The Demand Side Grid Support Program:
An Assessment of Scale and Value

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Notice

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BACKGROUND

The Demand Side Grid Support (DSGS) program is a taxpayer funded program run by the California Energy Commission (CEC), designed to improve the reliability of the California power system by tapping into the capabilities of behind-the-meter (BTM) resources such as batteries.

PURPOSE OF THIS STUDY

Sunrun and Tesla Energy commissioned The Brattle Group to evaluate the benefits and costs of DSGS Option 3, which is the participation option that accommodates battery storage.

OUR APPROACH

We evaluate the cost-effectiveness of DSGS Option 3 by simulating the optimal dispatch of DSGS residential batteries with a forward-looking focus on value the program could provide over the next four years. Our estimate of system benefits is limited to the incremental value that the participating batteries would provide beyond that of the standard cycling patterns that they would exhibit in the absence of the DSGS program.

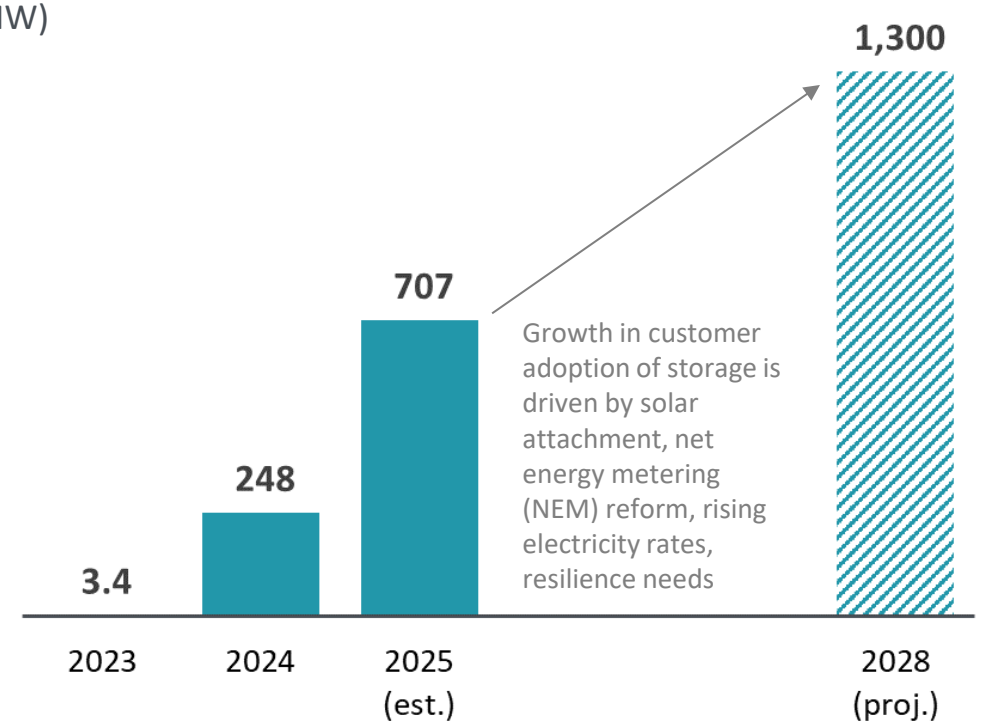
STUDY SCOPE

- Focuses exclusively on residential behind-the-meter batteries participating in DSGS via Option 3.
- Assumes value-maximizing use of DSGS batteries between 2025 and 2028, accounting for a reasonable level of enrollment growth during that period.
- Relies on recent historical market prices as the basis for establishing near-term future value.
- Accounts for potential energy and capacity value of the program (does not include any transmission and distribution, T&D, value).

Key findings

DSGS storage capacity has scaled quickly, and continued growth is expected.

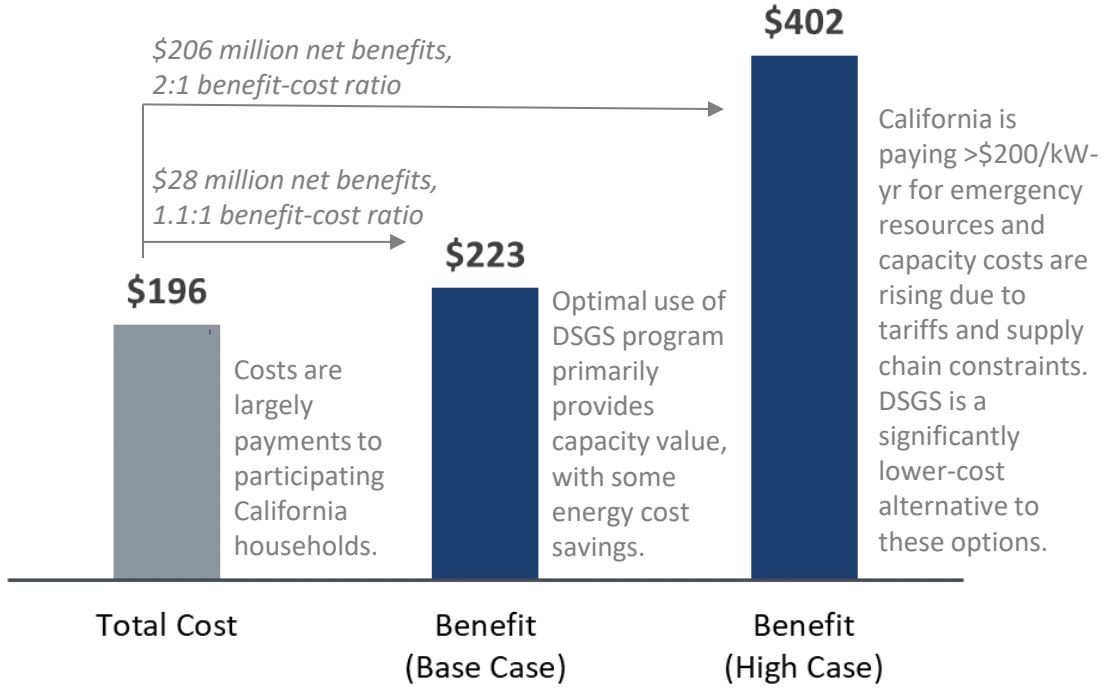
DSGS Battery Capacity, Option 3
(MW)



Notes: Historical (2023, 2024) capacity based on reported enrollments. 2025 enrolled capacity is as of July 2025 from Olivine. Final 2025 capacity will be available at the end of the program season. 2028 enrollment projections assume one half of residential forecasted distributed battery capacity participates in DSGS Option 3. Forecasted capacity based on the 2024 IEPR Storage Forecast mid-case adjusted with 2024 actuals and 2023 IEPR Residential Storage Forecast share. All values reflect historical or estimated enrollment capacity that is further subject to program baseline and accreditation protocols.

DSGS can provide significant net cost savings to California, especially in a suddenly inflationary environment.

DSGS Benefit and Cost Estimate, 2025-2028
(Millions, Present Value)



Notes: Costs include performance payments and DSGS program administration costs. Benefits are the capacity and net energy value of DSGS batteries that are strictly incremental to their baseline cycling patterns (i.e., cycling patterns in the absence of a DSGS event). We assume batteries are dispatched in the highest priced 35 events per season. High case assumes more expensive capacity than the base case (see appendix for further detail).

SUMMARY

Takeaways

SIGNIFICANT SCALE

In less than three years, DSGS Option 3 has scaled to reach 700 MW of nameplate battery capacity, similar in size to a gas plant.

GROWTH POTENTIAL

If the DSGS program is continued, we expect growth to persist. Given the recent success of the program and the trend toward organic adoption of residential behind-the-meter batteries in California, we estimate that enrolled capacity in DGSS Option 3 could reach 1,300 MW by 2028.

NET BENEFITS

The value of that capacity is significant. Over the next four years, DSGS Option 3 could deliver up to $206 million in net savings to all California ratepayers. The net cost savings will benefit all California customers, and participants in the program will be compensated for the services that they provide to the power system.

PROVEN PERFORMANCE

Residential batteries are dependable grid assets. Our analysis of a recent test event in California estimated that residential batteries participating in the event provided over 500 MW of capacity. Performance was consistent throughout the event and largely incremental to baseline battery operations.

LOOKING AHEAD

If the DSGS program is continued, opportunities to maximize the value of the program include increasing the flexibility of the event trigger, incorporating the program into resource planning initiatives, and optimizing the dispatch patterns of participating batteries to provide a broader range of grid services.

Section II
Introduction and Background

Introduction

The Demand Side Grid Support (DSGS) program is a taxpayer funded program run by the California Energy Commission (CEC). It is designed to improve the reliability of the California power system by tapping into the capabilities of behind-the-meter (BTM) resources such as batteries.

The purpose of this study is to analyze the benefits and costs of the DSGS program to the California power system. As such, our analysis provides perspective on the program's impact on energy affordability in the state. We focus specifically on "Option 3" of the DSGS program, which is the participation option that accommodates batteries.

Additionally, we provide an estimate of the scale that the program is likely to reach if it continues to be offered and highlight the performance of BTM batteries during a recent test event in California. We conclude with considerations for further enhancing the value of the program in the future.

How does DSGS provide value from batteries?

DSGS taps into the underutilized ability of battery fleets to provide services to the power grid. The participating customer is compensated for providing those services without giving up significant use of the battery, thus unlocking additional value from their battery system.

As a result, DSGS is able to leverage private investment to improve energy affordability for all California customers. The net cost of obtaining services from BTM resources such as batteries can be **significantly less** than developing new large resources from scratch.

Emissions are reduced by displacing carbon-emitting peaker plant operations with output from clean, distributed solar and storage resources.

The grid benefits from added reliability, particularly during emergency situations. **If implemented effectively, it can be a win for customers, the power grid, and the environment.**

California's residential BTM storage trajectory

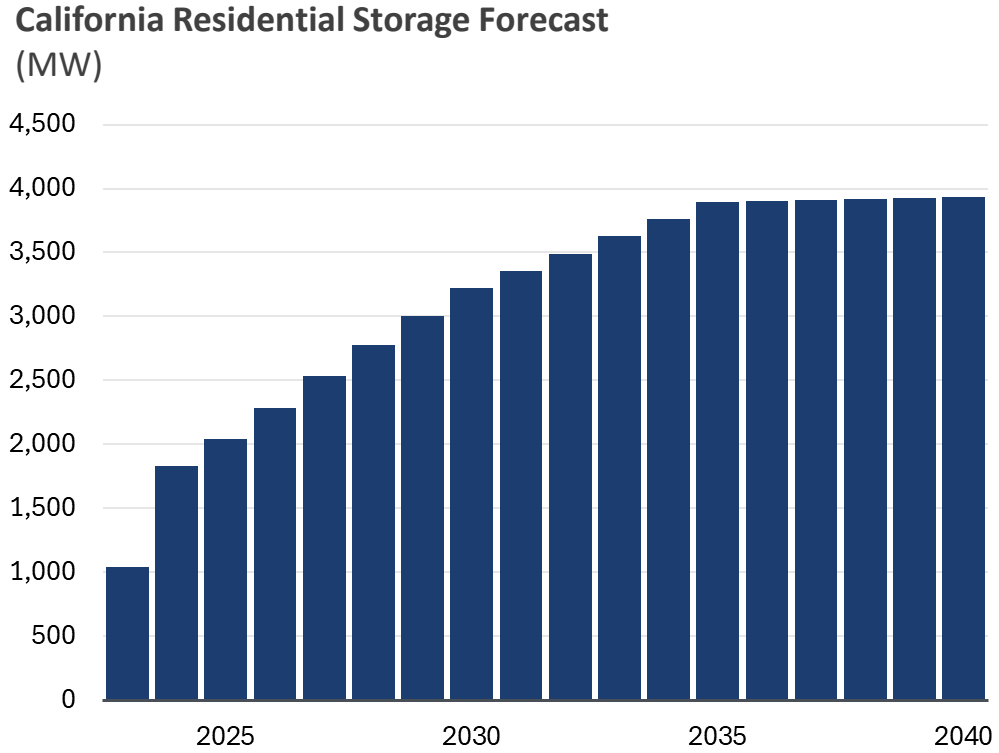
BTM storage is expected to scale dramatically in California over the next decade.

Currently, around 2% of California electricity customers have batteries, representing over 2,500 MW of capacity (roughly the same capacity as the Diablo Canyon nuclear facility) of which more than 1,800 MW is residential.

BTM battery capacity is growing and is expected to accelerate. More than 50% of rooftop solar installations in California now come paired with a battery, compared to around 20% in 2023. Some developers like Sunrun are now pairing almost all new rooftop solar installations with storage.

By 2040, the CEC's 2024 Integrated Energy Policy Report (IEPR) forecasts that almost 4,000 MW of residential distributed battery storage could be online, roughly doubling existing residential distributed storage capacity.

Customers typically install storage for two reasons: (1) for electricity bill management by consuming energy stored from paired rooftop solar PV systems and (2) as backup power during outages. While those are valuable use cases, they do not fully utilize the battery.



Notes: 2023 and 2024 based on data from the California Energy Storage System Survey. 2025 and onwards from the 2024 IEPR Storage Forecast mid-case adjusted with 2024 actual data and 2023 IEPR Storage Forecast residential share.

DSGS program overview

California's DSGS program unlocks benefits from underutilized behind-the-meter batteries.

The DSGS program pays customers to provide grid services (demand reductions or output from on-site generation) to support the state's electrical grid during extreme events and reduce the risk of rotating power outages.

The DSGS program, launched by the CEC in August 2022, is part of California's Strategic Reliability Reserve. It was introduced in response to grid reliability challenges during extreme events such as heatwaves and wildfires. There are four participation options (see table at right).

The DSGS program first offered a pathway for battery participation ("Option 3") in 2023. It provides compensation to customers who choose to enroll their batteries and allow the batteries to be dispatched for grid services during a limited number of hours per year. As of the 2025 season, Option 3 contributed more than half of all DSGS capability.

The remainder of the report focuses exclusively on residential battery participation in DSGS Option 3.

DSGS Participation Options

Option 1: Emergency Dispatch	Non-residential load shed or backup generator dispatch during EEA events
Option 2: Market-Integrated Demand Response Incremental Capacity Pilot	Existing proxy-demand-response resources are compensated for capability beyond their resource adequacy capacity commitments
Option 3: Market-Aware Storage Virtual Power Plant Pilot	Aggregated BTM batteries (or EVs) dispatch when day ahead price > $200/MWh or during EEA events
Option 4: Emergency Load Flexibility Virtual Power Plant Pilot	Aggregated load flexibility VPP aggregations respond during EEA events

DSGS Option 3 details

DSGS Option 3 has a number of design features that make it uniquely attractive to participants while also unlocking value to the power system.

The DSGS program structure is designed to balance predictable participant payments with reliable performance: batteries are provided a performance-based capacity payment and then discharged during high CAISO energy price hours or, if needed, during emergency conditions.

As currently designed, DSGS resources would expect to be called dozens of times per summer with a goal to prevent stressful grid conditions from escalating to emergency status.

Program Feature	DSGS (Option 3)	Implications of Feature
Program purpose as currently designed	Increase supply before conditions escalate to CAISO Energy Emergency Alert (EEA) status and dispatch during emergency events.	*DSGS reduces grid stress before escalation to (and during) emergency events.*
Governance and eligibility	CEC-led program including all utilities (investor-owned, municipal, and Community Choice Aggregations).	*Statewide implementation reduces administrative barriers and costs for aggregators and 3rd party participation.*
Event trigger	Market-driven events when CAISO day-ahead energy price exceeds $200/MWh (~35 events/yr) and during CAISO emergency events beginning in 2025.	*Clearly defined and relatively frequent events each year create certainty for participants.*
Performance payment	Annual capacity payment ($62.10 - $82.80/kW) based on actual capacity delivered to the grid, calculated monthly.	*DSGS capacity payment attracts program growth through performance-based revenue certainty.*
Administration costs	DSGS administration costs (for all options) totaled $5 million for the 2022-2024 program years, exclusive of VPP performance payment.	*DSGS has operated with lower administrative burden through a centralized program design compared to other CA emergency programs.*

Section III
Analytical Approach

Approach overview

System Benefits

We estimate the **energy benefit** of DSGS batteries as the value of discharged energy during high priced hours, less any charging costs. We use historical market prices from 2022-2024 as a proxy for near-term future energy value.

Batteries enrolled in DSGS provide emergency **capacity value** required to meet system needs outside of standard reserve margin planning criteria. We value DSGS batteries as replacing additional investments in emergency resources or, if incorporated into resource planning initiatives in the future, as a reduction in the cost of standard capacity additions.

Battery Operations

We simulate DSGS battery dispatch based a review of the performance capabilities of currently program participants. The simulations maximize the value of the batteries to the system (i.e., by discharging during the highest priced hours, subject to battery operational constraints).

We limit quantified benefits to the incremental value that the participating batteries would provide beyond that of the standard cycling patterns that they would otherwise exhibit in the absence of the DSGS program.

Program Costs

Our analysis accounts for annual performance payments to participating batteries as well as program administration costs of the CEC and the third-party program administrator. In the DSGS program, performance payments represent the majority of program costs and are therefore returned directly to participating customers.

Forecasted Enrollment

We model program benefits and costs for the period from 2025 through 2028, assuming the program grows linearly to 1,300 MW enrolled residential capacity from its current (2025) level. This projection is based on analysis of CEC battery adoption forecasts as well as historical growth trends.

See appendix for further details on modeling assumptions.

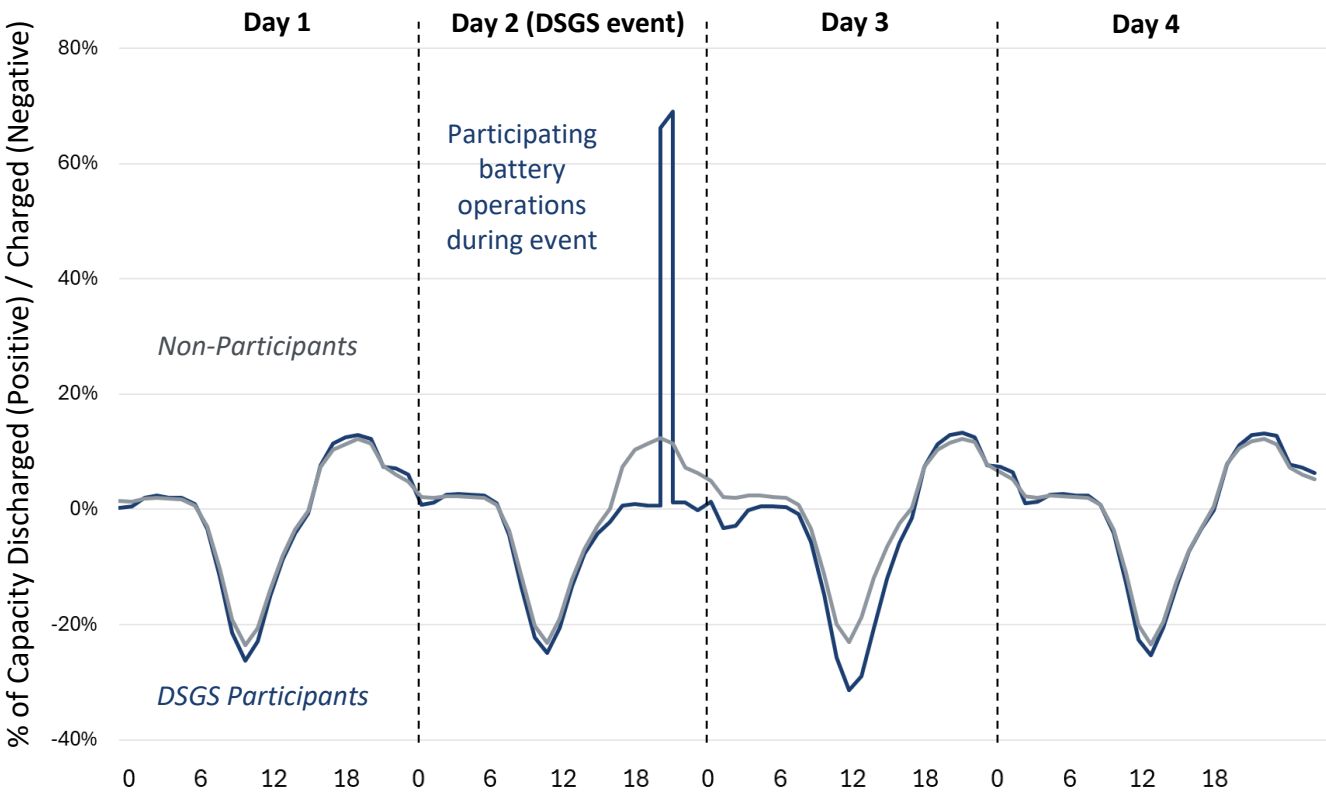
Incremental value

Our estimate of DSGS value is incremental to any value the assets would contribute without program enrollment.

Without enrollment in DSGS, most batteries operate to maximize self-consumption of paired solar PV output and reduce electricity bills accordingly. The batteries also provide backup during power outages. This does not guarantee maximum dispatch of storage capacity when needed most by the power system. DSGS unlocks additional performance from batteries during events.

We only attribute capacity and energy benefits for dispatch beyond the naturally occurring baseline level of output. To do this, we apply the baseline reduction specified in the DSGS program guidelines (0.074 * kWh capacity), which implies baseline dispatch of ~17% of nameplate capacity for a 2.3-hour duration battery. Our analysis also assumes an additional 20% of nameplate capacity is reserved by the customer and does not participate in events.

Illustration of Battery Operations for DSGS Participants and Non-Participants (2024)



Notes: Telemetry data shown for June 26, 2024 through June 29, 2024 for Tesla Energy fleet. 7-9 pm on June 27, 2024 was a DSGS event. Figure has been updated since the initial report release (August 2025) due to updated processing of Tesla non-participant data.

Section IV

Potential Scale and Benefits

Forecasted growth

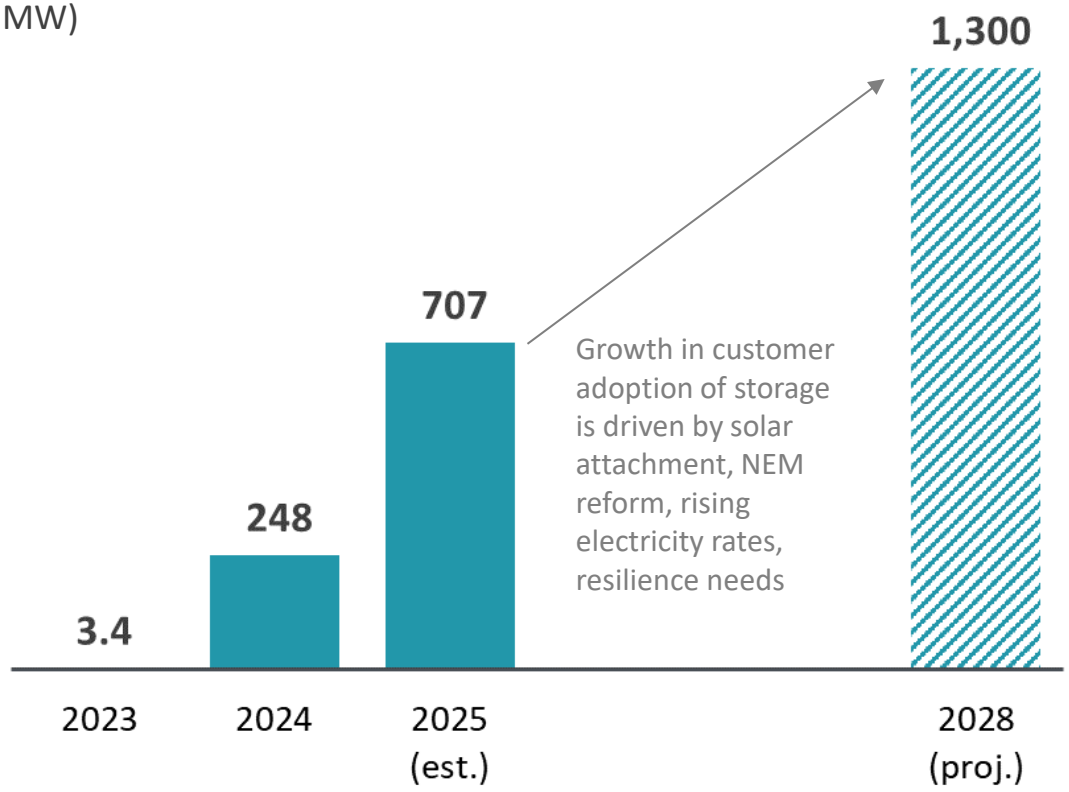
DSGS storage capacity has scaled quickly, and continued growth is expected.

Since Option 3 was introduced in 2023, enrolled capacity has grown to an estimated 700 MW. That is the equivalent of bringing online the capacity of a conventional gas plant in less than 3 years.

By 2028, we estimate that the program's enrolled capacity could reach 1,300 MW, representing continuation of recent growth and accounting for roughly half of the residential BTM storage capacity forecasted by the 2024 CEC IEPR mid-case.

Most currently deployed batteries were adopted for resilience or electricity bill management (i.e., paired with PV).

DSGS Battery Capacity, Option 3
(MW)



Notes: Historical (2023, 2024) capacity based on reported enrollments. 2025 enrolled capacity is as of July 2025 from Olivine. Final 2025 capacity will be available at the end of the program season. 2028 enrollment projections assume one half of residential forecasted distributed battery capacity participates in DSGS Option 3. Forecasted capacity based on the 2024 IEPR Storage Forecast mid-case adjusted with 2024 actual data and 2023 IEPR Storage Forecast residential share. All values reflect historical or estimated enrollment capacity that is further subject to program baseline and accreditation protocols.

Net benefits

DSGS can provide significant net cost savings to California, especially in a suddenly inflationary environment.

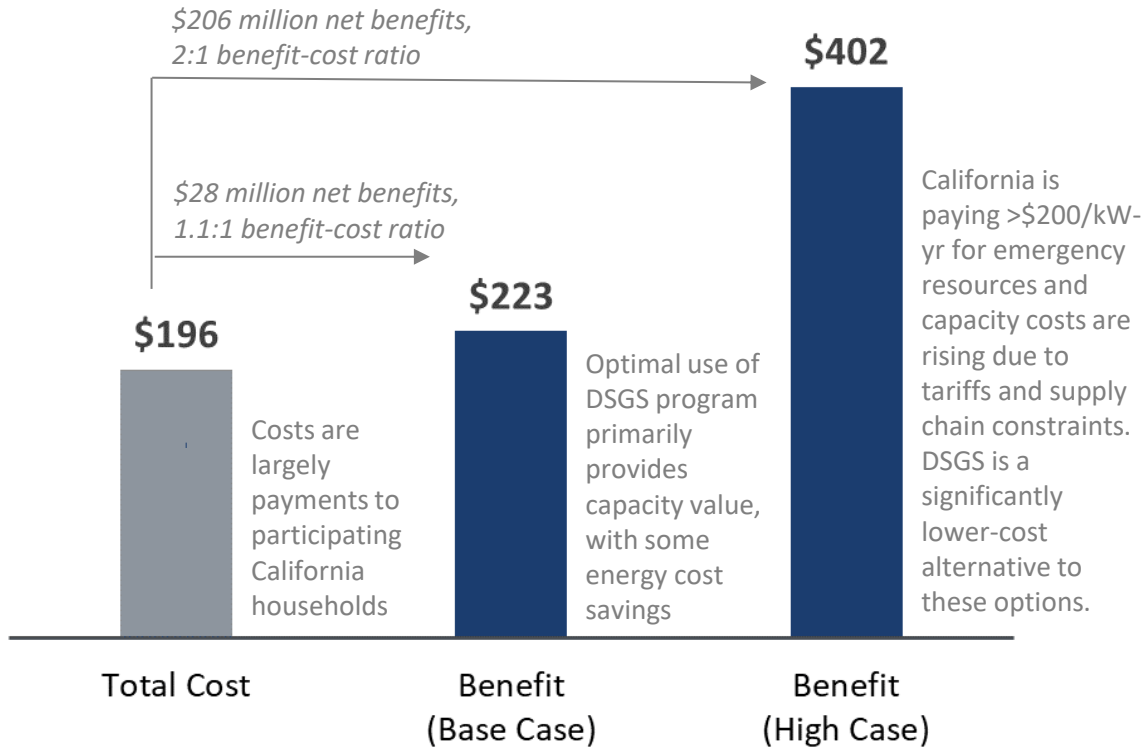
We estimate that the net present value (NPV) of benefits over the 2025-2028 study period could outweigh the costs over that same period by between 10% and 100%.

The result would be between $28 million and $206 million in net system cost savings (present value). The range depends on the future cost of capacity investment that the program avoids. Incorporating DSGS into California's resource planning initiatives will maximize this value.

These benefits are incremental to the baseline value that distributed storage assets contribute to the grid when not enrolled in a VPP program.

See appendix for additional detail on estimates of benefits and costs.

DSGS Benefit and Cost Estimate, 2025-2028
(Millions, Present Value)



Notes: Costs include performance payments and DSGS program administration costs. Benefits are the capacity and net energy value of DSGS batteries that are strictly incremental to their baseline cycling patterns (i.e., cycling patterns in the absence of a DSGS event). We assume batteries are dispatched in the highest priced 35 events per season. High case assumes more expensive capacity than the base case (see assumptions slides for further detail).

Section V

Proven Performance

July 29, 2025: A BTM battery test event

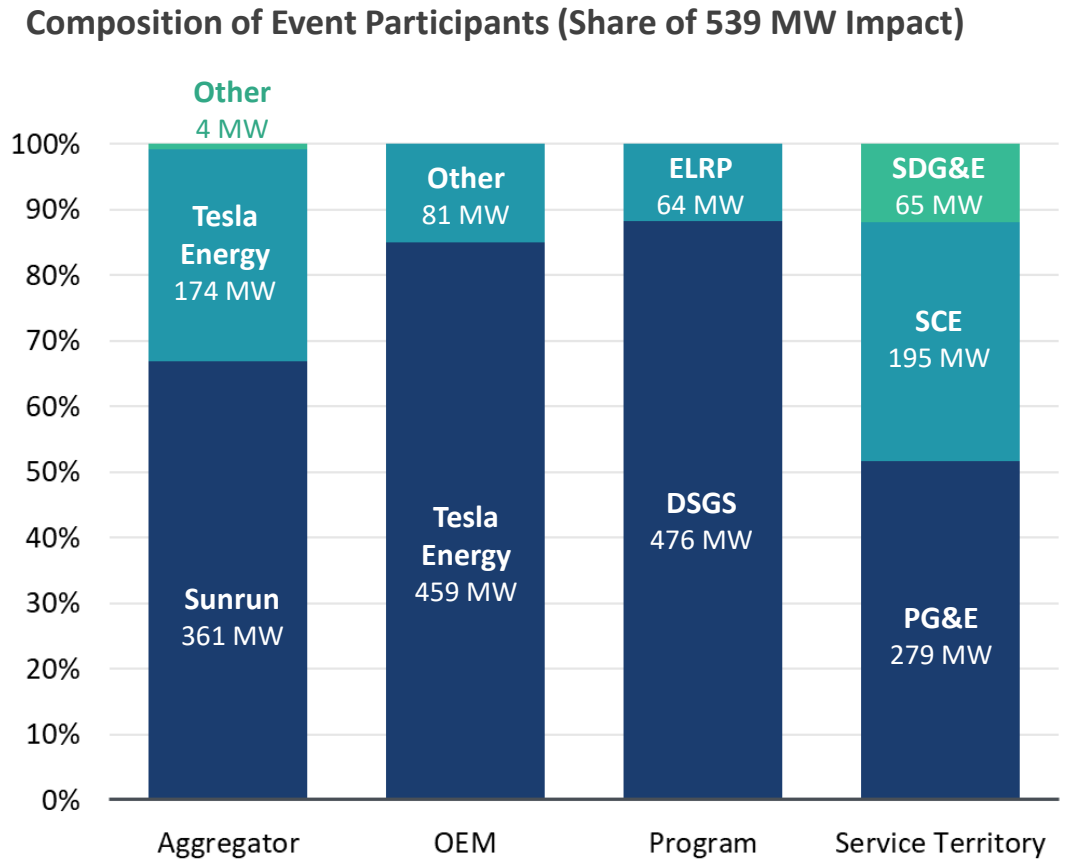
A recent VPP test event in California demonstrates the capability of BTM batteries to provide dependable capacity at scale.

On July 29, 2025, several aggregators in California discharged their portfolio of batteries between 7 and 9 pm, producing 539 MW of average output from more than 100,000 participants.

The aggregators conducted the event to assess the performance capability of their battery fleet heading into California's summer peak season, when the grid services will be needed most.

The participants accounted for a diverse mix of battery manufacturers, aggregators, virtual power plant (VPP) programs, and geographic locations. Sunrun was the largest aggregator, Tesla Energy was the largest OEM, and most of the batteries were enrolled in DSGS.

According to PG&E, "it was the largest test of its kind ever done in California—and maybe the world."



Notes: Based on Brattle analysis of 5-minute and 15-minute telemetry data provided Tesla Energy and Sunrun, respectively. Percentages indicate share of 539 MW impact. ELRP = Emergency Load Reduction Program, OEM = Original Equipment Manufacturer. Values may not add to total due to rounding.

Battery fleet operational profile

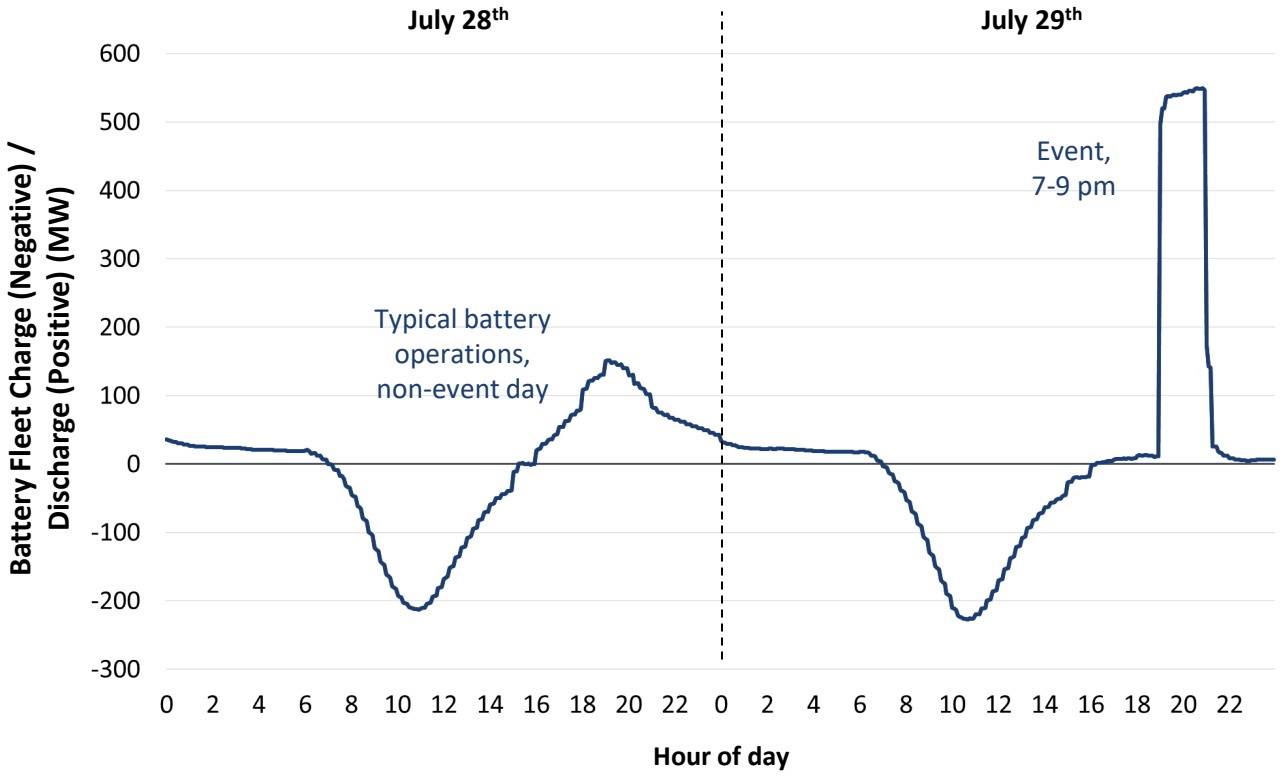
Aggregate performance during the event was persistent and mostly additive to status quo operations.

The figure at right compares the operation of the batteries on the day before the event to their operation on the day of the event.

Battery performance during the event demonstrates a significant departure from status quo operations. In other words, most of the 539 MW of battery output was additive; it would not have occurred in the absence of calling an event.

Additionally, the figure illustrates relatively consistent output from the batteries for the duration of the event, without significant fluctuations or any performance attrition.

Battery Operations Before and During the Event



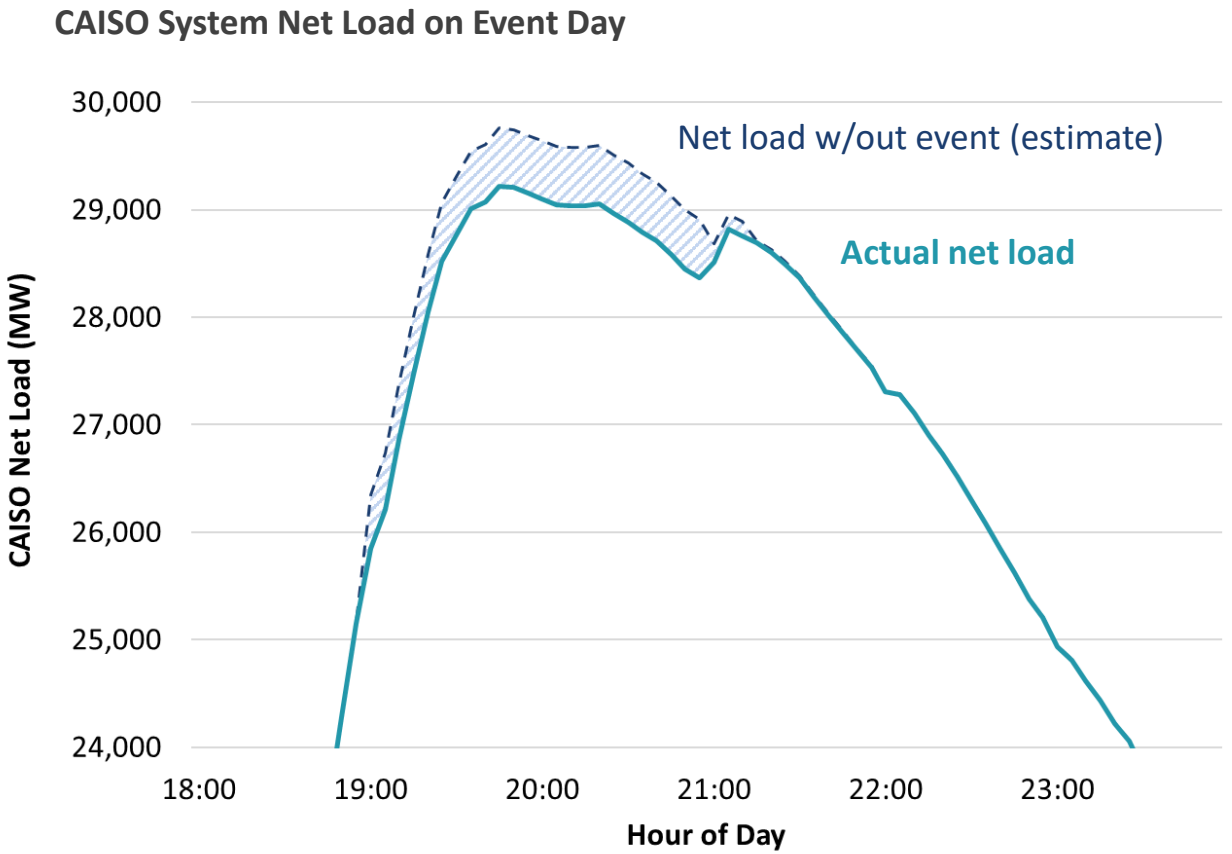
Notes: Based on Brattle analysis of 5-minute and 15-minute telemetry data provided Tesla Energy and Sunrun, respectively. Battery dispatch is raw power output, without any baseline adjustments.

CAISO system impact

The battery fleet operated during CAISO's net system peak, the time when output typically is most valuable to the system.

The timing of the event coincided with CAISO's net peak demand (i.e., load minus wind and solar generation) on the event day. There was a visible reduction in net load, with the average reduction of 539 MW representing roughly 1.9% of CAISO's net peak demand during the event.

The test event illustrates how, on peak days, using BTM batteries to serve CAISO's net peak could reduce the need to invest in new generation capacity and/or relieve strain on the system associated with the evening load ramp. In other words, the batteries could help to mitigate some of the challenges associated with California's "duck curve".



Notes: Net load sourced from CAISO and reflects actual demand less solar and wind output. Baseline net load in the absence of the event was constructed using 5-minute and 15-minute telemetry data provided Tesla Energy and Sunrun, respectively. All battery output is shown as a reduction in net load, including exports to the grid.

Section VI
Conclusion

CONCLUSION

Moving forward with DSGS

If continued, the DSGS program is likely to grow significantly, further improving energy affordability and reliability for Californians.

Batteries participating in DSGS have scaled to the equivalent capacity of a large natural gas plant over only the past three years. Over the next three years, that DSGS battery capacity could double, providing over 1 GW of fast, reliable performance to the California power system.

Like much of the U.S., the cost of electricity in California is rising. Expensive generation capacity options driven by supply chain constraints and an uncertain cost environment underscore the need for cost-effective resources. Our analysis has shown that DSGS likely will cost significantly less than alternatives.

FUTURE OPPORTUNITIES

Optimized program design and coordination with system operators could maximize the value of DSGS and increase the likelihood that the benefits identified in this study are fully realized. Potential opportunities to enhance the performance and associated value of the DSGS program include:

- Increase flexibility in the event trigger. For example, the trigger could be based on net load or a price threshold lower than $200/MWh. This would allow CAISO to rely on distributed batteries in additional hours as needed, while still maintaining high quality of service to participants.
- Incorporate DSGS capacity into resource planning initiatives. This would ensure that DSGS is more fully “competing” with alternatives and offsetting investment in higher cost resources.
- Optimize battery output patterns. Batteries are highly flexible resources. Coordination with CAISO could allow battery output to be “shaped” on an hourly or sub-hourly basis to further enhance system value.

Appendix
Additional Detail

Program valuation assumptions

Value Category	Description	Methodology and Sources
Energy value	During DSGS events, batteries reduce system operational costs by concentrating dispatch in high stress hours on the power system – which provides more targeted system value than their daily cycling patterns.	Historical energy prices from each IOU DLAP zone for 2022-2024. DSGS program events assumed to be called on the 35 highest price days during the May-October season. We model 2-hr events in the highest 70 priced hours from 4pm to 9pm per season. We do not restrict program events to hours with prices above $200/MWh to illustrate the value the program can provide if dispatch were adjusted to maximize value. We reflect the net energy value after adjusting for charging costs. All batteries are assumed to have 20% storage reserve levels.
Value of increased battery adoption	The availability of DSGS participation payments motivates customers to install battery storage that would not have otherwise in the absence of the program. We account for the daily energy value that these batteries provide to the system on non-DSGS event days (based on natural charge/discharge patterns) as a program benefit.	Recent Tesla Energy statistical analysis of battery VPP program participation found that 16% more customers would adopt distributed storage with the availability of DSGS-level compensation. Tesla Energy conducted a regression analysis relating program compensation levels and uplifted adoption. We account for this incremental, DSGS-specific value with daily battery cycling data from Sunrun and Tesla Energy 2024 fleets on non-DSGS event days.
Capacity value	Batteries enrolled in DSGS provide crucial emergency capacity value required to meet system needs outside of standard reserve margin planning criteria. DSGS batteries replace the need for additional investments in emergency resources or could reduce the cost of standard capacity additions if incorporated into California resource planning initiatives.	We model a base ($108/kW-yr) and high estimate ($215/kW-yr) for capacity value. The base estimate is consistent with recent California RA contract prices from the CPUC's 2022 RA Report (published May 2024). The high value represents potential increases in capacity costs due to supply chain constraints and growing demand and is consistent with recent estimates of California's alternative emergency program costs (e.g., DWR ESSRP). We assume a 60% ELCC value when estimating capacity benefits (generally consistent with energy limited resources in the CA 2021 ELCC Study) with an additional DSGS accreditation adjustment based on the baseline-adjusted available capacity calculated over a price weighted average of DSGS event hours (77%).
Baseline treatment	Our estimated system benefits (energy and capacity) are incremental to (i.e., exclusive of) the benefits provided from "normal" cycling patterns (i.e., charging/discharging patterns in the absence of the program).	We apply baseline adjustments to energy and capacity value. We apply the baseline to all batteries (even though stationary export-only assets are exempt currently) to account for the fundamental incremental value attributable to the DSGS program. We assume all batteries are residential and apply a 0.074 * nameplate capacity (kWh) reduction in all dispatch hours from DSGS guidelines. We apply a consistent baseline adjustment to the charging costs. All participating batteries are assumed have an energy ratio of 1 kW|2.3 kWh (i.e., 2.3-hour duration).
Program administration costs	CEC and third-party program administrative costs incurred to operate the DSGS program.	Total 2022-2024 DSGS program administrative costs for all options, excluding incentive payments total ~$5 million. We allocate Option 3 cost contributions proportionally based on the share of annual enrolled MWs for the 2022, 2023, and 2024 program years. We assume historical administrative costs scale linearly with program growth in future years. This is a conservative assumption that may decline due to efficiencies of scale.
Customer performance payment	Annual performance payment for DSGS Option 3 participation	All modeled batteries are assumed to register as 2-hour assets and earn payments of $62.10/kW with 30% bonus sourced from Olivine. Bonus assumed to no longer be available beginning with the Summer 2027 program year.

APPENDIX

DSGS benefit and cost estimates

The value of DSGS grid services outweigh the operational costs of the program at ratio of 1.1x to 2x.

Customer performance payments make up the majority of program costs. The streamlined statewide administration of DSGS enables cost efficiencies.

Capacity value is the largest benefit stream. We test the sensitivity of our findings with two capacity estimates. The lower estimate values DSGS as a replacement for standard capacity costs based on 2022 resource adequacy contract prices. The higher estimate values capacity at other CAISO emergency program per kW costs and is consistent with a significant upward trend in resource costs that has occurred since 2022. The other benefit streams remain the same across the cases.

DSGS Benefit and Cost Estimates ($2025 NPV, 2025-2028)

Value Stream	Base Case ($M)	High Case ($M)
Program administration cost	$18	$18
Performance payment cost	$178	$178
Total costs	**$196**	**$196**
Adoption value	$3	$3
Energy value	$38	$38
Capacity value	$182	$360
Total benefits	**$223**	**$402**
Total net benefits	**$28**	**$206**
Benefit-cost ratio	**1.1**	**2.0**

APPENDIX

California's emergency capacity programs

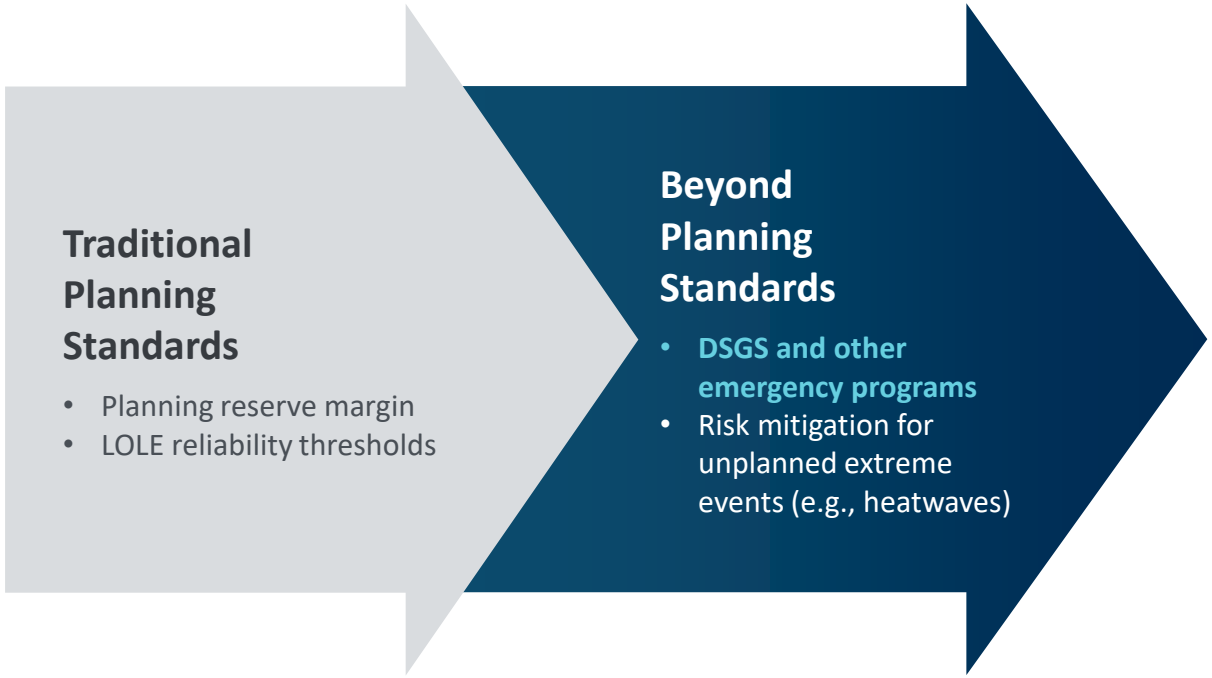
There is precedent for large power emergency programs in California.

In its current form, DSGS exists primarily as an insurance policy to prevent power grid emergencies and reduce costs.

Several other such emergency programs exist as well. Those include Emergency Load Reduction Program (ELRP), the DWR Electricity Supply Strategic Reliability Reserve Program, and thermal plant retirement extensions, which together represent more than 4,000 MW of emergency capacity.

Bulk thermal resources in the DWR Electric Supply Strategic Reliability Reserve Program contribute the majority (3,000 MW) of California's contingency resources. DSGS is the second largest contributor – and driving growth in clean reliable capacity. In this regard, DSGS is currently one important element of a broader portfolio of options for keeping the lights on when supply-demand conditions are strained.

Role of Emergency Programs in California



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