A load management strategy: The missing link

By Steve Fine and Patty Cook, ICF

Executive summary

In addition to their traditional mission to provide safe, reliable, and affordable electricity, utilities today have emerging goals tied to decarbonization, resilience, and economy-wide electrification. At the same time, many utility customers now have choices over how they independently generate and consume their energy—in some cases irrespective of the grid's needs.

This dynamic has put utilities at a crossroads. Failure to align and reconcile these objectives will come at significant costs to both customers and the grid if not managed with an eye toward the future. In contrast, by modernizing their grid, and developing new partnerships and innovative customer programs, utilities can play a central role in serving these multiple objective functions through utility-enabled and -hosted flexible load management.

This paper explores how Flexible Load Management (FLM)—automated programs that alter customer energy consumption in near-real time to deliver customer benefits and support clean energy policy goals—can play a key role in achieving increasingly challenging utility goals and customer expectations simultaneously.

Why FLM now?

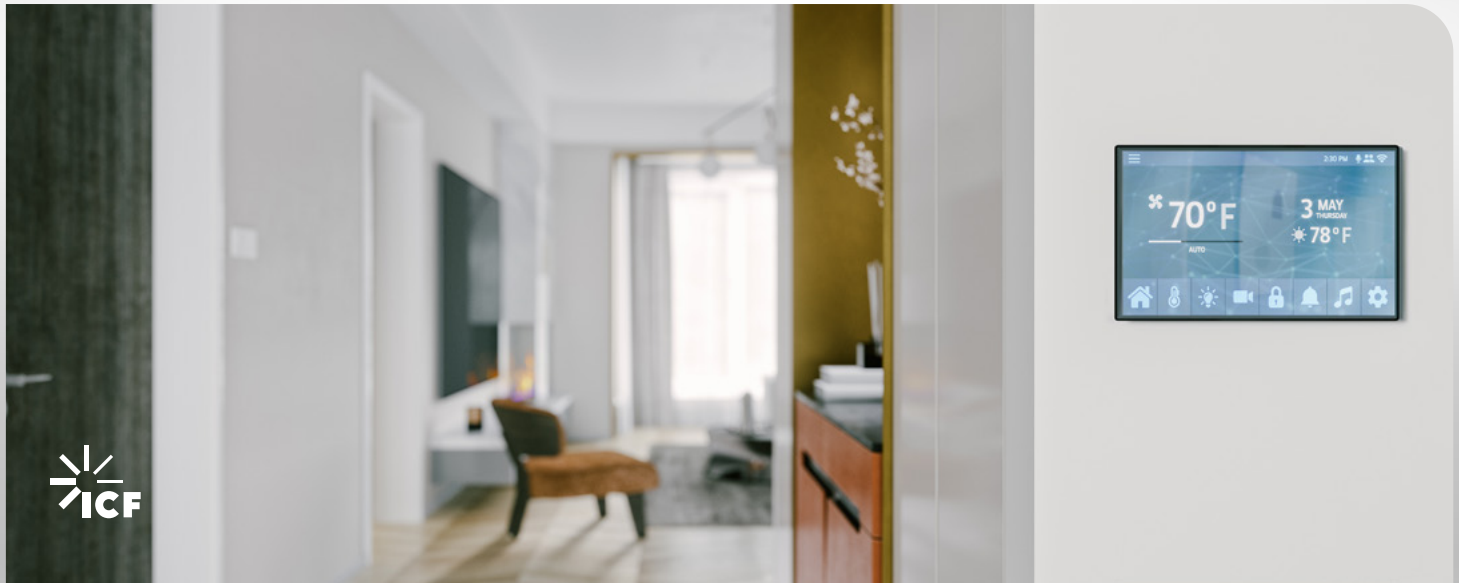
Historically, the provision of energy services has focused on the procurement, distribution, and management of supply-side resources, with demand side resources (including customer programs) playing a minimal role in maintaining reliability and actively balancing the grid. With the proliferation of customer-owned assets and devices, such as smart thermostats, roof-top PV, batteries, electric vehicles, and controllable water heaters, the role of customer-sided contributions will become increasingly important in balancing demand and supply, particularly as the resource mix becomes more intermittent, extreme weather events become more common, and load grows due to increasing electrification. The 2,000 MW decrease in energy use that "saved the CAISO grid"[1] on September 6th underscores the increasing co-dependency between customer-sided resources and the reliability of the grid.

FLM allows utilities to enable automated, coordinated, and aggregated real-time changes to grid-edge assets and devices without significantly impacting customers' energy consumption habits. For example, FLM can reduce the temperature of a hot water heater in a household while leaving it high enough to ensure everyone in a household gets a hot shower.

While there is a plethora of third parties pushing the envelope on technological advancements in behind-the-meter technologies such as solar, storage, and smart thermostats, as well as a multitude of providers of Software as a Service (SaaS) control platforms (DRMS/DERMS), in addition to third-party aggregators looking to take advantage of arbitrage opportunities to benefit their specific customers, none of these entities are accountable for maintaining the reliability and affordability of electric service for all of their customers. To paraphrase Harry S. Truman, the buck stops at the utility.

By developing a flexible load management strategy now, utilities can position themselves to be on the leading edge of an approach that will become increasingly important over the next decade as managing growing load from electrification and ensuring the reliability of the grid become increasingly dependent.

[1] CAISO avoided outages in September heat wave – a 'remarkable outcome' – with 4 GW storage, conservation | Utility Dive



Delivering on utility and customer goals requires a load management strategy

Utility goals

Utility leaders know their "new" goals tied to decarbonization of energy supply, increasing grid resilience in the face of more extreme weather events, and enablement of the electrification of other sectors are closely interrelated. FLM can play a key role in advancing these three goals.

FLM enables decarbonization: A key difference between FLM and traditional demand response is that FLM isn't used only when needed during system peak demand events. FLM can also be used for decarbonization—an emissions response event—by optimizing customer energy use and DER energy supply every day, maximizing the use of low-carbon energy on the grid, reducing total energy use, and managing load on a sub-hourly basis. Existing demand response programs are incapable[2] of shifting loads to periods of high renewable generation, and thus are inadequate for supporting the carbon-free grid of the future. FLM can help achieve this without significantly impacting customers' energy consumption habits. Utilities can also use an FLM strategy to reduce the need to curtail excess solar output.

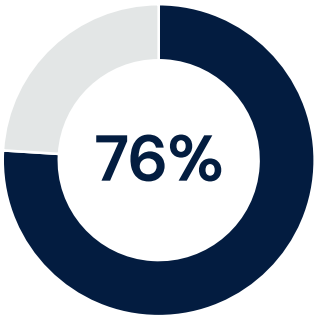
FLM enables resiliency: Without load management, heat waves and other extreme weather can threaten grid reliability. With demand response, utilities call on customers for voluntary energy reducing actions on a limited system emergency basis. The more utilities call on customers to take these actions, the more "demand response fatigue" they will encounter in the form of customer opt-outs and overrides. With FLM, utilities can use a light touch by automatically making real-time micro-load modifications at the premise level that provide meaningful and measurable system-level load reductions that can enhance grid reliability.

These capabilities are driven by the internet-of-things and advanced metering infrastructure (AMI) and help utilities better optimize their grid system planning and operations. They enable consistent and quantifiable load reductions on a more dynamic basis that can alleviate peak demand-related pressure at the local and system levels that could otherwise cause reliability events or require expensive new infrastructure to address.

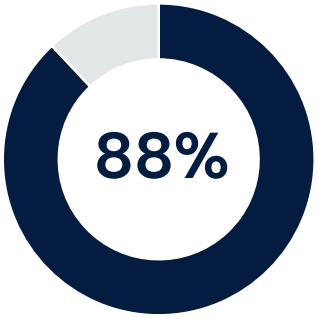
[2] Analysis of Potential Amendments to the Load Management Standards | California Energy Commission

Utility executives share their investment priorities

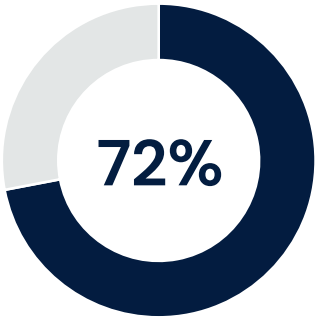
ICF surveyed 190 utility leaders to learn how they're approaching decarbonization, resilience, electrification, and energy equity. Here's what they're investing in:



Over 3 in 4 (76%) organizations plan to invest more in emissions reduction or decarbonization (compared to last year).



Of utility leaders say climate change resilience is a moderate or high priority for their organization.



Of utilities are increasing their electrification investments this year

Source: ICF

ICF's analysis shows that FLM, for one utility's service area, can reduce systemwide peak loads by about **19%** from the expected peak in **2032**. The combination of FLM and energy efficiency could reduce peak load in **2050** by **25%** and reduce average annual load growth so that, instead of increasing by **0.5%** each year, load decreases by **2.3%** per year.

Source: ICF

FLM enables electrification: Many electric utilities are on the front lines of decarbonizing large parts of the economy, most notably the building and transportation sectors. The increased load caused by electrification will likely lead many utilities that today experience peak demand in the summer to face a significant switch to winter peaks. In addition, new heating and vehicle charging loads—both residential and fleets—will come with a significantly different load shape than these utilities have traditionally faced. Unless these new and increased loads are actively managed through tools such as FLM to mitigate peaks and match load to generation—both centralized and distributed sources—costs and, therefore, rates are likely to be much higher, to the detriment of customers and the grid.

Customer goals and expectations

While utilities have emerging goals, customers increasingly desire choice over their energy use, such as selecting a renewable energy supply option from the utility to installing behind-the-meter (BTM) DERs. Most importantly, customers invest in BTM clean energy technologies for their own purpose and use. Utilities may incentivize these investments or enable them through Tariffed On-Bill approaches that leverage third party financing, for example, but any FLM strategy must consider the value proposition ***to the customer*** of potential shared, dual use of customer-owned assets.

Additionally, unless autonomous BTM DERs are associated with a utility program or a tariff, it's difficult to optimize these resources to their full potential. In fact, consumer choice can present a challenge when not coupled with FLM. DERs like rooftop solar systems can add destabilizing stress to the grid where constraints exist by creating voltage or hosting capacity issues. This stress can raise costs and test grid resilience and has often led to long interconnection delays that can frustrate customers. FLM makes automated, real-time optimizations to these connected devices to help customers tap the full energy savings and value DER offers. By leveraging data and smart controls like distributed energy resource management systems (DERMS), FLM can turn DERs from a grid weakness to a grid strength by helping better control solar and storage and integrate it with customer demand. **In effect, FLM can harness the full value of DERs by balancing the many points of supply and demand, thereby optimizing the grid and increasing grid resilience at the local and system level.** Though this vision for aggregating and managing FLM with real-time utility operations has not yet been achieved by any utility at scale, technology innovation and boundary-pushing utility customer programs are keys to getting there. As this vision is realized, both customers and utilities will be able to use DERs and achieve the control and choice they want.

Developing an FLM strategy

A well-developed FLM strategy can support a utility's strategic roadmap from end to end. Enabling FLM requires a system-wide load management strategy, i.e., "orchestrated decentralization"—at the distribution level to balance local supply and demand—as well as a modernized, two-way grid that provides increasing telemetry, visibility, and management of these devices. In addition, utility leaders tasked with developing comprehensive FLM strategy should consider the following steps:

- Prioritize the objectives that flexible load management can help achieve, such as integrating a more intermittent and renewable resource mix, mitigating potential impacts associated with aggressive building and transportation electrification, and supporting GHG emissions reduction goals.
- Understand the jurisdictional policy landscape and customer trends, including the role of the customer—their motivation for various energy management choices and their willingness to share dual use (however imperceptible) of their clean energy technologies.
- Identify appropriate retail tariffs or incentives to enable the desired grid and customer benefits.
- Undertake granular load forecasting and integrated distribution planning to identify investments needed to support increased electrification.
- Evaluate the costs/benefits associated with addressing locational and temporal grid needs given increasing levels of electrification.

Pursue FLM pilots and programs aligned with your load management strategy

Once a strategy is in place, the next step is for utilities to design and implement customer programs, starting with pilots. Well-designed FLM programs will require a proactive approach that cuts across traditional internal silos. Fortunately, there are a number of potential approaches to explore that will enhance a utility's ability to actively manage customer loads through FLM on a path toward the ultimate vision for an optimized grid.

- **Load and DER forecasting:** What are the implications to a utility's grid from the new sources of load and DERs? Utilities need to undertake bottom-up analytics and conduct trend analyses of key areas such as EV adoption, rooftop solar, and building heat electrification. Running multiple models and scenario planning will allow utilities to assess important trends and when they are likely to reach a critical impact on the grid. That, in turn, allows utilities to determine when they need new generation, grid infrastructure upgrades, or new FLM capabilities in place.
- **Realizing DER value:** DERs can bring many forms of value to the grid, but utilities must prioritize which benefits they value most—capacity, greenhouse gas reduction, locational, system-level—and how those values translate to customer benefits. When utilities understand the forms of value they seek, they can design tariffs and programs that benefit customers while maximizing a specific value, particularly as new technologies emerge to create finer resolution and control of electricity use and movement.
- **Navigating vendor and technology solutions:** In the world of demand-side management technologies and providers, utilities face a messy environment. There is no shortage of providers claiming to offer a DERMS solution to seamlessly control distributed loads and optimize the grid. The providers range from startups to established multinational corporations. Their technologies may have only been used as a control for demand response events or they may have been born from complex utility systems. The field is evolving quickly, and utilities must navigate the selection process for pilots by making careful choices based on their specific use cases, with an eye to future expansion as the need to aggregate horizontally across diverse customer-sited resources becomes more critical.
- **Customer and DER targeting:** Not all customers have the same potential or desire to contribute to pilots and programs, and ideally, customers will want to be served by the grid—not managed by it. Some customers have the most potential to "move the needle," some are more likely to participate in a program, and some bring unique benefits such as advancing energy equity. Therefore, utilities must have a clear sense of the value proposition to the customer, i.e., what they can offer their customers by participating in a program, how they can support financing or incentivize dual participation of customer-owned assets, then use analytics based on their AMI and demographic data to understand how they should be engaging with specific customers. This will ensure FLM capabilities are growing in ways that best serve program goals.
- **Pilot and program design and implementation:** While using customer loads as a grid asset through FLM is a wonderful vision, questions remain today about how firm those resources really are. To support grid planning, the load management promised by FLM needs to be certain. Through pilots and scaling into larger programs, utilities can use data and analytics to learn which customers are most likely to allow load management actions to occur uninterrupted and which are likely to intervene, such as by turning a thermostat up or down manually and charging EVs at specific times. As they collect data, utilities will get a clear picture of their real load management capacity versus the theoretical, informing future iterations of programs as utilities advance toward realizing the full value of FLM.

Ask and answer the right questions to inform an FLM program

- How can DERs and FLM be managed for both customer and system benefit?
- How rapidly and at what scale do we expect DERs and electrification to be deployed—organically, through advanced financing mechanisms such as Tariffed On-Bill, and through federal, state, and utility incentives?
- What contribution to overall GHG reduction goals should I plan for or expect from my customer programs?
- What is the load forecast given the increased electrification of heating and transportation end uses?
- What is the FLM potential in our service territory, and what will the interaction between behind-the-meter devices and the resulting net load potential and shape be?
- What is the value of these resources when aggregated and managed, for example, to mitigate the impacts of electrification?
- How can AMI data be leveraged to gain insights into the above issues?
- What type of control platforms would I need to deploy to capture system benefits in the near-term and with an eye to the longer-term?
- What is the role of independent third parties (i.e., traditional aggregators) vs. program implementers in aggregating customer resources and what are the potential implications for the grid and the ability to achieve GHG emissions reduction?
- What regulatory approvals or obstacles would be involved to pursue FLM via a customer program?
- What type and level of controls are my customers comfortable with?

Conclusion

FLM will be a critical tool for utilities to decarbonize, build grid resilience, and enable electrification. To get started, utilities will need a clear understanding of the value FLM can provide to customers and the grid as well as the lost opportunity associated with ceding this functionality to independent non-load serving entities. Next, they'll need a load management strategy or roadmap to identify the staged grid investments, regulatory treatment, technology requirements, data management strategy, and enabling retail tariffs needed to manage the grid, provide value to customers, and achieve policy goals. Finally, utilities can implement their FLM strategy through programs, starting with pilots. This approach will ultimately help utilities use FLM to continue to provide safe, reliable, and affordable electricity to all customers while also achieving their emerging goals around decarbonization, grid resilience, and electrification.

About the authors

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Steve has over 30 years of experience evaluating the economics of conventional and renewable energy resources—both central station and distributed generation—within the context of developing technologies, market design, and environmental regulations. Working with major U.S. power companies and developers, he helps evaluate the impact of distributed resources on their systems and the implications for business models and distribution system planning and operations.

Steve publishes numerous whitepapers on the value of solar and distributed resources. Steve is the lead author of multiple analyses that evaluate the impact of carbon and other environmental policies on the future generation fleet at national and regional levels.

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As a strategic leader with over 25 years of experience in energy, environmental policy, and management consulting, Patty leads our distributed energy resources (DER) flexibility services product and market development activities in North America. Working at the intersection of customer preferences, emerging technology, and evolving regulatory policy, she is redefining integrated demand-management programs to help clients navigate the transformation to a decarbonized, affordable, customer-centric grid.

Patty's previous leadership roles include vice president for market development and strategy for our U.S. Commercial Accounts and vice president for Jones & Stokes, where she was responsible for western regional operations, including oversight of energy and environmental infrastructure projects and programs in six states.

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