sense

Capitalizing on the Future of the Grid

$176 per customer per year in system benefits driven by real-time decision-making.

Achieving meaningful greenhouse gas (GHG) emissions reduction goals will depend on how customers manage home energy resources, including how they choose to consume and produce energy. Exactly how customers engage with energy services is shifting subtly, but with great implications for the grid. Moving beyond the century-old status quo of supply following load, we now operate in a new paradigm, where load and supply must both dynamically respond to system needs.

This capability, demand flexibility, is a cost-effective catalyst to the deep decarbonization of the power grid. It can be further unlocked with high-fidelity, high-granularity real-time informational feedback that is both readily accessible and actionable. With the potential to align customer priorities for comfort, convenience, and affordability with system needs such as reliability and sustainability, this type of informational feedback revolutionizes the way customers interact with the energy system. And by engaging customers in this new, real-time way, grid operators can encourage demand flexibility through a number of ways to balance load on the distribution system as needed.

The Inadequacy of the Status Quo

Today, customer electricity usage data is not readily available. Even when available, data is delayed and does not reflect instantaneous conditions; or is not granular enough for customers to understand what electric appliances they can adjust in their homes; or is cumbersome for customers to obtain. Further, the feedback, if provided, is not interactive, and customers do not know right away the significance of their actions. These limitations reduce the relevance and impact informational feedback can have on customer behaviors and load flexibility programs, resulting in higher customer bills and increased costs to the electricity system.

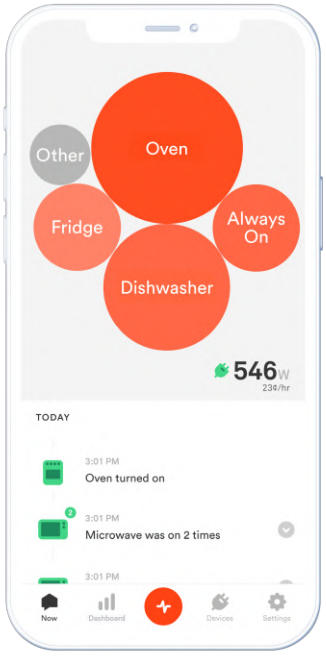
Likewise, distribution operators are handicapped by a lack of localized grid intelligence and visibility into where the distributed resources are clustering. An increased level of granularity in forecasting is a prerequisite for operators' ability to plan and manage increased electrification from electric vehicles and heat pumps, and to integrate DER resources like solar and storage. The absence of detailed forecasts presents both a reliability risk and a missed opportunity: new loads are added to infrastructure that is not prepared to support the increased demand, and some of these resources can be aggregated into Virtual Power Plants to address emerging grid needs.

Overcoming Limitations with Granular, Real-time Feedback

Additional granularity provides insights that can be used for load flexibility programs and can help customers optimize their energy usage in a way that suits their preferences while also providing benefits to the power grid. With real-time information, customers can optimize electricity generation from their rooftop solar systems, manage charging schedules for their electric vehicles, and operate their electric heat pumps in a way that minimizes their energy bills while alleviating strains on the electric grid. Just like the distribution system requires a management system - customers have their own demand and resource capacity to manage in coordination with the macro signals coming from grid operators, weather, etc. In turn, grid operators can view customers as a resource rather than as a burden.

A Real-Time Experience is Now Possible for All Customers

Sense, a pioneer in real-time intelligence, is revolutionizing the way utilities engage with customers and optimize the grid. Sense gives customers a real-time view of the energy being consumed in their home, at the device level. Customers can act on Sense-enabled insights to maximize their comfort, save energy and money, and reduce their impact on the environment.



Embedded in next-generation smart meters, Sense uses high resolution data (1MHz) and edge computational technology to instantaneously analyze waveforms using sophisticated machine learning algorithms and AI. This immediacy allows customers to take timely and relevant actions to manage their consumption effectively, resulting in a higher level of impactful engagement for a greater number of people compared to delayed information. Furthermore, Sense can become customers' "coach" as they interact with the grid, including maximizing renewable, low-carbon generation resources or reducing energy use during critical events.

Sense's real-time high-resolution data also helps to identify and localize faults, improving reliability and safety for customers. Take for example, a flickering light. Today, with only AMI data, finding a root cause would be impossible. However, as more Sense-enabled meters are deployed, our view extends beyond the home and across the grid. Identifying disturbances in the waveform data and comparing with other homes on the same transformer, we can determine if the problem stems from something inside the home or on the grid.

Driving Conservation Impacts without Increasing Costs

Deployed as a software solution on smart meters at a marginal incremental cost, Sense's real-time energy information leads to a significant reduction in energy usage, thereby promoting energy conservation. Sense's ability to identify and provide device specific load information empowers customers to customize or adjust usage of specific appliances. Insights from Sense can also help customers identify and address parasitic loads, powering their overall energy consumption profile.

Assuming these capabilities are embedded in all smart meters that will be deployed, and using a conservative assumption that about a third of customers engage in Sense-enabled apps, the annual conservation benefit derived from Sense-enabled smart meters (before the implementation of any load flexibility programs) could exceed $1.3 billion annually by the end of the decade. (For comparison, California spends about $1 billion a year on energy efficiency programs.)

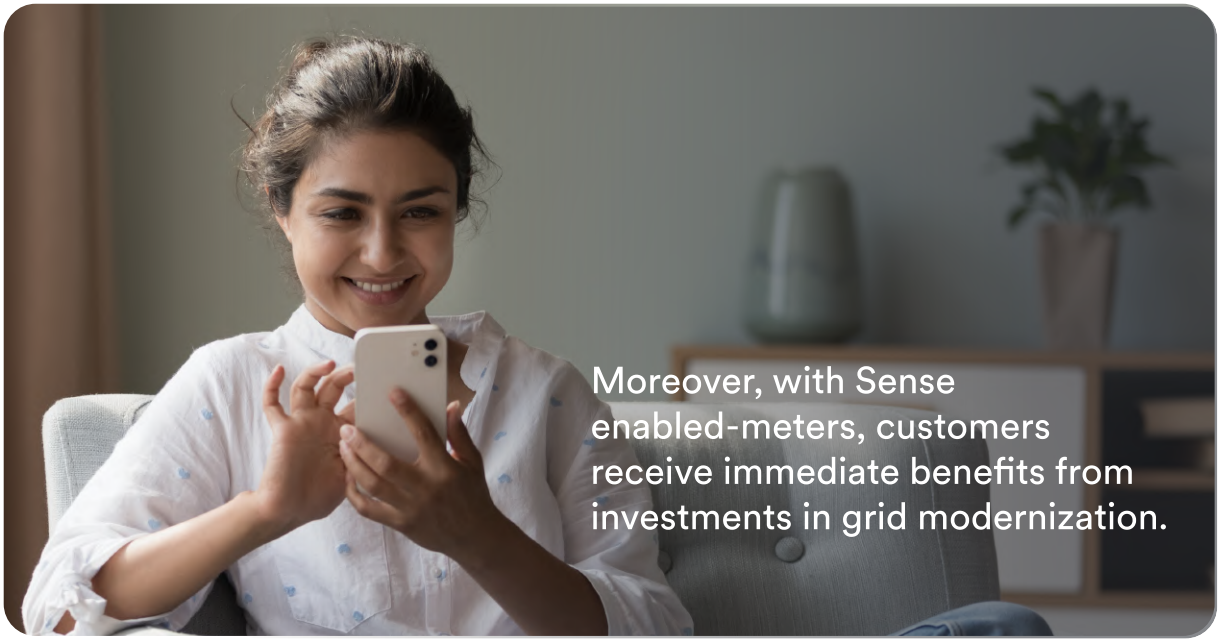
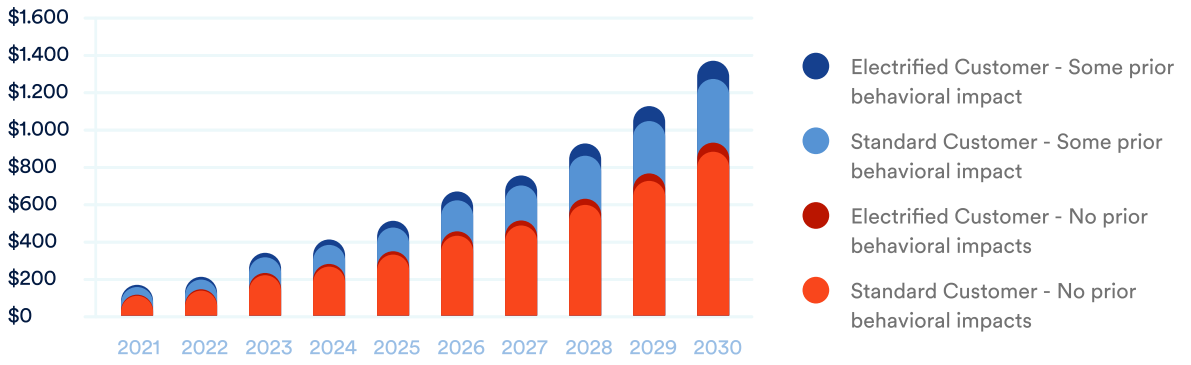


Figure 1: Cumulative Energy Conservation Benefits



According to analysis from The Brattle Group, the per-customer system benefit from the conservation effect is up to $93 per year. System benefit stems from savings from lower energy usage for an average customer not previously exposed to energy conservation programs. Savings also come from avoided generation, transmission, and distribution capacity costs, as well as avoided GHG emissions. For a growing number of customers with increased electrical loads (e.g., customers with electric vehicles, heat pumps), the system benefits are higher, about $176 per customer per year.[1]

Figure 2: Per-Customer Benefits

Average Benefits per Customer

Customer Type	Standard Customer	Electrified Customer
Customers with no exposure to conservation programs	$93	$176
Customers with previous exposure to conservation programs	$20	$39

It is important to note that these quantified benefits do not include other potential benefits due to improved implementation of load flexibility and time-varying rate programs, as discussed below. While the benefits are very likely for the latter, quantifying these additional benefits is reserved for future studies.

[1] Under this definition, by 2030, more than a third of residential customers will have high electric loads.

Beyond Energy Conservation: Enhancing Benefits to Customers and the Electricity Grid

Device-specific energy usage data can help utilities identify distributed energy resources such as rooftop solar, EVs, and electric heat pumps – information that can help utilities monitor and optimize assets on the distribution system to ensure system reliability. Utilities can use this information to develop targeted engagement for load flexibility programs such as smart thermostats or smart charging programs. These programs not only benefit both customers and the grid, but also strengthen the relationship between utilities and their customers. In addition, customers will be able to set appliance level preferences (e.g., fixing their thermostat to specific setpoints or how far their EV needs to go the next day) and enable Sense to respond to the real conditions of the grid as expressed through price signals or local congestion levels.

Sense-enabled smart meters can increase the effectiveness of load flexibility programs while promoting customer-centricity. Take time-varying rates (TVR) for example. Utilities can increase enrollment and participation in TVR via targeted marketing and coaching through the Sense app and the insights it provides. Those insights can help customers understand how they can adjust their energy usage to save on electricity bills and respond to times when the grid is more stressed. Indeed, data from over 400 treatments of time-varying rates show that customers reduce their peak demand at greater levels with the help of technology and informational feedback.

With Sense-enabled smart meters, customers could also be more likely to participate in VPP offerings. While VPPs are implemented for a number of reasons ranging from addressing local distribution network constraints (i.e., non-wires alternatives) to avoiding energy costs, a recent Brattle study found that the net cost to the utility of providing resource adequacy from the VPP is only roughly 40% to 60% of the cost of the alternative options. Extrapolating from this observation, a 60 GW VPP deployment could meet future resource adequacy needs at a net cost that is $15 billion to $35 billion lower than the cost of the alternative options by 2030. Given this huge potential, it is instrumental to engage customers who can participate in a VPP portfolio.

As more customers electrify their homes, this type of edge intelligence provides new visibility to utility operators that can improve both daily and long-term reliability. Utilities will be able to plan and respond to new consumer behaviors spurred by increased electrification down to the transformer level, something that is completely absent in today's landscape of the grid.

Sense-enabled smart meters are driving a revolution in energy consumption and grid decarbonization. By providing real-time, detailed insights and actionable information, Sense empowers customers and utilities to take control of their energy costs, optimize usage, and actively participate in utility programs and provides powerful, localized insights to help distribution operators better manage the grid.

With millions of new smart meters set to be deployed in the next few years, the potential benefits are immense, and the opportunity cost of not pursuing real-time information feedback is high. As the deployment of smart meters continues to expand, the benefits of real-time information feedback will play a vital role in achieving a cleaner, more resilient power grid. With Sense, customers and utilities can forge a new path towards a sustainable energy future.

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