Just Ducky

If you provide free storage and distribution services, too much will be used, and costs for everyone else will go through the roof(top).

By Steve Huntoon

This is a cautionary tale of two curves. The first is California's now-famous Duck Curve, shown in Figure 1. Let's understand what it depicts, and why it's happening.

The Duck Curve depicts net load, which is gross load net of renewable resource generation (primarily solar). Stated differently, this net load represents the portion of customer demand that is greater than available renewable energy, so that it must be served by other resources, such as conventional thermal generation (or perhaps by energy storage).

As renewable resource generation increases, this net load gets smaller in the afternoon and greater in the evening. The neck of the Duck Curve gets longer every year due to California's energy policies, especially net metering subsidies in the form of free storage and distribution services. By the year 2020 it looks more like a goose, so maybe it should be called (did you see this coming?) the Duck, Duck, Goose Curve.

There are lots of ways to deal with this, such as (perish the thought) reforming the net metering subsidies. Another option: getting rid of existing time-of-use rates which, *counter-productively*, charge high prices when net load is low and charge low prices when net load is high (e.g., Southern California Edison's Rate TOU-D-T with high prices from 12-6 pm and low prices after 6 pm).[1]

Here's another: charging real-time prices, which would encourage all consumers to respond to real prices by deferring electric use from high-price peak hours to low-price off-peak hours (such as occurs in Texas when retail prices can be zero during times of high wind generation).[2] Deferred use is effectively *storage of demand*. It's incredibly cheap and efficient.

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Instead of these sensible alternatives, California has focused on subsidizing incredibly expensive energy storage. It plans to start with procuring at least 1,325 MW by the year 2020, at a ballpark cost of $2.6 billion, without any cost-benefit or market-need analysis to support that mandate.[3] Thus far, the CPUC has approved 261 MW of battery projects for Southern California Edison (SCE). The 261 MW includes 50 MW, at an estimated cost of $100 million, from a two year old company headed by an industry insider, and now backed by the Terminator himself. Kaliforneyah!

But wait, there's more.

Here's where the second curve comes in. Let's look at hourly demand at commercial office buildings in Southern California, as shown in Figure 2.

Please note the peak in demand around 2 pm. Keeping that in mind, let's circle back to SCE's battery storage procurement. Most of that battery storage will be 135 MW of behind the meter batteries apparently destined for peak shaving in commercial office buildings.[4]

In other words, these batteries will be reducing commercial building demand around 2 pm. Thus, around 2 pm, when the Duck Curve net load is at its lowest, battery storage at commercial buildings will be reducing net load even further. This is the worst possible outcome.

To connect the dots (so far): First, California subsidizes solar creating the Duck Curve with low net load in the afternoon. Second, the state eschews sensible alternatives in favor of

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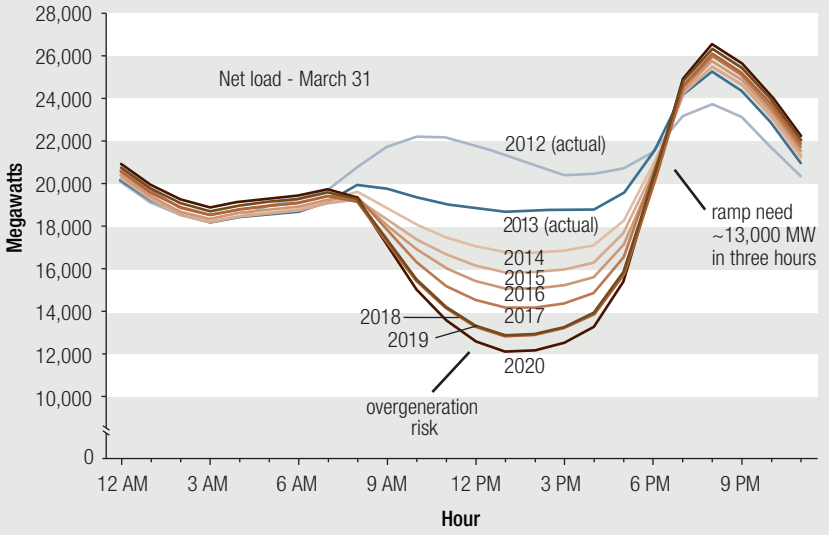
FIG. 1 CALIFORNIA'S DUCK CURVE

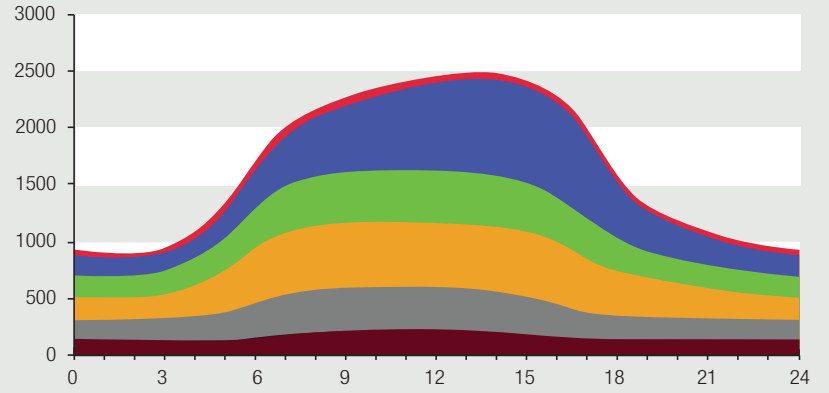
How solar is growing fat mid-day.



Source: California ISO

FIG. 2 MID-DAY PEAK DEMAND

California's energy storage mandate will shave mid-day peak demand – when net load per Figure 1 is lowest.



subsidizing incredibly expensive battery storage. And third, most of the battery storage it subsidizes will further reduce net load in the afternoon making the Duck Curve problem worse instead of better, presumably leading to a need for even more storage, *ad infinitum*.

But wait, there's even more. The Duck Curve's rooftop solar is said to create the need for a bidirectional distribution grid, and that ain't gonna come cheap. SCE, for example, says its "Distribution Resources Plan," which is only for distribution system enhancements, will cost between $1.8 and 3.1 billion, with the least expensive Scenario 1 presumably at the low end of the range and the most expensive Scenario 3 at the high end.[5]

Scenario 1 is based on a need to accommodate rooftop solar of 1,636 MW, which is about 500 MW more than the 1,128 MW of existing rooftop solar.[6] Scenario 1 would cost $1.8 billion, so that amounts to $3,600/kW for distribution system enhancements to accommodate that additional 500 MW of rooftop solar.[7] For context, utility-scale solar projects average $1,380/kW – this is for the projects themselves.[8]

So the sad fact is that distribution system enhancements to accommodate more rooftop solar will cost two and a half times as much as utility-scale solar projects would cost. Yipes!

The moral to this cautionary tale: If you provide something for free, like the free storage and free distribution services provided to net metered solar customers, then too much of the free stuff will be used, expensive and irrational fixes will proliferate, and the costs for everyone else will go through the roof(top).

Just Ducky. PUF

Endnotes:

1. In December, the California Public Utilities Commission (CPUC) opened a rulemaking (R.15-12-012) to look at time-of-use time periods, but without any apparent sense of urgency. The target is for redesigned TOU rates to be effective January 1, 2019. And all net metering customers at that time could continue on the old TOU rates for another five years (Order in R.14-07-002, Jan. 28, 2016, pages 93-94). Some reform may (or may not) occur earlier in individual utility proceedings.
2. It's not only shifting time of use of washing machines and dryers, but the lowly hot water heater. As discussed in a February 2016 *Public Utilities Fortnightly* article, "Community Storage – Coming to a Home Near You," home electric water heaters are essentially 50 million thermal batteries.

3. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M078/K929/78929853.pdf, page 21, "… we are not prevented from establishing procurement targets, based on our expertise and authority, in the absence of a system needs determination."
4. http://www.prnewswire.com/news-releases/irvine-company-and-advanced-microgrid-solutions-announce-groundbreaking-initiative-to-create-fleet-of-hybrid-electric-buildings-300157715.html. The press release says the batteries will be used to shave the buildings' peaks: "The first phase of the Irvine Company project – which will include up to 24 office buildings in Irvine – is expected to reduce peak demand in those buildings by 25%..."
5. http://www.edison.com/content/dam/eix/documents/investors/events-presentations/EIX-SCE-DRP-Presentation-07-01-15.pdf. For Scenario 1: $225 million in Distribution Automation, $215 million in Substation Automation, $277 million in Communications Systems, $345 million in Technology Platforms and Applications, and $690 million in Grid Reinforcement.
6. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K181/158181678.pdf, page 17. No Distribution Resources Plan has been needed for this existing rooftop solar.
7. Although there are other distributed energy resources, they are load reducers (demand response and energy efficiency), or are projected to not increase (SCE Application, page 73, "no net growth in supply-side CHP [combined heat and power]"), or have no net injections to the grid at peak (SCE Application, page 82, "no need to establish a fixed load shape for energy storage devices)". The one exception is electric vehicle load which is projected to increase, but that increase is more than offset by load reductions such that the 10-year annual growth rate in overall load declines from 1.4% to 1.0% under Scenario 1 (SCE Application, page 93). Thus, rooftop solar appears to be the sole driver of costs in SCE's Distribution Resources Plan (DRP).

   Offsetting benefits to the distribution system from distributed energy resources, such as deferring distribution system upgrades, appear highly problematic (SCE Application, pages 91-97, 183-184, 190-191, 192-193), and would appear inconsistent with SCE's investor view of the DRP as a major driver of rate base *growth*, http://www.edison.com/content/dam/eix/documents/investors/events-presentations/eix-november-2015-business-update.pdf, slide 4. As one example, SCE cites distributed energy resources, presumably solar, as a reason to upgrade existing 4 kV distribution circuits to 12 kV or 16 kV (SCE Application, pages 204-205). All this should put paid to the notion that distributed generation decreases distribution system costs. Nope.
8. SEIA/GTM Research, "U.S. Solar Market Insight," December 2015, http://www.seia.org/research-resources/solar-market-insight-2015-q3, Figure 2.4.

Innovating

(Cont. from p. 49)

vision for future overhead transmission line inspection and monitoring systems capable of autonomous operation, with the idea for a transmission line inspection crawler emerging at an advanced technology readiness level, a measure of product maturity. Innovation scouting and input from utility personnel supported initial conceptual design of a robot capable of running largely on power harvested from shield wires and of interrogating components in areas not readily accessible to helicopter over flights and otherwise challenging to observe and monitor. The transmission line inspection robot entered EPRI's pipeline in 2010 with the decision to accelerate its development and demonstration as a breakthrough technology.

Since then, the team has made significant progress in taking the product to full maturity. Significant developmental work on the robotics platform was conducted on a dedicated test circuit at EPRI's laboratory in Lenox, Massachusetts. Field demonstrations of Ti began in 2013 in close collaboration with a commercial vendor and several utilities.

Ti traverses an energized transmission line during a mobility and endurance test run.

In conjunction with the full-scale demonstration currently underway, EPRI will continue monitoring for key performance and safety metrics, and continue to define the value proposition for utilities and stakeholders. Since the EPRI efforts began, other vendors have entered the market.

Updates on Ti can be found at www.epri.com, the Technology Innovation Program, and Power Delivery & Utilization Sector. To see Ti in action, go to this YouTube site: https://www.youtube.com/watch?v=IXjsH7zx1Ss. PUF