OPINION

Demand response is dead. Long live Flexiwatts!

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Demand Response is dead.

That's how the topic of Demand Response (DR) typically comes up in conversation. And let's be honest: That statement isn't entirely false. DR as we know it isn't sexy. It's not AI-enabled like storage. It can't be visibly installed on a rooftop like solar.

Instead, DR is an invisible negawatt, an unused unit of energy. For residential customers, it's turning off the air conditioner on a hot summer day when you'd much rather blast cool air inside your home. For large industrial customers, it's turning off a factory for four hours and halting productivity.

For most of us who consume energy, DR — turning off appliances in the middle of using them — is often irksome and sometimes extremely frustrating.

But that isn't what killed DR.

In fact, DR hasn't had it easy: In a landscape of grid evolution and innovation, market structures have predominantly inhibited DR growth due to outdated load shedding models. Difficulties in quantifying baseline consumption levels have guillotined DR, especially since incentivizing customers to shed load is based on reducing below a seemingly arbitrary setpoint. The result is an arcane model of DR that fails to provide flexibility.

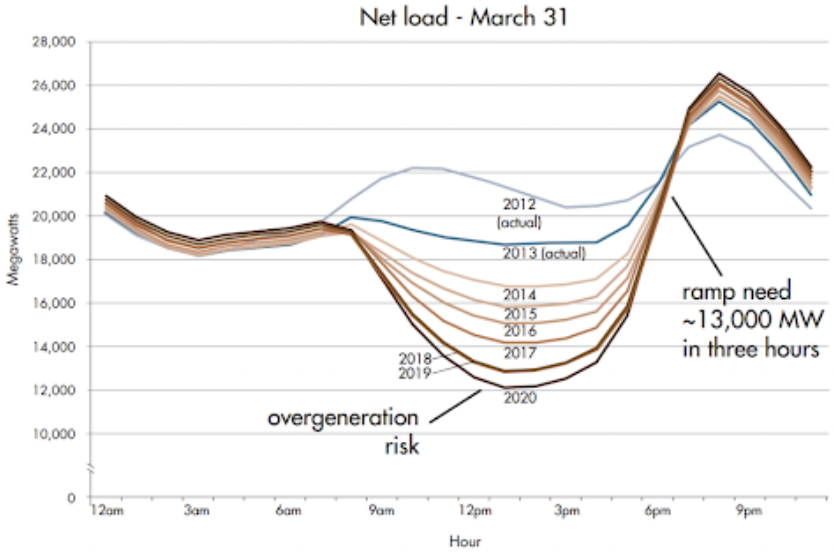
Rather than mourning DR's death, it's time to embrace the potential for transformation. As load shedding becomes passé, DR can evolve into Flexiwatts — its grid-of-the-future counterpart. Flexiwatts, a load-shifted megawatt of DR, incorporate demand flexibility and load adaptability in a time of smart, grid-connected devices.

Old school demand response

To date, DR has mostly been load shedding: curtailing energy usage during times of peak load to reduce stress on the system. When viewed through this lens, DR helps mitigate the risk of brownouts and blackouts by being available during grid-based emergencies.

Think about it in terms of California's infamous Duck Curve, which shows California's typical daily net load, meaning the difference between demand and supply of electricity. Many of us know the drill: As an abundance of renewables come online between now and 2020, solar and wind generation will exceed demand in the middle of the day (the "belly" around noon to 4:00 pm) and won't keep pace with demand from 4:00 to 9:00 pm (the "neck").

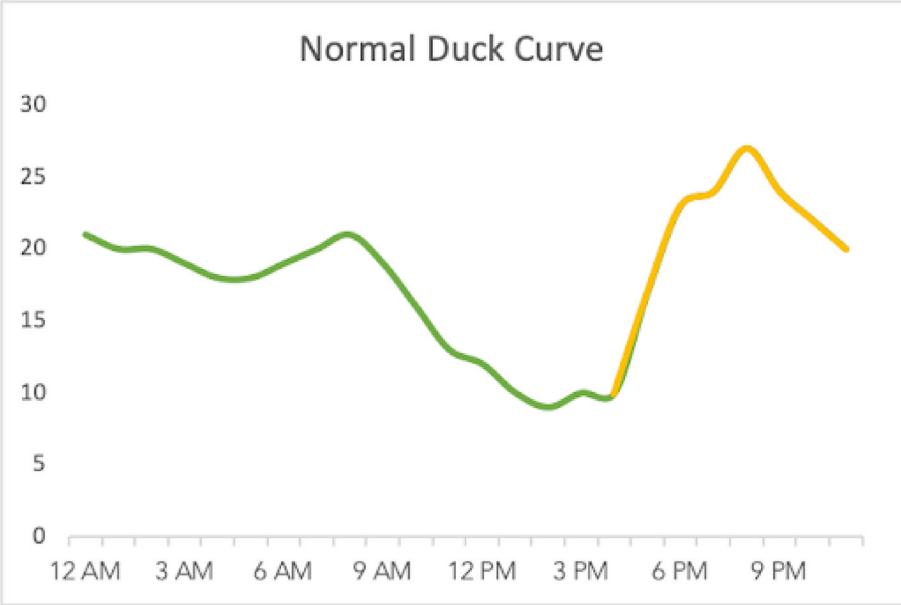
During the belly, load risks overgeneration, which would cause midday renewables curtailment. During the neck, on the other hand, utility managers, policymakers and grid operators argue that natural gas peakers are (and will continue to be) necessary to meet this steep ramping of net load starting.



California's Duck Curve highlights how net load will evolve with more renewable penetration on California's grid. Note the overgeneration risk in the middle of the day (which leads to renewables curtailment) and steep ramp in the late afternoon (which leads to natural gas peakers coming online). Credit: National Renewable Energy Laboratory

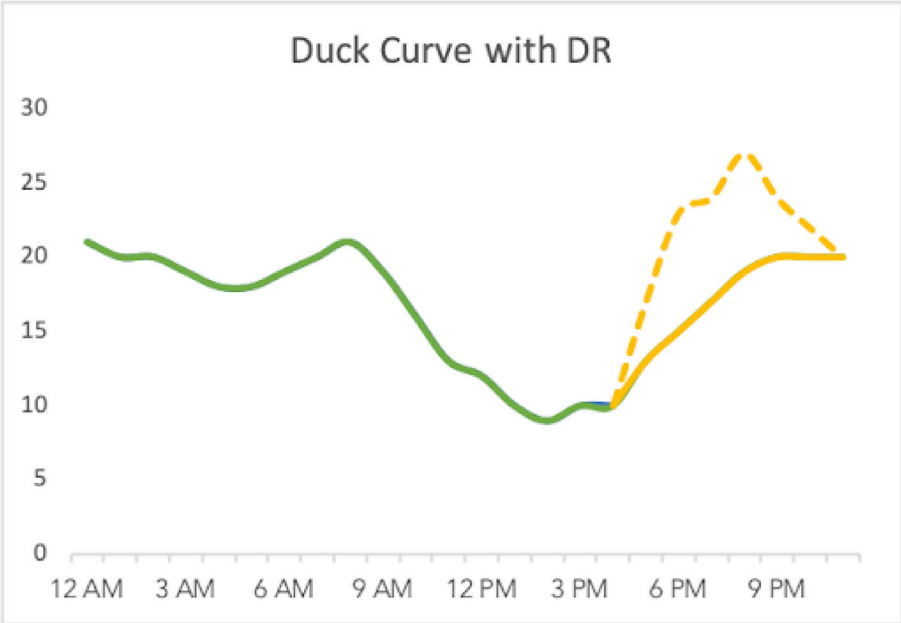
Under California's 100% clean energy targets, natural gas peaker plants need to start being phased out. Traditional DR complements these peaker plants by reducing demand during the neck and thus mitigating the need for natural gas.

DR essentially takes the neck of the duck and makes it go from this:



Duck Curve seen today with the neck of the Duck highlighted in yellow.

To this:



Again, the neck of the Duck highlighted in yellow. The dashed line represents net load without DR; the solid line highlights the potential net load after shedding.

While this type of load-shedding resource is valuable, it's only one-quarter of what DR can offer.

Shift vs. Shed

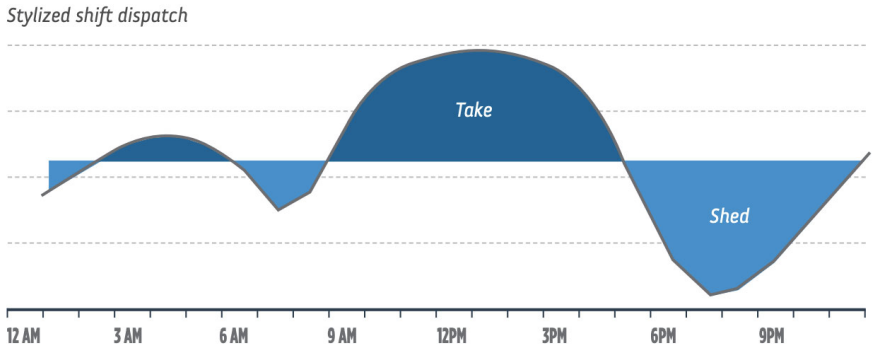
Yes, taking care of the neck of the duck is important, but DR has much more potential than just during the 4 p.m. to 9 p.m. ramp.

According to Lawrence Berkeley National Laboratory's (LBNL's) 2025 California Demand Response Potential Study, DR is actually composed of four core categories: Shed, Shape, Shift and Shimmy. Shed is what is currently being done today. In terms of what can come tomorrow, Shift is the next step.

Due to its nature, Shift can perfectly complement the Duck Curve. In addition to encapsulating Shed and targeting the neck of the Duck, load-shifting DR can help trim the belly of the Duck as well, mitigating the need to curtail renewables.

Under a Shift model in California, customers would reduce electricity consumption in the late afternoon/early evening during periods of renewable scarcity ("Shed" in the figure below) and instead use it when there is high renewables penetration ("Take").

Load shifting, therefore, is exactly what it sounds like: encouraging customers to shift their electricity consumption to best take advantage of clean, renewable energy.



With Load Shifting, customers shift their energy usage from 4:00 to 9:00 pm ("Shed") to 9:00 am to 4:00 pm ("Take"). Note these trends are complementary to the net demand curves exemplified in the Duck Curve. Credit: Load Shift Working Group

In addition to working with customers to reduce load from 4 p.m. to 9 p.m., DR programs could incentivize these customers to consume electricity in the middle of the day.

For example, customers could benefit from using power from 12 p.m. to 4 p.m. when renewable generation is highest and grid emissions are cleanest. Midday usage not only leads to greenhouse gas benefits, but this timeframe also happens to be when wholesale prices of electricity are cheapest.

Over time, these customers would adapt to shifting what would have been evening load to running appliances during times of high renewable generation. Consequently, DR programs would encourage load shifting that better integrates renewables and successfully balances the grid.

And this integration provides high potential value: LBNL's study estimates that load shifting could save California up to $600 million annually by avoiding the need to curtail renewable generation.

Flexiwatts rising from the ashes

Now is the time to take advantage of Shift.

The recently enacted SB 100 means even more renewables will be coming online in California, further exacerbating the Duck Curve problem. Load-shifting DR is available to help with renewable integration, and it can effectively mitigate the imbalanced Duck.

But first, DR needs to be rebranded.

Rather than thinking of DR as a burdensome activity that involves shutting everything off, it should be reframed as an opportunity to use energy more intelligently. Moving away from the idea of DR being an unused electron, DR needs to be highlighted in terms of flexibility.

Most importantly, DR should no longer be referred to as negawatts.

And thus enters Flexiwatts, a load-shifted megawatt that incorporates flexible demand and Shift onto the grid. Flexiwatts incentivize consumers to adapt their energy usage habits to patterns in renewable generation, thus shaping load to make sure it is balanced.

Going back to the Duck Curve, Flexiwatts are the units of energy that will not just reduce peak demand during the neck of the Duck, but will move that peak demand to capitalize on midday overgeneration, thus trimming the Duck's belly.

One could even argue that Flexiwatts are the hot new energy diet fad.

Bring on the smart devices

To realize Flexiwatts' full potential, smart devices must manage electricity consumption.

These energy-efficient smart devices, which include Internet-of-Things (IoT) technologies like Wi-Fi thermostats, smart plugs and even electric vehicles, are key to shifting load because of their ability to automate the timing of demand. Thanks to this automation, smart devices effortlessly overcome the irksome factor of traditional load-shedding DR.

Leveraging the power of Shift, smart devices can mitigate energy use by turning appliances off when demand is high or electricity generation has high emissions, and instead running them during times of low demand and high renewable penetration.

Even more, smart devices have the capability to directly connect smart buildings to the smart grid. With this new intersection of high-tech devices and energy efficiency, any electricity consumer is empowered to play a role in balancing the grid and advancing California's clean energy goals.

California Senate Bill 49, currently going through the legislative process, could catalyze smart device penetration. This bill would allow the California Energy Commission to advance DR and load management technologies by creating standards that "facilitate the deployment of flexible demand technologies."

Similarly, PG&E's WatterSaver Program is incentivizing Flexiwatts using heat-pump water heaters under a pay-for-performance model. Innovative policies and programs like these make it easy for all electricity consumers to be equipped with smart devices that take advantage of Shift, thereby setting Flexiwatts up for success.

New grid's resolution

While Flexiwatts may have flex-appeal, a greater push is needed to fully incorporate this valuable DR resource onto the grid. Without one, California will not adequately take advantage of the full potential of Shift.

As the state strives to meet its 100% carbon-free goals, California should incorporate renewable energy intelligently. Rather than simply developing more renewables, thus further intensifying Duck Curve-related challenges, California should set a goal for Shift.

DR isn't dead unless we let it be. With a small makeover and some goal-setting, Flexiwatts could be the key to evolving California's smart grid.