SMUD's holistic DER planning process could set new standard for utilities

Even solar advocates are praising the distributed resource planning done by Sacramento's municipal utility

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Britain ruled the world on its army's adage that “proper planning prevents poor performance.” California’s Sacramento Municipal Utility District (SMUD) is taking that idea to its distribution system. A recent SMUD estimate found customers and third-party developers spend from $150 million to $200 million annually on distributed energy resources (DERs) in its territory, which is more than the utility is investing in utility-scale renewables to meet the state’s 50% renewables by 2030 mandate. As DERs proliferate, SMUD, the sixth-largest municipal utility in the nation, is now testing new planning methods to maintain reliability and control costs, incorporating five steps laid out in a 2016 white paper from the Smart Electric Power Alliance (SEPA) and consultancy Black & Veatch.

In a follow-up study, SEPA and B&V summarized what SMUD gained from integrated DER planning, which includes combined heat and power, distributed photovoltaic solar, energy efficiency, behind-the-meter energy storage and electric vehicles.

“To now, we have only seen impacts of DER individually. This showed how they fit together at the distribution system land bulk system levels,” said SMUD DER manager Obadiah Bartholomy. “Seeing the interactive effects and what the net effects are was powerful.”

SMUD may be the first utility to have gone through such a comprehensive planning process, according to SEPA.
SMUD “took that more holistic view, instead of, like a lot of utilities, doing only individual pieces,” said Dan Wilson, one of the paper’s co-authors.

The analysis starts with a customer adoption forecast, Wilson said, and then looks at how customers will use new technologies, and what their impacts on the grid and utility finances will be.

It’s a planning procedure so comprehensive that even solar advocates are taking notice, arguing the process could provide lessons for utilities nationwide.

**Five steps to DER success**

The first white paper offered a five-step blueprint for utilities contending with rising customer demand for DERs.

The first step in the distribution system planning process was a comprehensive system assessment from the customer’s point of view. The utility not only needs to forecast load, but also the technical, economic, and achievable DER deployment potential, as well as the likely customer demand. The second step was estimating the derived net load and impact of the DERs profile on the transmission and distribution systems. The third step was applying a similar analysis to the utility’s bulk power generation and transmission systems to get an understanding of what is coming at the distribution system.

The fourth step was a comprehensive assessment of the utility’s financials, rates and regulatory responsibilities. That would include the locational costs and benefits of DER, how they might defer or avoid traditional investments, and what new policies would grow DER at the right place and right time. The fifth step was developing a DER strategy and putting that strategy into operation.

“SMUD is one utility making changes in distribution planning and ‘one size does not fit all,’” said Daisy Chung, a SEPA Research Manager and paper co-author. “But the more ready a utility is to proactively look at distribution planning from the customer level, the more it will benefit from DER.” Offering a series of recommendations, the paper says DER planning should be part of the regulator utility planning processes, like the Integrated Resource Plan (IRP).

To most effectively integrate DERs, a utility should have a “multidisciplinary analysis team” and should build “a robust DER customer database.” It should also “model the entire distribution system, rather than a subset of feeders” to better understand impacts and mitigations.

Planning must include statistically valid assumptions and datasets so analysis of rate design impacts on customer adoption can be accurate, the paper added.

With this kind of analysis, a utility like SMUD can target and develop of new programs, products, and services. It also enables utilities to track how much load they can lose to grid defection before there are significant financial implications.

With these datasets, utilities can accurately pinpoint where DERs can serve as non-wires alternatives to defer costly upgrades to its system and where DER penetration is high enough to provide ancillary services. What’s more, utilities can use these numbers to figure out how to structure rates and incentives that spur DER deployment from consumers and third-party developers.

“Utilities are very good at predicting load growth but with the pace of DER coming into the grid, traditional planning does not give them visibility into how customers will make choices about DER,”
SEPA’s Chung said. “This type of planning will allow them to see at a very granular level how and where customers may be adopt DER.”

Detailed DER analytics can guide new infrastructure builds and better DER adoption forecasts, the paper concludes. The forecasts will allow the utility to plan deployment of system software, it adds. “It is statistical modeling,” B&V’s Wilson said. “The analysis is to figure out what the well-known S-curve of adoption might look like, based on empirical specifics about SMUD’s service territory and how quickly these technologies have been adopted in the past.”

B&V statistician Elizabeth Warden said there was greater certainty about DER technologies like rooftop solar because there is historic data. Emerging technologies like electric vehicles and storage required “more forward-looking assumptions.”

The planning process being pioneered by SMUD has “broader implications for the electric utility industry,” according to the paper. It introduces into planning DER locational benefits and cost-benefit analysis for NWAs and for distribution system IT. It also introduces into planning utility human resources, utility-customer engagement, and the DER marketplace.

Finally, the integrated DER process faces up to the evolving utility business model and the utility’s role in managing “the grid of the future,” the paper reports.

**But what will it cost?**

Customer demand for DERs in SMUD’s territory has accelerated in recent years, especially since 2016. The growing volume of interconnection requestions was a key driver, for SMUD’s planning, magnified by legislative and regulatory policies designed to boost DER deployment.

But integrating DERs is not cheap, and, in fact, could exceed the benefits to utilities, the white paper warned. In a scenario with high DER penetration, the cumulative cost of lost revenues and DER integration through 2030 could reach more than $100 million.

SMUD’s current rates are inadequate to recover those levels of lost revenues and integration costs. These estimates came after SMUD quantified DER potential and adoption for each customer based on technical and economic potential various DER technologies, analyzing 65 in all.

The analysis forecasted DER adoption to be widespread throughout SMUD’s territory, but uneven and clustered by “demographics, and technical and economic factors.” Planning based on this profile would look for mitigations to locational overloading, the paper reported. Those could be customer-focused DER rates and incentives or programs like community solar and strategic EV charger deployment.

SMUD ran scenarios for the impact of each DER independently, the paper reported. Meanwhile, a “combined case” scenario modeled “the blended impacts of a high DER adoption scenario.”

The combined case found a “1,000 MW reduction in the system peak net load on highest load days in 2030” and “reduced average ramp rates.” Peak demand shifted toward later in the evening and was flatter, requiring less use of natural gas peaker turbines.

“This integrated DER process gives us some important insight into how the Duck Curve will be affected by the combined impacts of DER,” said SMUD’s Barthomy. “High PV penetration may cause midday solar overgeneration that exacerbates the Duck Curve but combining it with storage can shrink the Duck Curve and help us reduce peak demand.”
Though he expected “a lot more ramping from having a high penetration of solar,” there was actually less ramping needed with a high penetration of all the technologies.

The other key aspect of the DER planning is modeling the financial impacts, the study said. SMUD found DERs provide production cost savings that range from $70/MWh to $100/MWh, while program costs range from $1/MWh to $17/MWh. The result is revenue losses to SMUD.

More analysis is needed for newer demand resources like dispatching utility demand response, customer demand response, customer energy storage and utility-owned energy storage, the study concluded. “Current DR programs may be cost effective under the 2017 rate structure, but changing rate structures could impact their net value.”

For rooftop solar, the integration cost is $0.08/watt and it is $100 per EV, SMUD's Bartholomy said. “That is a pretty significant cost.”

Though the benefits of single technologies do not justify that cost, planning provides a different cost-benefit perspective, he added.

With SMUD’s rising DER penetrations, a diversified DER portfolio “likely causes rate increases, but it causes a lower overall total cost of energy and a lower overall electricity bill,” Batholomy said. That situation is the result of two forces acting on rates. As DERs undermine electricity sales, rates are pushed higher. But if DERs relieve the need for new grid or generation infrastructure, they can relieve upward pressure on rates.

Even so, other questions remain. “With this integrated DER work, you can see those impacts on the bulk system but the question becomes whether it can be predicted accurately enough at a feeder or circuit level to avoid a specific investment,” Bartholomy said.

The big endorsement
Even with these questions remaining, the paper attracted the endorsement of major solar advocacy group Vote Solar.

It’s rare when a solar advocate endorses utility planning. But Vote Solar’s Ed Smeloff, the regulatory team managing director, said the SEPA/B&V white paper is “forward-looking in its embrace of DER technologies and the opportunity they offer.”

SMUD’s financials as a public power company might make it easier to accommodate an accelerated DER uptake than it would be for an investor-owned utility said Smeloff. But, like other utilities, SMUD is faced with the challenge of planning for the decisions of its customers, anticipating potential bottlenecks and ensuring fair allocation of costs.

Despite these challenges, SMUD’s planning process recognizes the importance of rate design and procurement on managing DER growth, he added, while anticipating the need for forecasting, planning, operations, and financial tools necessary to integrate DERs.

“The paper acknowledges that there is a need to model the entire distribution system, feeder by feeder and substation by substation, rather than make generalizations about grid impacts from sample sections of the grid,” Smeloff said. “This study should be on the reading list for utility executives across the country.”