[8] http://www.caiso.com/Documents/2015AnnualReportonMarketIssuesandPerformance.pdf; p.49
[9] IRP; p.13

The impact of a high renewable portfolio can leave CCAs or other Load Serving Entities exposed on the wholesale market during times of high demand and low renewable generation. Despite the complementary nature of wind and solar, California experiences imbalance in late morning and early evening[10].

CCAs have an opportunity to use local markets to provide value to their consumers by leveraging the inherent flexibility in DERs. With increased digitalization and autonomy, DERs can help CCAs reduce energy and capacity procurement costs and can provide new cost savings and revenue opportunities to asset owners. In particular, new demand side technologies offer the following types of value from flexibility:

- Solar: off-set energy procurement costs and reduce customer bills
- Batteries: load shift by matching charging periods to renewable excess and discharge to high carbon or high-cost periods
- Electric vehicles: load shift by matching charging periods to renewable excess
- Smart home devices: devices such as smart thermostats and electric hot water heaters can be dispatched to shift load

The role of local markets in unlocking DER value:

Utilities, retailers, and system operators have used multiple tools to incentivize more efficient matching of electricity generation and demand. Options can be categorized into four main classes, further summarized in Table 1: [11]

- Market – based Approaches
- Consumer Incentive
- Dynamic Rates
- Long-Term Procurement

A transition to market-based approaches reflects the desire to match supply and demand in real-time and compensate local resources using performance-based methodologies. In particular, real-time markets introduce more options for participants to account changing conditions which influence energy or capacity availability, such as weather or existing demand constraints. Markets are therefore effective for coordinating resources when grid conditions are volatile or liable to change.

	Market-basd	Consumer Incentives	Dynamic Rates	Long-Term Procurement
Example of Incentive	LMP, Value-Driven	Bill rebate[12]	VPP, CPP, TOU, RTP	PPAs

[10] http://www.caiso.com/Documents/2019AnnualReportonMarketIssuesandPerformance.pdf; p.40
[11] Adapted from "The National Potential for Load Flexibility: Value and Market Potential Through 2030" by The Brattle Group
[12] For example the Sonoma Clean Power GridSavvy program; https://sonomacleanpower.org/programs/gridsavvy

Role of incentive	Prices can be based on a sub-hourly signal, driven by the buyer or seller. This allows prices to be better tailored to the market need	Customers are provided a simple way to opt-in to a program, with a clear understanding of their financial value	Easy to understand model with consistent timings	Procurements are based on bilateral contracts to lower commodity cost and provide certainty of supply
Advantages	Value can be optimised by market inputs by system or customer	Simple: Fixed incentives are predictable for consumers Easy to implement	Provides better reflection of system needs (e.g. capacity constraints or carbon levels) Does not require customer input.	Creates stable financial position; Often low cost
Disadvantages	Value is 'pay-for-performance' Can require more customer engagement	Fixed incentive may not reflect true value of flexibility to the system.	Only reflects value to price maker (e.g. grid or generator)	Utilities/ retailers have to hedge to manage periods of supply or demand uncertainty.

Table 1. Customer Incentive Design Options

5 Electron Approach to Market Discovery:

Electron used the criteria below to identify eight options for local markets.

5.1 Market Identification

5.1.1 Value Streams

Electron identified five different value streams that could be leveraged to achieve the project-level objectives described in Section 1.1. Value streams are broken into two categories. Direct value streams result in cost savings to SVCE. Indirect value streams leverage SVCE consumer device flexibility, but create channels to access value generated from revenue opportunities in other markets (e.g. CAISO wholesale participation). In all cases, consumer would likely receive an indirect value of bill savings from energy reduction.

5.1.1.1 Direct Value Streams

Minimize Exposure on CAISO Markets
An imbalance between forecasted demand and real-time supply requires rebalancing of the Day Ahead (DA) and/or Real Time (RT) markets. To the extent that real-time demand exceeds forecast demand, this may result in higher real-time market prices as CAISO seeks additional resources to meet real-time demand. Real-time prices in CAISO markets are likely to be higher and more volatile than long-term procurement contracts. SVCE can mitigate exposure by

leveraging demand flexibility to shed or shift load, reducing the total procurement volume required.

Hourly Emissions Reduction

SVCE currently procures enough zero carbon and renewable energy generation to cover annual demand. However, without an hour-by-hour strategy of matching clean energy to consumption, generation sources such as gas peaker plants may still be dispatched by CAISO during times of peak demand. This is reflected when SVCE procures energy through the CAISO wholesale markets when SVCE is in imbalance. The generation procured through the day ahead or real-time markets reflects the carbon intensity of the California grid[13]. While new accounting strategies are deployed to create hourly renewable certificates,[14] SVCE can begin to reduce hourly carbon consumption by incentivizing demand flexibility to shed or shift load during times of peak demand.

Resource Adequacy Reduction

SVCE has an obligation to procure resource adequacy based on system, local, and flexible requirements. The three-part cost structure for resource adequacy, particularly the determination of Flexible and System RA requirements, introduces opportunities to leverage flexible demand to reduce a portion of the cost during peak periods. Reduced cost of flexible RA can be achieved if demand side flexibility is incentivized to shift or reduce during peak periods.

5.1.1.2 Indirect Value Streams

5.1.1.3

Non-Wires Alternatives

One consequence of increased uptake of DERs is demand or generation congestion on the local distribution grid. As a result, PG&E and other investor-owned utilities will need to upgrade the distribution grid assets to ensure reliability of service. By leveraging the DER located on the distribution grid, PG&E can defer or avoid these costs by incentivizing DER owners to act reduce or shift their demand at times when the distribution grid is approaching a voltage or capacity limit. Shifting cost away from physical asset investment ("wires") to demand-side flexibility ("non-wires") offers an opportunity to keep consumer bill costs low and provide supplementary value streams to DER owners.

Facilitate access to wholesale markets

SVCE can bid aggregations of DERs secured through its marketplace into CAISO markets. Providing DERs access to new revenue streams can improve the investment case for these technologies and help to accelerate electrification in the SVCE region. In this scenario, SVCE would effectively be acting as an aggregator of aggregators. This means that the DERs would be paid by the counterparties trading in CAISO.

5.1.2 Product Traded

Electron identified the product traded to capture each value stream. The product traded is the measurable unit which is being bought and sold in the marketplace.

i) Energy: amount of power delivered over a specific period of time.
ii) Capacity: instantaneous available import or export.
iii) Green Credits: a product which values avoided carbon consumption.

[13] http://caiso.com/Documents/GreenhouseGasEmissions-TrackingReport-Aug2020.pdf
[14] https://www.energytag.org/wp-content/uploads/2021/05/EnergyTag-and-granular-energy-certificates.pdf

iv) Renewable Energy Credits (RECs): tradeable attribute associated with renewable and environmental attributes associated with electricity production.

5.1.3 Market Mechanism

The market mechanism indicates the action taken to generate the tradable product. The market mechanisms identified are:

1) Load Shedding: Curtailing load to provide capacity. Load Shedding reduces consumers' overall energy consumption and impacts instantaneous demand levels.
2) Load Shifting: Shift energy consumption from periods of high demand / high cost into periods of low demand/low cost. Load Shifting changes the shape of a demand curve, but not the overall quantity of energy consumed.
3) Attribute purchasing: Green attributes to meet energy or carbon objectives.

5.1.4 Market Structure

Three market structures were identified to implement the various market mechanisms. Each structure has a different set of regulatory and technical considerations influencing the final implementation:

i) SVCE-only: SVCE owns and operates the marketplace. The market is not integrated with other regional or wholesale markets.
ii) CAISO: SVCE bids DER aggregations into markets operated by CAISO. These market options tend to have higher regulatory barriers.
iii) PG&E: SVCE can operate a market to reduce distribution grid congestion during periods identified by PG&E, e.g. through a potential non-wires solution.

5.2 Detailed Assessment

Combining the available value streams, products, market mechanisms and market structures, Electron identified eight options for possible local markets. Each market option was scored against a set of criteria that aligned with SVCE's objectives for the project.

Market Value:

1. **SVCE Surplus:** SVCE surplus can be assessed by comparing the benefit to SVCE of implementing a market against alternative ways to achieve the same outcomes.
2. **Customer Surplus:** Measures the value and opportunity cost to the seller of participating in the market.

Market Liquidity: Measures the ability to buy or sell a product without affecting its price, and without incurring significant transaction costs. Markets with higher liquidity facilitate better price discovery. Determinants of market liquidity include the volume of transactions; the frequency of these transactions relative to the transaction volume (the 'churn rate'); and the transaction cost.

Societal Value:

1. **Transferable:** Measures how easily the market design can be replicated by other LSEs, retailers and CCAs.
2. **Scalable:** Measures whether the market design engages diverse device and customer types.
3. **Decarbonization:** Assesses the market's efficacy in reducing carbon emissions. Carbon reduction can be direct, such as a market that procures RECs or reduces load

during periods of high carbon consumption, and indirect, for instance through increased electrification and DER adoption.
4. **Grid Reliability:** Market facilitates improved grid reliability. E.g providing an NWS to reduce transmission and distribution investment.

SVCE Role:
1. **Strategic Alignment:** Market enables SVCE to meet its overarching program strategy to procure and maintain carbon-free power supply; electrify the built environment and mobility; and to promote energy efficiency and successful grid integration[15].
2. **Market Positioning:** Market leverages and reinforces SVCE's strong customer relationships and its position as an LSE.

Summary of Value Assessment Criteria:

Value Criteria	High	Low
SVCE Surplus	High value to SVCE relative to no market	Market does not create extra monetary value for SVCE
Seller Surplus	High value for seller relative to no market	Market does not create extra monetary value for seller
Market Liquidity	Diverse set of participants with varying characteristics can trade	Participant diversity is limited to particular device or customer types
Transferable	Model can be easily adopted by other LSEs, retailers and CCAs in California	Model can be used by SVCE only or will face barriers expanding to other regions
Scalable	Market can be accessed by aggregators and device types, particularly those forecasted to grow in SVCE IRP scenarios for 2030[16]	Market excludes aggregators or device types
Decarbonization	Market reduces GHG emissions on an hourly basis	Market does not impact grid marginal or average emissions
Grid Reliability	Market improves grid reliability (e.g. provides NWS)	Market does not improve reliability or help to reduce T&D upgrades
Strategic Alignment	Market helps SVCE to decarbonize, increase electrification and reduce customer bills	Market does not help SVCE to decarbonize, increase electrification and reduce customer bills
Market Positioning	SVCE is uniquely positioned to implement and operate market	Market does not leverage SVCE core strengths or is better operated by third-party

[15] https://www.svcleanenergy.org/wp-content/uploads/2018/12/SVCE-Decarb-Strategy-Programs-Roadmap_Dec-2018.pdf
[16] IRP Appendix A; Energy & Environmental Economics Slide 63ff

6 Market Summary

6.1 Market Options

Combining the value streams, market mechanisms, product traded and market structure, Electron identified eight different options for detailed market design[17].

#	Value Stream	Market Mechanism	Product	Market Structure
1	Minimize Wholesale Exposure	Load Shedding	Energy	CAISO
2	Minimize Wholesale Exposure	Load Shedding/ Shifting	Energy	SVCE-only
3	Reduce Peak Demand (Resource Adequacy)	Load Shedding	Capacity	SVCE-only
4	Reduce Peak Demand (Non-Wires Alternatives)	Load Shedding/ Shifting	Capacity	PG&E
5	Hourly emissions reduction	Load Shifting	Energy	SVCE Only
6	Hourly emissions reduction	Load Shedding	Energy	SVCE Only
7	Hourly emissions reduction	REC Procurement	REC	SVCE Only
8	Provide access to CAISO wholesale markets	Load Shedding	Energy/ Ancillary Services	CAISO

6.2 Preliminary Assessment

Markets were reviewed against the criteria in Section 5.2 and given high, medium, and low scores. Three markets received 'high' ratings, three received 'medium' ratings, and two received 'low' ratings.

The market options with the highest overall value were:

> Market 2: SVCE-owned marketplace to minimize wholesale exposure through load shedding/ load shifting.
>
> Market 3: SVCE-owned marketplace to minimize Resource Adequacy payments through load shedding.

[17] The options for load shedding and load shifting have been combined into a single option where the market is incentivizing demand reduction. Load shifting for reducing hourly emissions has been split into a separate option because it requires the availability of clean local generation as well as flexible load, affecting the potential market surplus and liquidity.

Market 5: Hourly emissions reduction by load shifting.

Markets 2 and 3 help SVCE reduce its energy procurement costs through management of wholesale exposure and reduction of RA payments. As SVCE-only markets, each allows SVCE to strengthen customer relationships, whilst avoiding the added administration costs of integrating with existing CAISO and PG&E markets.

Market 5 is strategically aligned with SVCE objectives to decarbonize with a high potential for market liquidity driven by assets which can shift their overall demand; however, the direct monetary value placed by SVCE on decarbonization remains challenging to define.

Market 1, to minimize wholesale exposure by bidding on CAISO, scored less highly than SVCE-only markets due to the increased administration costs of registering the aggregation as a Proxy Demand Resource (PDR) or Distributed Energy Resource (DER).

The PG&E integrated peak avoidance market scored Medium: Whilst strongly aligned with SVCE's strategic goals and grid reliability objectives, PG&E have not yet announced tenders for distribution deferral via flexibility in SVCE's territory. Buyer and seller surplus from an NWS market is therefore uncertain.

Option 7, to reduce hourly emissions by REC procurement, was considered low priority. REC value from a monetary perspective is low; the market does not help SVCE to reduce its energy costs or improve grid reliability; and reducing its carbon emissions on an hourly basis is not an immediate strategic priority for SVCE.

Option 8, facilitating access to CAISO markets, provides limited monetary and societal value to SVCE as the market intermediary. This market does not differentiate SVCE in terms of its customer relationships, since DERs can already access CAISO markets via aggregators.

6.2.1 Preliminary Assessment Results

Table 2 summarizes how each of the 8 options scored against the criteria in Section 5.2. Section 7 discusses six of these markets in detail. The markets for REC procurement and providing access to CAISO have been ruled out for further consideration.

High	Medium	Low	TBD

Table 2: Summary Assessment

	Structure	Mechanism	#	Market Value			Societal Value				SVCE Role		Overall
				SVCE Surplus	Customer Surplus*	Market Liquidity	Transfer-able	Scalable	Decarb.	Grid reliability	Strat. Align.	Market Position.	
Minimize Wholesale Exposure	CAISO	Load Shed	1										
	SVCE	Load Shed/Shift	2										
Reduce peak demand (RA)	SVCE	Load Shed	3										
Reduce peak demand (NWS)	PG&E	Load Shed/ Shift	4										
Hourly emissions reduction	SVCE	Load Shift	5										
		Load Shed	6										
		REC Procurement	7										
Provide CAISO access	CAISO	Load Shed/ Shift	8										

6.3 Market Interactions

Each market was assessed independently to ensure a common evaluation framework; however, a key factor affecting potential value is how different value streams could be leveraged in a single market event. As discussed in section 4, the nature of California's energy system means that periods of high carbon intensity, high wholesale prices and high demand can coincide.

During summer months, the early evening demand peak coincides with a fast-ramping period as solar production declines and the CAISO system dispatches other resources to meet system demand. SVCE has identified that 2/3 of its wholesale supply from 4-9pm is met with the supply mix as dispatched by CAISO[18]. As a result, SVCE procures power with the carbon intensity of the grid mix rather than directly from a decarbonized source. The net result is an increased hourly emissions profile and high procurement costs. Finally, the majority of grid constraints PG&E has identified as eligible for Non-Wires Alternatives occur during summer afternoons and evenings[19].

Figure 1 below maps California electricity demand and the carbon intensity of its grid mix over a day in summer 2020. The red boxes highlight the periods when markets for reducing peak load, carbon consumption and wholesale exposure are likely to operate. The figure also includes two of SVCE's residential TOU rates. It shows that periods of high market value are likely to coincide with peak TOU pricing when DER owners are already likely to be reducing their electricity consumption.

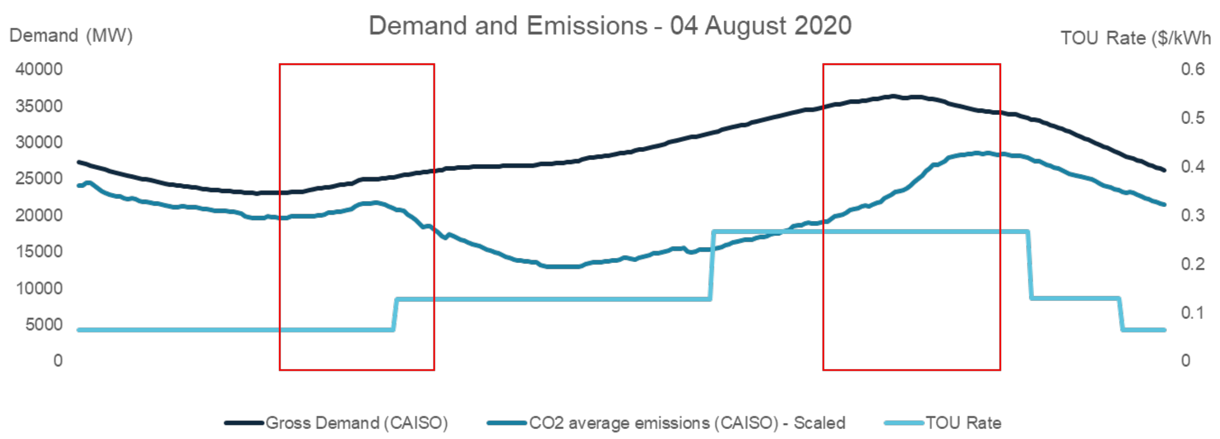

Figure 1: Demand and Emissions; 4th August 2020

The coincidence of demand, carbon, and high prices illustrates how a single request from SVCE for demand response could access all three value streams simultaneously. Electron will pursue a detailed market design to consider how a SVCE market can be layered on top of these existing price signals without cannibalizing existing initiatives or risking double payment.

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[18] Ascend Analytics; SVCE IRP 2020; p.173
[19] PG&E 2021 DIDF Solicitation Protocol; p.10, 11

6.4 Recommendation

SVCE can gain the most near-term value by incentivizing market-based flexibility using market options two, three, and five. Each market addresses an important financial or societal value driver and relies only on SVCE to implement and operate. Furthermore, the market mechanism relies on a set of shared devices shedding or shifting load.

The similarities between each of the markets creates an opportunity design a single market structure to access value different parts of a value stack. As summarized in Section 6.5, each market is driven by external triggers that occur in a shared 4 – 9 pm summer peak. Under a single construct, SVCE can alter the inputs to the marketplace, such as the price or the volume of energy/ capacity request, according to its own procurement position and the grid context.

Electron recommends that SVCE pursue a single market structure with variable price signals that capture each of the available value streams. The detailed market design will address how price signals and market timings can be structured to meet near term objectives within the existing market structures and longer-term objectives driven by broader market reform.

7 Detailed Feasibility Assessment

7.1 Minimize SVCE Wholesale Exposure

7.1.1 Option 1: Minimize SVCE Wholesale Exposure in CAISO DA/ RT Market

SVCE mitigates against possible volatility in the price of its energy supply by hedging; however, at times when the generation SVCE has procured does not match its forecast demand, SVCE rebalances by trading on the CAISO markets, where prices tend to be higher than its longer-term supply contracts. SVCE can bid energy into the CAISO RT or DA markets to offset this wholesale exposure.

7.1.1.1 Value Assessment

Objective	Minimize SVCE exposure on CAISO DA and RT markets	
Product	Energy	
Mechanism	Load Shed	
Buyer	CAISO	
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Intermediary	SVCE	Wants to reduce wholesale market exposure
Payment	Payment is passed through from CAISO to SVCE to customer	
SVCE Surplus		Medium
Existing estimates	Arbitrage Opportunity[20]: Day Ahead: $5m Real time: $6m	
Market alternatives	▪ Alternative is to invest in improved demand-forecasting ▪ Increased % of hedging ▪ Procured resources/ storage	
Cost without market	Per imbalance event: CAISO Wholesale Price (MWh) * Imbalance Volume* time (h) An additional consideration is that SVCE could use the Proxy Demand Resource to contribute to its Resource Adequacy requirements. The economics of the CAISO market mean that any resource registered as a PDR would need to be RA qualified. The added restrictions on qualifying aggregations for RA would further increase the administration costs of this option.	
Customer Surplus		Medium
Value from market	$/kWh paid for reduction Pass through from SVCE value to participating customers; Lower energy bill	
Opportunity cost	▪ Periods of wholesale exposure (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy ▪ DER/ Aggregator integration costs	
Liquidity:		High

[20] Ascend VPP Options Analysis; slide 12

Buyer Transaction Volume	▪ Determined by SVCE arbitrage opportunities on CAISO
Seller Transaction Volume	▪ Forecast maximum installed capacity[21] in 2030: 1045 MW plus seasonal HPWH and HVAC capacity ▪ *Transaction volume could be estimated by looking at:* ○ *No. of DERs not committed to alternative programs* ○ *No. of DERs not already involved in CAISO markets* ○ *DER availability during hours when market is likely to be required*
Transaction Frequency (Churn Rate)	▪ High: 2/3 of supply 4-9pm is forced market exposure[22]
Societal Value	**Medium**
Transferable	High – this model is applicable across CAISO's territory
Scalable	Medium – there are administration costs for DERs bidding into CAISO as a Proxy Demand Resource or Distributed Energy Resource
Decarbonization	Medium/ High: emissions in California are correlated with high wholesale prices[23]. This means that responding to wholesale price signals can reduce carbon consumption.
Grid Reliability	Medium/ High: current PG&E tenders suggest grid constraints occur at times when SVCE tends to be exposed on wholesale markets (i.e 4-9pm, particularly in the summer).
SVCE Role	**Medium**
Strategic Alignment	High – reduces SVCE energy costs; incentivizes DER uptake and supports emissions reduction
Market Position	Medium – aggregators can access CAISO wholesale markets without SVCE

7.1.2 Option 2: Minimize SVCE Wholesale Exposure through load shedding/ load shifting

SVCE can reduce its energy procurement costs by incentivizing DERs to shed or shift load during periods when it is exposed on the DA and RT markets. Unlike in 7.1, in this option SVCE does not bid energy into the CAISO market.

7.1.2.1 Value Assessment

Objective	Minimize SVCE exposure through load shedding	
Product	Energy	
Mechanism	Load Shed/ Load Shift	
Buyer	SVCE	Wants to reduce wholesale exposure costs
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Payment	Payment from SVCE to customer for reducing load ($/kWh)	
SVCE Surplus		**High**
Existing estimates	Arbitrage Opportunity[24]: Day Ahead: $4.5m	

[21] Energy & Environmental Economics forecasts for DER electrification adoption potential; SVCE IRP 2020 p.63 ff
[22] Ascend Analytics; SVCE IRP 2020; p.173
[23] Gridworks VPP Options Analysis; p.7
[24] Ascend VPP Options Analysis; slide 12

	Real time: $6m
Market alternatives	▪ Alternative is to invest in improved load-forecasting ▪ Increased % of hedging ▪ Procured resources/ storage ▪ Other rate designs
Cost without market	Per imbalance event: CAISO Wholesale Price (MWh) * Imbalance Volume* time (h)
Customer Surplus	**Medium**
Value from market	$/kWh paid for reduction
Opportunity cost	▪ Periods of wholesale exposure (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy ▪ DER/ Aggregator integration costs
Liquidity	**High**
Buyer Transaction Volume	▪ Determined by SVCE wholesale exposure
Seller Transaction Volume	▪ Forecast maximum installed capacity[25] in 2030: 1045 MW plus seasonal HPWH and HVAC capacity
Transaction Frequency (Churn Rate)	▪ High: 2/3 of supply 4-9pm is forced market exposure[26]
Societal Value	**High**
Transferable	High – this model is applicable across CAISO's territory
Scalable	High – SVCE operated market avoids CAISO qualification process
Decarbonization	Medium/ High: emissions in California are correlated with high wholesale prices[27]. This means that responding to wholesale price signals can reduce carbon consumption.
Grid Reliability	Medium/ High: current PG&E tenders suggest grid constraints occur at times when SVCE tends to be exposed on wholesale markets (i.e 4-9pm, particularly in the summer).
SVCE Role	**Medium**
Strategic Alignment	High – reduces SVCE energy costs; incentivizes DER uptake and supports emissions reduction
Market Position	High – SVCE-operated market would provide new revenue streams for DERs in its region

7.2 Reduce Peak Demand

SVCE can incentivize DERs to shed load during periods of high demand. Value from this action is derived from reduced capacity rather than reduced energy. There are two major potential sources of value for SVCE in reducing load during periods of peak demand:

i) Reduced SVCE RA requirement

[25] Energy & Environmental Economics forecasts for DER electrification adoption potential; SVCE IRP 2020 p.63 ff
[26] Ascend Analytics; SVCE IRP 2020; p.173
[27] Gridworks VPP Options Analysis; p.7

ii) Reduced Transmission and Distribution upgrade costs (Non-Wires Alternatives)

7.2.1 Option 3: Reduce SVCE RA Requirement:

The CPUC requires SVCE to purchase sufficient resources to meet its peak demand plus a 15% Planning Reserve Margin. SVCE can reduce Resource Adequacy (RA) payments by reducing peak demand during the summer months.

Electron is considering two designs[28] for a market that incentivizes load reduction to reduce SVCE's Resource Adequacy requirements:

a) Year-Ahead demand reduction: SVCE could run a procurement market for peak season reduction. The procured capacity would be sent to CEC with sufficient notice for it to be included in SVCE's RA requirement. (This approach is similar to SVCE's current VPP program with Sunrun). Project discussions raised several issues with this option:

   i. A forward market several months in advance may result in low participation, particularly since the devices would be required to reduce during highly competitive periods.
   ii. The requirement for regular reduction at the same time of day over long periods makes this option more suitable for a customer incentive program (in the manner of the SunRun VPP) than a market.

b) Real time peak reduction: SVCE could run a market for demand response on the days that it forecasts its peak demand. This would likely be a few days during high summer. This market would reduce the peak capacity figure on which its System RA requirement is based. SVCE would therefore have a reduced RA payment in the following year.

   Benefits:

   i. SVCE can alter the volume and price of its demand response request according to near real time conditions.
   ii. Fewer events are required, reducing SVCE's total expenditure on the market.

   Issues:

   iii. The market relies on immediate customer response. There is a risk that customers do not accept SVCE's price and that it fails in reducing its peak capacity.
   iv. SVCE would rely on the reduced peak demand achieved by the market feeding into the calculation used to calculate its RA payment; however, RA forecasts for CCAs are formed from both the SVCE expected forecast and PG&E's own forecasts for the SVCE region. Both forecasts feed into the CEC's Integrated Energy Resource Plan (IEPR) and SVCE does not know how its own forecast is used as an input for the overall RA calculation.

7.2.1.1 Value Assessment

[28] As mentioned in Section 7.1.1, SVCE could additionally reduce its RA payments by bidding RA-qualified resources into CAISO markets as part of Market 1 (to reduce wholesale exposure).

Objective	Reduce SVCE load during periods of peak demand to reduce Resource Adequacy costs	
Product	Capacity	
Mechanism	Load Shed	
Buyer	SVCE	Wants to reduce Resource Adequacy costs
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Payment	Payment from SVCE to customer for reducing load ($/kWh)	
SVCE Surplus		High
Existing estimates	$6.6m[29]	
Market alternatives	▪ Procurement ▪ VPP programs	
Cost without market	*SVCE current RA costs*	
Customer Surplus		Medium
Value from market	$/kWh paid for reduction Pass through from SVCE value to participating customers; Lower energy bill	
Opportunity cost	▪ Periods of peak demand (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy ▪ DER/ Aggregator integration costs	
Liquidity:		Medium
Buyer Transaction Volume	▪ Maximum available reduction below SVCE 800MW peak	
Seller Transaction Volume	▪ Forecast maximum installed capacity[30] in 2030: 1045 MW plus seasonal HPWH and HVAC capacity	
Transaction Frequency (Churn Rate)	▪ Determined by number of summer evenings that SVCE approaches 800MW peak	
Societal Value		High
Transferable	High – this model is applicable across CAISO's territory	
Scalable	High – SVCE operated market avoids CAISO qualification process	
Decarbonization	Medium/ High: emissions in California are correlated with periods of high wholesale prices, which are also likely to coincide with periods of peak load.	
Grid Reliability	Medium/ High: current PG&E tenders suggest grid constraints may occur at times of peak demand.	
SVCE Role		High
Strategic Alignment	High – reduces SVCE energy costs; incentivizes DER uptake and supports emissions reduction	
Market Position	High – SVCE-operated market would provide new revenue streams for DERs in its region	

[29] Ascend VPP Options Analysis; slide 12
[30] Energy & Environmental Economics forecasts for DER electrification adoption potential; SVCE IRP 2020 p.63 ff

7.2.2 Option 4: Non-Wires Solutions

SVCE can coordinate DERs to shed or shift demand to avoid or defer investment in electricity distribution and transmission infrastructure. Where the grid is highly constrained, this action can also help to improve grid reliability.

In its most recent Distribution Investment Deferral Framework (DIDF) Request for Offers (RFO)[31], PG&E identified seven locations for distribution deferral opportunities, for about 25.4MW of reduction. Whilst none of these locations are in SVCE territory, SVCE considers that non-wires alternatives will soon be required in its region based on feedback from its customers. The RFO is helpful for indicating when market events would be likely to happen. The 2021 RFO calls for flexibility during the summer months (generally June to September) and usually in the afternoon and evening[32].

7.2.2.1 Value Assessment

Objective	Reduce SVCE load during periods of peak demand to avoid T&D investment and improve grid reliability.	
Product	Capacity	
Mechanism	Load Shed/ Load Shift	
Buyer	PG&E	Wants to reduce T&D investment costs
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Intermediary	SVCE	Wants to facilitate reduced T&D upgrades and to improve grid reliability
Payment	Payment from PG&E to DERs via SVCE for reducing load ($/kW * duration of service)	
SVCE Surplus		Low
Existing estimates	▪ 2021 RFO deferral values range from $460k - $2.3m, depending on size of constraint and hours required ▪ Flexibility requirement for each location varies in number of months and no of hours	
Market alternatives	▪ PG&E runs program internally ▪ PG&E chooses to upgrade grid	
Cost without market	▪ If PG&E runs own program, SVCE loses customer engagement opportunity ▪ T&D upgrade costs passed through to SVCE consumers	
Customer Surplus		Low
Value from market	▪ $/kW paid for reduction ▪ Pass through value based on PG&E valuation of deferral opportunity	
Opportunity cost	▪ Periods of peak demand (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy ▪ DER/ Aggregator integration costs	
Liquidity:		Low

[31] https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-supply/electric-rfo/wholesale-electric-power-procurement/2021%20DIDF%20RFO/2021_DIDF_Solicitation_Protocol_Redacted.pdf
[32] RFO; p.10-11

Buyer Transaction Volume	▪ Determined by location and timing of PG&E constraint
Seller Transaction Volume	▪ Determined by installed capacity at required location; PG&E accepts the following technology types: DR; Storage; Energy Efficiency; Permanent Load Shift, Renewable/ non-renewable distributed generation; EVs[33]
Transaction Frequency (Churn Rate)	▪ Location dependent; 2021 RFO between 8 and 122 times per year
Societal Value	**High**
Transferable	Medium – model is applicable across PG&E territory
Scalable	High – PG&E current tenders are open to a wide range of DERs[34]
Decarbonization	Medium: Periods of grid constraint may coincide with periods of high energy demand/ high grid emissions
Grid Reliability	High: supports improved grid reliability and reduced T&D upgrades
SVCE Role	**High**
Strategic Alignment	High – aligned with SVCE DSO strategy and customer primacy goals
Market Position	High – helps SVCE maintain consumer primacy; opportunity for SVCE to leverage stakeholder relationships and local knowledge; emergent opportunity to define DSO structure.

7.3 Hourly emissions reduction

Despite procuring enough zero-carbon energy to meet forecasted demand, SVCE must still manage times where production from contracted generators does not satisfy consumer demand. This can result from two scenarios:

1. SVCE incorrectly forecasted demand and must procure energy through the wholesale market.
2. Generators under deliver and SVCE is reliant on supply from the electric grid.

The energy accessed through the CAISO wholesale markets reflects the carbon intensity of California's generation mix. The CAISO grid mix usually consists of some carbon-free and some carbon-based power[35]. When the zero-carbon generation that it has procured does not meet its forecast demand, SVCE can incentivize customers to either:

1) Shift load into a period of surplus clean generation
2) Reduce load

7.3.1 Option 5: Hourly emissions reduction through load shifting

Objective	Reduce hourly emissions by shifting load into periods of surplus clean generation
Product	Energy
Mechanism	Load Shift

[33] PG&E 2020 RFO; p.13
[34] PG&E 2020 RFO; p.13
[35] http://caiso.com/Documents/GreenhouseGasEmissions-TrackingReport-Aug2020.pdf

Buyer	SVCE	Wants to reduce carbon consumption on hourly basis
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Payment	Payment from SVCE to customer for shifting load ($/kWh)	
SVCE Surplus		
Existing estimates	▪ Est. 1,732MWh/yr clean energy shortage[36]	
Market alternatives	▪ REC/ credit procurement	
Cost without market	▪ Avoided carbon cost: ○ Estimated value can be calculated: Forecast marginal emissions (lbs C02/kWh) * total market reduction * Cap and Trade monthly price of carbon)[37] ▪ There is a desire to ultimately move SVCE energy procurement to be carbon free in all hours of the day[38]. SVCE may wish to place an adder on this market price to reflect its decarbonization goals.	
Customer Surplus		Medium
Value from market	▪ $/kWh paid for reduction ▪ Societal value customer places on helping to reduce hourly emissions ▪ Shifting demand into periods of surplus clean generation may reduce customers' energy costs	
Opportunity cost	▪ Periods of wholesale exposure (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy ▪ DER/ Aggregator integration costs	
Liquidity:		High
Buyer Transaction Volume	▪ Determined by extent of SVCE wholesale exposure	
Seller Transaction Volume	▪ Surplus solar generation, 803MW + seasonal HPWH, HVAC capacity	
Transaction Frequency (Churn Rate)	▪ Determined by availability of surplus solar generation (SVCE solar owners); forecast SVCE exposure	
Societal Value		High
Transferable	High – this model is applicable across CAISO's territory	
Scalable	High – SVCE operated market avoids CAISO qualification process	
Decarbonisation	High – market supports SVCE move to reduce hourly emissions	
Grid Reliability	Medium/ High: current PG&E tenders suggest grid constraints occur at times when SVCE tends to be exposed on wholesale markets (i.e 4-9pm, particularly in the summer).	
SVCE Role		High
Strategic Alignment	Medium – incentivizes DER uptake and supports emissions reduction; reducing hourly emissions is not SVCE's short term focus.	

[36] Ascend IRP Analysis; Slide 200 (38MMT profile)

[37] A benchmark figure for a typical summer evening is c. $0.06/kWh based on Aug Cap &Trade price of $16.68 per ton

[38] SVCE IRP; p.47

Market Position	High – SVCE operated market would provide new revenue streams for DERs in its region.

7.3.2 Option 6: Hourly emissions reduction through load shedding

Objective	Reduce hourly emissions by shedding load when PPA generation does not match forecast demand	
Product	Energy	
Mechanism	Load Shed	
Buyer	SVCE	Wants to reduce carbon consumption on hourly basis
Seller	Aggregators	Want to be paid for providing flexibility via DERs
Participants	DER Owners	Want to be paid for device flexibility
Payment	Payment from SVCE to customer for reducing load ($/kWh)	
SVCE Surplus		Medium
Existing estimates	▪ Est. 1,732MWh/yr clean energy shortage[39]	
Market alternatives	▪ REC/ credit procurement	
Cost without market	▪ Avoided carbon cost: ○ Estimated value can be calculated: Forecast marginal emissions (lbs C02/kWh) * total market reduction * Cap and Trade monthly price of carbon)[40] ▪ There is a desire to ultimately move SVCE energy procurement to be carbon free in all hours of the day[41]. SVCE may wish to place an adder on this market price to reflect its decarbonization goals.	
Customer Surplus		Medium
Value from market	▪ $/kWh paid for reduction ▪ Societal value customer places on reducing hourly emissions ▪ Load shedding also reduces customers' energy costs	
Opportunity cost	▪ Periods of wholesale exposure (particularly 4pm – 9pm during summer) are likely to coincide with consumer need for energy DER/ Aggregator integration costs	
Liquidity:		High
Buyer Transaction Volume	▪ Determined by mismatch between PPA generation and SVCE wholesale exposure	
Seller Transaction Volume	▪ Forecasts maximum installed capacity[42] in 2030: 1045 MW plus seasonal HPWH and HVAC capacity	

[39] Ascend IRP Analysis; Slide 200 (38MMT profile)
[40] A benchmark figure for a typical summer evening is c. $0.06/kWh based on Aug Cap &Trade price of $16.68 per ton
[41] SVCE IRP; p.47
[42] Energy & Environmental Economics forecasts for DER electrification adoption potential; SVCE IRP 2020 p.63 ff

Transaction Frequency (Churn Rate)	▪ High: 2/3 of supply 4-9pm is forced market exposure[43]
Societal Value	**High**
Transferable	High – this model is applicable across CAISO's territory
Scalable	High – SVCE operated market avoids CAISO qualification process
Decarbonisation	High – market supports SVCE move to reduce hourly emissions
Grid Reliability	Medium/ High: current PG&E tenders suggest grid constraints occur at times when SVCE tends to be exposed on wholesale markets (i.e 4-9pm, particularly in the summer).
SVCE Role	**High**
Strategic Alignment	Medium – incentivizes DER uptake and supports emissions reduction; reducing hourly emissions is not SVCE's short term focus.
Market Position	High – SVCE operated market would provide new revenue streams for DERs in its region.

[43] Ascend Analytics; SVCE IRP 2020; p.173

8 Appendix:

8.1 Summary of SVCE Objectives for ResponDER Marketplace

The following objectives were identified by the SVCE ResponDER team at an early objectives-setting meeting:

Customer	Offset cost of resiliency
	Show value of at least two different asset types
	Increase ability of customers to benefit from on-site generation
	Improve customer satisfaction
	Have at least 150 customers participating in marketplace
	New market for 3rd party developers
	Offset electrification measures (buildings, transportation)
	Reduce SVCE RA Costs
Grid Management	Encourage resiliency (non-wires alternatives)
Environment	Optimize SVCE procurement
	Make measurable impact on local VRE consumption
	Reduce customer carbon footprint
	Support hourly emission reduction goals
	Enable grid with high penetration of renewables
Other	Facilitate pay for performance type approach
	Understand whether this may be an opportunity to prototype a new baselining methodology
	Cultivate ecosystem of solutions (inc. from third parties)
	Develop a market design/ program structure that could scale statewide to other regions
	Hedge against cost to serve (real time price spike)
	Support innovative companies in the community