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Californians saved the grid again. They should be paid more for it

Smart thermostats, solar-charged batteries, EVs and other household devices can shore up the stressed grid. Why isn't the state going all in on incentives?

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(Marcela Gara, Resource Media)

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Last week, for the second time in three years, California's power grid was strained to the limit by record-high demand in the midst of a searing heat wave. But just like they did during the state's grid emergencies of 2020, California consumers came to the rescue.

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At around 5:45 p.m. on September 6, as state grid operator CAISO was preparing to initiate rolling blackouts to stave off grid collapse, the California Governor's Office of Emergency Services issued a statewide text message alert asking people to "conserve energy now to protect public health and safety." Over the next half an hour or so, demand dropped more than 2,000 megawatts below its record-setting peak of just over 52,000 megawatts.

This "demand-response event" — the utility industry term for asking customers to reduce power use to help the grid — "made an enormous difference in our efforts to keep the power flowing, and I cannot thank the public enough," CAISO CEO Elliot Mainzer said the day after in a video update.

This and other similar experiences during summer heat waves in Texas this year and in New York City last year demonstrate that consumers are capable of reducing their household loads to help shore up beleaguered power systems. For millions of residents, this means setting their thermostats to reduce air conditioning or heating loads or turning off appliances and lights. For big power customers, it means shifting when they run refrigeration systems, water pumps or industrial processes.

But in markets such as California, a growing number of consumers are participating in demand-response events in more technologically sophisticated ways, for example, by putting to use batteries that charge up with rooftop solar during the day and discharge power during post-solar peaks, or with electric vehicles that they wait to charge until after those peaks fade.

The number of these types of "demand-side systems" is projected to grow to the multi-gigawatt scale in the next few years. That represents gigawatts of flexible grid load, available to shift power use away from times when rolling blackouts loom or to inject stored power back onto the grid when it's needed.

But very few of the owners of these devices are earning money today for their contributions to the grid — certainly not compared to the fossil-gas-fired power plants, utility-scale solar and battery systems and out-of-state electricity importers that sold power for the high price of $1,000 per megawatt-hour in California during the peak of last week's emergency.

By failing to pay people for the services their distributed energy resources can provide, the state risks seeing a valuable set of demand-side resources fail to show up when the grid could use it — and spending far more money than might otherwise be needed on imported power and utility-scale infrastructure to make up the difference.

Treating these demand-side energy resources as something that's only tapped during grid emergencies is fundamentally flawed, advocates say, as is relying on the voluntary, altruistic actions of millions of consumers when those emergencies strike.

Mainzer acknowledged as much at a Thursday press conference, calling California's emergency text alert, which came after a week of less-urgent CAISO "Flex Alerts" asking state residents to voluntarily reduce power use, "a tool of last resort."

CAISO's actual and forecasted demand for Sept. 6, when emergency text alerts led to a 2,000-megawatt decrease in electricity use (CAISO)

Instead, "California is embarking on a more rigorous and sophisticated approach to demand response," he said, one in which "utilities and customers will see much more of an automated response," and customers are "engaged in programs where they're actually compensated for reducing their consumption."

That's good news for advocates of demand-response systems, but it will require significant reform of the current system of rules and regulations, starting with making sure customers' contributions to the grid are accurately recorded.

"Every time one of these [events] happens, it's flexible load and demand response that saves us," said V. John White, executive director of the nonprofit Center for Energy Efficiency and Renewable Technology. "[But] we don't want to pay them! That's the missing ingredient."

Demand-response systems as the rule, not the exception

Demand-response programs have been around for decades, but they've evolved far beyond old-school methods, such as when utilities would call up factories to ask them to turn off production lines or use one-way pager networks to trigger load switches that could turn off home air conditioners.

Today, two-way wireless and broadband communications and machine-learning-informed digital controls are enabling "virtual power plants" — a combination of technologies installed in homes, stores, office buildings, factories, farms and other utility customer sites that can mimic the responsiveness and impact of power plants in helping to balance the grid.

Smart thermostats alone can deliver load reductions of about a kilowatt per home, which can add up to hundreds of megawatts at scale. Those provided by Google Nest cut roughly 75 megawatts of power use during last week's grid emergency, according to Aaron Berndt, head of energy industry partnerships at Google. Ecobee, the smart thermostat company acquired by Generac last year, has more than 50,000 thermostats voluntarily enrolled in eight utility programs that responded to 37 demand-response events across the state during the emergency, Tami Kou, Generac's director of marketing communications and public relations, said in an email. And San Francisco–based startup OhmConnect has about 200,000 customers in California participating in CAISO's energy markets, offering the potential of up to hundreds of megawatt-hours of load reduction per year.

Other companies that manage virtual power plants are tapping a much wider array of devices to ease demand on the grid. Leap, a startup that manages a 77-megawatt portfolio of more than 21,000 devices including EV chargers, smart thermostats, building management systems, batteries and water pumps for customers across the state, was able to shave about 1,000 megawatt-hours of power between August 31 and September 8, according to Caroline Thompson, the company's marketing manager. Enel X, another demand-response provider, deployed its portfolio of 100 megawatts of commercial and industrial sites and EV chargers across the state, said Molly Jerrard, senior director of energy markets.

These virtual power plants can also include behind-the-meter batteries, charged by the rooftop solar power that floods California's grid throughout the day, then discharging during hours of peak demand to reduce the use of power in buildings or even to send electrons back to the grid. Solar and battery vendors Tesla and Sunrun have reported tapping this capacity among participating customers to marshal more than 100 megawatts of peak-reducing capacity over the past month.

This is likely an undercount of the grid capacity value already being supplied by behind-the-meter battery systems from companies such as Swell Energy, sonnen, Sunnova, Stem, Enel X and others, according to the California Solar and Storage Association. The trade group estimates that more than 81,000 customer-sited batteries connected to the state's grid are likely delivering up to three times as much grid demand reduction than estimated even if they're not being actively called on to do so, simply by storing and discharging solar power to save money under the state's time-of-use electricity rate structures.

Eventually, these virtual power plants will also include the millions of electric vehicles called for by California policy. Research firm Wood Mackenzie estimates that charging EVs will add up to 11.5 gigawatts of electricity demand in California by 2025. That power draw will add major burdens to the grid unless charging sessions are scheduled to soak up cheap overnight energy or ample midday solar power and then sit idle during grid peaks — or, potentially, send battery power back to the grid when needed.

All of this offers significant money-saving potential for utilities and their customers. Tapping the latent flexibility of technologies that are already being installed in increasing volumes by California residents means not having to invest as much in building larger-scale alternatives such as power plants or batteries that are only active during relatively rare but dangerous grid emergencies. A 2020 report from Lawrence Berkeley National Laboratory found that smarter utilization of demand-side resources could replace the need for billions of dollars' worth of batteries and other utility-scale resources.

But today, demand-side resources are being paid a fraction of what "supply-side resources" such as power plants and solar and battery farms are earning, if they're being paid at all, said White, CEO of the Center for Energy Efficiency and Renewable Technology. That's because California's energy policy still hasn't been able to properly assess and reward the value that customers are already providing to the grid, he added.

When grid emergencies are "right on our doorstep and we have to run the diesel generators, we pay them well," White said. Governor Gavin Newsom's emergency order that enabled last week's mass energy-saving alerts also temporarily freed power plants and backup generators to ignore air and water regulations, and the state's budget passed last month contains billions of dollars for a "strategic reserve" of mostly fossil-fuel-fired generation resources for emergency use.

"We have not institutionalized the practice of making flexible load something we want to pay for," he said.

Why demand-response providers think California's system isn't working

That argument has been made repeatedly by demand-response companies such as OhmConnect, Leap, Nest, Enel X, CPower and Voltus in filing after filing with the California Public Utilities Commission, which sets the rules for the state's demand-response programs.

Over the past decade or so, these companies say, the CPUC has undergone several policy shifts that, while meant to make demand response more valuable to the grid, have actually made it harder for it to thrive.

"We've been working on demand-response policy, and stuck in this same conundrum, for almost nine years," said Jennifer Chamberlin, CPower's executive director of market development.

Over that time, California has seen the load-reduction capacity in demand-response programs actually decrease, from about 2,000 megawatts in 2015 to about 1,600 megawatts today.

That stagnation in demand response has left the state more reliant on customers to cut power for free than on programs that secure their response via payment. Mark Rothleder, CAISO's chief operating officer, said in an August hearing in the California legislature that the roughly 1,600 megawatts enrolled in paying demand response programs have been matched by up to twice as much load reduction from "additional conservation and relief" during grid emergencies in 2020 and 2021.

Companies that enlist customers in demand-response programs say that this decline in participation is largely due to increasingly complex rules, along with structures that have increased the risks of customers not earning money for good-faith efforts to shed load when they're asked to.

Seth Frader-Thompson, CEO of EnergyHub, which manages demand-response programs for utilities across the country, said that this complexity is holding California back compared to other states. California "arguably has the highest number of [distributed energy resources] behind the meter," he said, but is lagging behind other states such as Arizona in enrolling them in utility demand-response programs. This is a result of how California policy dictates that distributed energy programs must be set up and "overly strict rules making program enrollment too complex."

CPower's commercial and industrial customers across California have been delivering about 70 megawatts of load reduction over the course of the past two weeks, Chamberlin said. But the company doesn't "know if our customers will be fairly compensated" for that effort, she added, because it will take months to get much of the data needed to calculate their actual performance from utilities' metering systems.

Even then, just how that meter data will be translated into performance payments will depend on how regulators determine what it's worth. One big problem on this front is the state's structures for creating "baselines" to calculate demand-response performance — in essence, predicting how much electricity customers would have used if they hadn't acted to reduce load.

Without careful adjustment, these baselining methodologies may indicate that customers who reduce their power use significantly on hot days actually failed to perform, because they're being compared to days before the heat struck when their power use was much lower.

Demand-response providers say they were spurned during the state's grid emergency in August 2020 when hundreds of megawatts of demand-side resources helped prevent rolling blackouts, but many companies were not credited for it because of these baselining issues.

OhmConnect reported that it lost hundreds of thousands of dollars that month, when the state was forced to institute rolling blackouts for the first time in two decades, as shown in the chart below.

A chart of OhmConnect customers' average load reduction versus CAISO's adjusted baselines for measuring their contribution to helping the grid. (OhmConnect)

Since the 2020 heat wave, state regulators have added more significant weather adjustments aimed at correcting this problem, Chamberlin said. "But we haven't seen major heat events" between then and last week's heat wave, she said, which means that demand-response providers aren't yet sure how the new rules will measure their performance over last week's heat emergencies.

In a September 6 tweet, OhmConnect CEO Cisco DeVries described an almost identical situation evolving for this year's heat wave. OhmConnect once again called on every customer to save energy at 6 p.m., despite the likelihood that they wouldn't be compensated for the load reduction that could achieve, according to DeVries.

@ohmconnect did a full system dispatch of EVERY user we have at 6pm. We are even paying customers that we can't get paid for through CAISO or CPUC. We will lose a LOT of money today, but it will be worth it if we help avoid blackouts.
— Cisco DeVries (@ciscodv) September 7, 2022

This baselining problem also makes it hard for the state's demand-response programs to keep up with the shift in technologies that are now available for helping the grid. Solar systems paired with batteries still can't earn money for power they export to the grid, for instance. And customers that take steps to permanently shift their power use away from times when the grid tends to be under the most stress — typically late afternoons and evenings during the hot months of August and September — end up eroding the baselines that determine how much they're paid for reducing power use.

The pros and cons of the Emergency Load Reduction Program

Ironically, OhmConnect's latest woes are based not just on longstanding problems with how demand response is valued, but also on the state's most aggressive effort to reform demand response since the 2020 grid crisis. Last year, the CPUC launched the Emergency Load Reduction Program (ELRP) to offer $1 per kilowatt-hour of load reduction — a price equivalent to the highest prices on CAISO's wholesale energy markets, and much higher than the incentives available under the state's other demand-response programs.

Governor Gavin Newsom later issued a series of emergency orders that, among other steps, increased ELRP compensation to $2 per kilowatt-hour. CAISO COO Mark Rothleder said last month that the program "has been adding at least 800 megawatts to the existing demand-response capability" during peak events.

ELRP is also one of the few demand-response programs that allows behind-the-meter batteries to be paid for the power they inject to the grid as well as for reducing building loads. That's allowed Tesla's new virtual power plant, which launched last year as a voluntary effort available to Powerwall-owning customers, to pay participants this year.

But ELRP has some big problems, demand-response companies and advocates say. For one, it doesn't offer set payments for companies that sign up customers to commit to it. These advance payment structures are a common feature of demand-response programs in other parts of the country, and they give companies and customers incentives to commit to them well ahead of when they can expect to actually be paid for reducing load.

Customers and companies are looking for programs that can set payments in advance for the capacity demand response providers are offering, or promise a certain minimum number of dispatch hours to provide more certainty of future value, said Kate Unger, California Solar and Storage Association senior policy advisor. "Emergency-only programs and short-term pilots don't provide the revenue certainty for companies to scale."

Second, ELRP came with complicated rules that exclude resources that are part of other demand-response programs — rules that third-party demand-response companies say have given utility-operated programs an advantage over their own. In particular, utility-administered ELRPs are triggered when CAISO calls a Flex Alert, while third-party-administered ELRPs are not, which has "created confusion and an uneven playing field," said Andrew Hoffman, Leap's chief development officer.

Third, ELRP sets limits on payments to demand-side resources that are enlisted in other grid relief programs. Nick Chaset, CEO of East Bay Community Energy, one of the state's growing number of community choice aggregators, pointed out that this has barred ELRP payments for the batteries deployed at nearly 1,000 homes as part of its 20-megawatt solar-plus-battery contract with Sunrun, which it dispatched during last week's grid emergency.

"There are some things we have great concern about" in terms of how ELRP is designed, Chaset said. But right now, "this is about the health and safety of our customers and all Californians."

Still, it would be helpful if customers could be incentivized to adjust how they use their thermostats or solar-plus-battery systems to maximize their grid value — particularly if it could lead to significant improvements in grid stability from relatively minor changes.

Sunrun, for example, has tracked roughly 80 megawatts of battery-stored solar energy from about 17,500 of its California customers that's now available to reduce load on California's grid. Almost all of that stored power is being discharged between 4 and 9 p.m., the hours when utility time-of-use rates make reducing consumption more valuable, said Nick Smallwood, Sunrun's senior vice president of product and strategic development.

By asking those customers to agree to a relatively simple adjustment to their battery settings, Sunrun has ensured that those battery discharges don't happen between 4 and 6 p.m., when the grid is still relatively stable, but instead between 6 and 9 p.m., when the state's solar power fades away and grid supplies are nearing their limits.

"We're doing it because we know it's going to be more beneficial for the grid, not because there's an incentive structure," Smallwood said. Only a handful of Sunrun's customers have access to ELRP payments, and the majority earn nothing from making that shift.

“We’ll keep on doing it,” he said. “But that’s not a good setup. You can’t just expect people to behave like that. And it’s not the best way to coordinate responses to match needs.”

Why it’s so hard for California to make progress on demand response

Yet another problem with ELRP is that it doesn’t address the more fundamental reforms needed in the state’s demand-response regimes, CPower’s Chamberlin said. “What we have not done in a meaningful way is to make it simple for demand response to be part of the market and resource stack,” she said. Instead, California’s system is far more complex and cumbersome than demand-response structures in other parts of the country, she added.

Some of the biggest issues lie in the complex and ever-changing nature of California’s resource-adequacy program, she said. “Resource adequacy” is California’s method of securing the resources it forecasts it will need to maintain grid reliability in future years. It’s the chief way that non-utility demand-response providers can secure a guarantee that they will be paid for load reductions they haven’t yet delivered.

But under California’s system, demand-response aggregators may need to wait for years after they’ve secured new customers before they’re allowed to count them as available for resource adequacy. And with state regulators in the midst of a highly complicated and contentious process to reform the program, aggregators don’t know how the rules that determine their value will change from one year to the next.

In a February 2022 report, the California Energy Commission made clear just how difficult it will be to achieve significant demand-response reforms while the state’s resource-adequacy framework is still in flux. CEC staff laid out two options for addressing this issue.

One would be to continue to try to make the existing structures work more efficiently. The other — a proposal from the California Efficiency + Demand Management Council, a group representing demand-response providers — was to move to an “incentive-based” approach like the capacity market structures used by Eastern U.S. grid operators such as PJM and the New York Independent System Operator.

Demand response plays a much more significant role in those markets than it has in California to date, largely due to their much simpler structures, Chamberlin said. “The demand-response provider is responsible for ensuring the resource is there” and posts financial collateral to the market as insurance against failing to show up and perform, she explained. Then the company either meets its promised targets when called upon or is penalized.

To be clear, the structures of these centralized capacity markets are better suited to simplified compensation models like these, compared to California's resource-adequacy framework. California requires individual investor-owned utilities, community choice aggregators and retail electricity providers to secure their own future capacity through bilateral contracts with generators, demand-response providers and other resources — a picture that's been further complicated by recent decisions that have centralized some, but not all, of this responsibility with the state's two biggest utilities.

But the primary barrier to simplifying California's treatment of demand response has been regulators' and utilities' reluctance to endorse a system that leaves so much in the hands of third-party aggregators, she said.

This reluctance mostly stems from the fear that demand response may not perform as well as aggregators claim and that the state needs more certainty before it can rely on them. A 2020 state agency report on grid failures that year presented data that appeared to indicate that some demand-response resources failed to provide the load reduction that they had promised they'd be able to deliver.

"That demand-response capability needs to be something we can measure or accurately forecast how much it would be expected to reduce demand under different conditions when needed," CAISO's Rothleder said in his August testimony to state lawmakers.

These concerns over claims of future performance versus real-world results have stymied the development of the Demand Response Auction Mechanism, once seen as the centerpiece of transforming the state's demand-response market, Chamberlin said. The budget for that program has been curtailed over the past three years, with no more than 200 megawatts of resources able to win contracts, and the state's utilities have proposed shutting it down after 2023.

But demand-response companies have long argued that the flaws in how California regulators measure the value of demand-side resources are something of a self-fulfilling prophecy. In essence, they say, rules and methods that undercount demand response's contribution to the grid feed into preconceptions that it can't be relied on.

"We've made it too hard because of an inherent suspicion on the part of staff at the CPUC," White said. "They don't trust it."

But neither is it clear that utilities and regulators should trust the fossil gas power plants that provide peak power or, through inaction, allow them to continue to suck up the financial rewards of being the primary resource for when the grid is near its breaking point, he said. Summer heat waves in California, Texas and elsewhere have seen some of these plants forced to shut down or curtail production because of heat-related problems.

Even when they do run, these peaker plants don't represent the best use of the money paid to keep them running, Sunrun's Smallwood said. "They are paid to be on standby and are never used 99 percent of the time, and they get paid very high energy prices when they are dispatched," he said. "If one-tenth of that support and payments could go to use the assets that are already in place — clean energy, solar-powered batteries, with customers who have resiliency needs — it would be a win-win for everyone."

How California can design smarter demand-response incentives

California's poor track record on demand-response policy reform doesn't bode well for those hoping that the status quo will improve quickly. But with heat waves giving customers multiple opportunities to show that they're capable of reducing power use in grid-saving ways, "this is the work we should be focused on between this summer and next summer, and the summer after that," White said.

Amisha Rai, managing director of the Advanced Energy Economy trade group, agreed."If we think more creatively and have the right signals in place for consumers — including incentives to take this sort of action — it could have a pretty dramatic impact."

The slew of energy legislation passed by California lawmakers last month could offer some opportunities for change, Rai noted. Much of the attention has been on the passage of a law that could allow Diablo Canyon, the state's last nuclear power plant, to stay open for at least five years past its planned 2025 shutdown. But several other budget items will "certainly expand California consumers' ability to participate in a more meaningful way with demand response," she said.

One of these is $900 million in funding for the California Energy Commission to incentivize solar-charged battery systems for homes. That program will be modeled on the Self-Generation Incentive Program, the state's premier policy for supporting the installation of behind-the-meter batteries. That's the same program that the California Solar and Storage Association says has made hundreds of megawatts of residential battery capacity available to help the grid during emergencies.

Another is the $295 million earmarked for the California Energy Commission's Demand Side Grid Support program. This newly created program tasks the CEC with creating demand-response-like structures that can be rolled out by municipal utilities, irrigation districts, community choice aggregators and other entities outside the state's big investor-owned utilities that provide electricity to customers.

That's an important expansion for a statewide demand-response regime that's largely been limited to CPUC-regulated utilities Pacific Gas & Electric, Southern California Edison and San Diego Gas & Electric, OhmConnect's DeVries said. "We need a simple umbrella tool that allows anyone to participate."

Chamberlin noted that the CEC has more freedom than the California Public Utilities Commission to design rules that depart from what she called the "archaic" structures developed for investor-owned utility demand-side programs. One of the more promising options would allow the program to commit to paying customers for the megawatts of load reduction they've committed to providing in future periods, something that the Emergency Load Reduction Program can't do.

East Bay Community Energy's Chaset highlighted the potential for the Demand Side Grid Support program to take a crack at another problem with today's demand response structures: their emphasis on only kicking in during emergencies.

He's hoping the California Energy Commission will allow community choice aggregators "to run programs that can deliver…emergency load reduction but also be much more integrated into wholesale markets," he said. In other words, rather than focus on paying customers lots of money to avert emergencies, it might be a good idea to pay them less money more often to change how they're consuming electricity in the first place to help prevent emergencies from happening.

OhmConnect COO Matt Duesterberg made this point in an August blog post after CAISO announced its first Flex Alert of the year. Because OhmConnect isn't eligible to participate in the Emergency Load Reduction Program, it wasn't able to receive compensation at that program's high prices on that day, he said, restricting the value for its customers to commit to participating. As a result, the company was able to achieve only 30 megawatt-hours of load reduction.

On the other hand, OhmConnect customers were active in the CAISO markets nearly every day in July and August, committing more than 400 megawatt-hours of load reduction over those two months.

This idea of making demand-side resources a standard part of how the grid operates every day is central to a number of innovative approaches being explored in California and around the country.

Some are trying to encourage people to shift energy use based not on how much power costs but on how clean it is compared to other times of the day, as with thermostat programs such as Google Nest's Renew offering, or EV charging programs being sponsored by community choice aggregators such as Silicon Valley Clean Energy.

Others are seeking to permanently shift electric loads away from peak grid times, as with Pacific Gas & Electric's Watter Saver pilot for electric water heaters that can store energy in the form of hot water, or the Market Access pilot program approved by the CPUC last year, which pays customers both for improving energy efficiency and for shifting power use away from times of peak demand.

OhmConnect's DeVries noted one paragraph in SB 846, the law that lays the groundwork for extending Diablo Canyon's operating life, that could enable the state to further embed this kind of load-shifting into how it manages energy policy. The language calls for the CEC, in consultation with other state agencies, to "adopt a goal for load-shifting to reduce net peak electrical demand" as part of the Integrated Energy Policy Report it produces every two years.

Among other significant energy policies that are set by the CEC's Integrated Energy Policy Report are the forecasts used by the CPUC to determine how much generation capacity individual utilities and community choice aggregators need to meet future energy demand. This new language sets load-shifting requirements into the scope of that work for the first time and puts "the CEC in charge of knocking down the regulatory barriers to unlocking it," DeVries said.

The next Integrated Energy Policy Report isn't due until 2023, and much work remains to be done to determine how the CEC might put this legislative mandate into action. But "if we make use of it properly, it's a way to elevate this and…look at this holistically across the whole state," he said.

CPower's Chamberlin said California regulators need to explore a number of longer-term options like these that can reward customers who help balance the grid. The alternative is to continue to ask customers to remain as committed to saving the grid by sacrificing their comfort and convenience as they've turned out to be so far. But it's unclear how long that goodwill might last. After all, "if we sent a text every day" like the one that startled Californians into saving the grid last week, Chamberlin said, "nobody would pay attention."

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