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## MICROGRIDS & THE TRANSITION TO DISTRIBUTED ENERGY

The 6th Annual **HOMER International Microgrid Conference and Exhibition** presented by *Distributed Energy* will bring together a global community of microgrid experts and financiers for the purpose of advancing high-quality, profitable distributed energy systems in on- and off-grid settings. We invite you to the beautiful Paradise Point Resort in San Diego's Mission Bay to participate in two days of conference activities presented by leading industry figures and a third day of hands-on training using the HOMER Grid and HOMER Pro software platforms.



# Mitigating Electricity Demand

Tools for streamlining solar + storage design

BY DR. PETER LILIENTHAL

## Utility Electricity Demand is Stagnating and Distributed Energy is Surging.

**T**he slowdown in the growth of electricity consumption and the rapid growth of distributed energy resources currently underway in the electric power sector is causing important utility revenue losses, resulting in challenges to century-old utility business models and current regulatory policies. It's also providing new opportunities for electricity customers.

Plummeting costs for renewable energy and energy storage are outpacing expectations, and concerns over climate change show no signs of abating, leading increasing numbers of utility customers to generate their own electricity. Meanwhile, the rapid evolution of power electronics and digital controls is enabling distributed energy technologies to revolutionize the electricity marketplace.

These trends are cutting sharply into utility income from

volumetric energy sales. They are also putting pressure on utilities to increase revenue from demand charges and revise their tariff structures by implementing time-varying rates.

Utility regulators are being forced to juggle a baffling array of (sometimes conflicting) objectives, such as keeping utilities solvent, ensuring that the economic advantages of distributed energy are shared fairly across different classes of ratepayers, enabling technical innovation, mitigating climate change, and smoothing the way for adopting even more renewable energy resources.

## What Will the Utility of the Future Look Like?

Utilities are exploring different pricing schemes to deal with these changes, creating new challenges for developers of distributed energy systems. Paul Zummo, Research Director of the American Public Power Association, explains that utilities believe demand charges are the most reliable way to

recover fixed costs, particularly in light of unpredictable new challenges such as fast EV charging. Often provoking intense customer pushback, utilities in some states—usually the ones with fast-growing distributed energy development—are also proposing to extend new demand charges to residential customers who have invested in rooftop solar.

HOMER Energy's new software product, HOMER Grid, has been specifically designed to help these users understand the potential for energy cost savings from demand management, time shifting of loads and solar energy, and self generation.

### **Understanding Demand Charges**

Jim Lazar, a rate design expert with the Regulatory Assistance Project, says "Most commercial entities don't understand demand charges, what they are, why they are, how to control them. Even school districts and manufacturers don't understand what drives their electricity bill." At HOMER Energy, our clients echo this confusion. Demand charges are usually based on the single highest 15 minute period of energy use in the month. Customers are often unaware of what causes a demand spike or are unable to control the event that caused it. Moreover, "ratchet clauses," based on a single 15-minute period, can lock in a high demand charge for an entire year.

Traditionally, larger commercial and industrial customers have paid for demand charges because utilities must make capacity available for them regardless of whether it is only used during peak loads. This model has worked effectively for utilities for over 100 years, and currently, demand charges make up about 25% of overall utility revenue from commercial and industrial (C&I) customers in the US. For individual customers, they can represent over 50% of an electricity bill. But, new technologies such as solar-plus-storage are poised to help commercial customers manage demand charges in ways that have never been possible before, and utilities are rethinking their traditional rate structures.

### **Demand Charges Can Change Behavior and Reshape Consumption Patterns**

The challenges that utilities face from the increasing penetration of renewable energy are technical as well as financial. Aside from cost recovery, utilities have historically used demand charges to shape customer behavior and create disincentives to use energy during costly system peak demand periods. Now, distributed solar is making usage peaks even worse, creating a sharp new demand ramp when the sun goes down. This is the source of the infamous "duck curve" where daytime solar PV generation is so successful that it requires utilities to ramp up electricity production sharply in the early evening, while also creating minimum load problems at noon.

While these problems are currently presenting serious challenges in states with high penetrations of renewable energy, they will eventually be important to consider everywhere.

### **How Storage Changes the Game**

According to Imre Gyuk, Energy Storage Program Manager

at the US Department of Energy, "Storage is a natural partner of renewable energy. It changes renewable energy into something that is dispatchable, that is predictable." That strange quality of electricity—that it must be used as soon as it is generated, and that supply must be balanced at every moment with demand—will no longer constrain our electric system. That's why the evolving storage market—fueled by EVs and the rapid growth of distributed energy resources—is going to cause profound disruptions in the electricity marketplace. On a practical level, storage is a hedge against changing electricity prices for commercial utility customers and a new opportunity to control their energy costs.

While energy efficiency measures and solar PV are a good way to reduce energy costs overall, they alone do not necessarily reduce demand charges. In a study by the National Renewable Energy Laboratory (NREL) and the Lawrence Berkeley National Laboratory (LBNL), researchers found that the median demand charge reduction for solar-plus-storage systems is 42% compared to just 7% for standalone PV.

While some energy storage vendors offer software with their products, HOMER Grid is the only comprehensive system design software that provides users with a clear financial evaluation of solar-plus-storage and/or combined heat and power (CHP) investments, based on the customer's real, local utility rates.

### **What's Your Utility Tariff Scheme?**

The traditional demand charge is based on a kW price multiplied by the peak demand in a monthly billing period, but variations in the way demand charges are structured can have big impacts on the ROI of distributed energy investments. That's why the regulatory environment where commercial electric customers are located can determine whether these customers benefit from solar-plus-storage systems.

### **Non-Coincident vs. Coincident Demand Charges**

Most demand charges are still "non-coincident," meaning they are based on customer demand without regard to the peak demand of the overall utility system. A legacy of the 19th century, non-coincident peak charges can help utilities with cost recovery, but they can penalize customers unpredictably without giving them a clear path to managing their energy costs.

On the other hand, coincident demand charges are timed to coincide with the utility's system peak, which typically occurs in the late afternoon in summer. Demand tariffs based on coincident peaks are more effective at reducing system peaks and cutting costs for the utility, ultimately benefiting everybody.

### **Time-of-Use Rates**

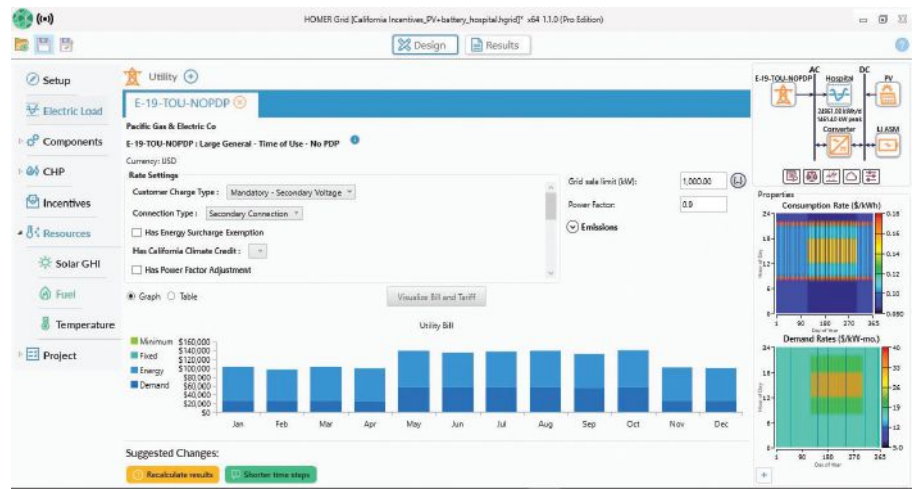
Finally, there is increasing recognition in the utility community that some combination of Time-of-Use (TOU) rates and demand charges send constructive price signals that are the most effective way to accommodate increasing penetrations of distributed renewable energy.

For example, San Diego Gas and Electric implemented TOU rates in December 2017 in order to shift load profiles and better manage peak demand. Unfortunately, that devalued existing PV systems. But, if customers add storage, they will be able to respond to the new rate structure and benefit financially.

### Which Companies Will Benefit Most from Solar-Plus-Storage?

Many commercial and industrial customers will be able to use solar-plus-storage and other distributed energy technologies such as generators and CHP to manage rising demand charges. Storage will give them the flexibility to reduce their energy costs substantially even in the face of unpredictable tariff changes. But how can companies determine whether they're included in this lucky group?

Unfortunately, there's no electricity cost reduction playbook that applies across the entire US. Instead, there's a nationwide patchwork of tariffs and renewable energy and storage incentives that change frequently, subject to the evolution of technology and shifting political winds in each state legislature and utility commission. But there are a few factors that indicate whether distributed energy resources are likely to produce important savings.



A HOMER Grid screenshot

### Big Loads, High Peak Demand

Customers whose peak loads tend to be extreme and variable are more apt to save on demand charges after investing in storage. By shaving these peaks, they can avoid demand spikes along with their unpredictable costs.

Buildings such as schools, hotels, and apartments tend to have a pronounced spike in their load profile, and power demands with a sudden, late afternoon peak. They can benefit the most from solar-plus-storage systems. In contrast, the business case for renewable energy with storage for hospitals, data centers, and other businesses with consistent daily load requirements depends

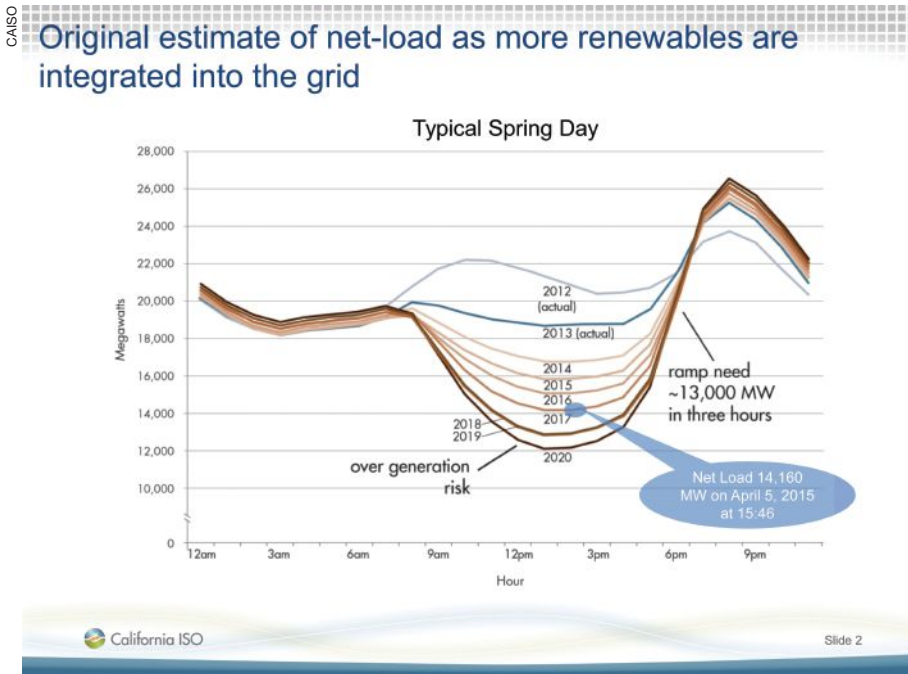
on other factors more than a drop in their demand charges.

It's also important to understand the impacts of climate and weather when estimating the ROI of solar-plus-storage systems. Customers in areas that have a strong solar resource but are otherwise subject to intermittent cloud cover, such as Miami and Hawaii, tend to benefit the most because batteries can quickly buffer variations in solar production.

### Sizing and Planning Solar+Storage Systems

It's clear that commercial electricity customers face complex and potentially confusing energy choices along with great opportunities. To help commercial utility customers understand their energy options, we at HOMER Energy created HOMER Grid to ease the design process for behind-the-meter, grid-tied, distributed energy systems.

HOMER Grid manages the complexity that goes into distributed energy resource design decisions and includes solar-plus-storage, wind, generators, and CHP. It also helps predict the impact of tariff changes. Incorporating the continuously updated Genability utility tariff database, HOMER Grid's inputs include utility tariffs from the US, Canada, and Mexico, customer load profiles, and equipment costs and performance data. Then it runs simulations for different system configurations for an entire year, and ranks the results by financial performance. Ultimately, HOMER Grid calculates costs and savings on demand



The duck curve is formed when utilities must ramp up energy production in the early evening.

charges and electricity consumption for each system and emissions and fuel consumption when relevant. It also helps users compare the performance of different equipment brands for PV, batteries, inverters, and other components.

### **Ideal Energy: Designing Commercial Solar + Storage**

Solar developer Ideal Energy, Iowa's leader in building complex solar-plus-storage systems for commercial and industrial customers, is one of the companies working with HOMER Grid to analyze the financial feasibility of solar-plus-storage projects for their clients, and to compare the economics of different system configurations.

"Companies that come to us are looking for demand mitigation strategies that will reduce their overall electric bills," says Ideal Energy CEO Troy Van Beek. "They also want the green branding that solar provides. Finally, a lot of companies we work with need to comply with stricter supply chain rules that mandate sustainability."

Van Beek points out that while Iowa has low energy costs overall, partly due to its spectacular wind resource, it has very high demand charges, as well as over 200 different utilities with a wide variety of tariffs to track. However, many potential battery customers aren't aware of possible savings, says Van Beek, or the fact that storage costs have declined so dramatically. He contrasts HOMER Grid with modeling software provided by storage vendors that can't handle the complex projects his company is designing.

Ideal Energy system designer Aurelien Windenberger is using HOMER Grid to model an industrial facility with a large electric load and big demand spikes. Preliminary results show significant demand charge savings from batteries and solar. Windenberger says that NREL has estimated that potentially 23,000 Iowa companies could benefit from battery investments.

### **Lowering the Soft Costs of Solar + Storage Design**

HOMER Grid is a response to market forces that continue to apply downward pressure on solar and storage prices, and to our customer base, which

wanted a product that would be as powerful as HOMER Pro, but simplify solar-plus-storage and CHP design work in grid-connected environments. Now integrated with Helioscope PV design software, the power of HOMER Grid is that, by streamlining the design process, it helps developers tackle the soft costs of behind-the-meter projects.

It's not easy to cope with all the moving targets that bedevil the creators of distributed energy systems—chang-

ing federal incentives, widely varying state regulations, evolving tariff schemes, import duties on solar panels, and fast-changing prices. We hope that by integrating all these variables into one software product, and providing a powerful algorithm that ranks the options economically, we can help move the industry forward. **DE**

*Dr. Peter Lilienthal is the CEO of HOMER Energy.*



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