Smart Buildings, Smarter Grid: The BMS-DR Connection

Tom Ledyard, DNV
Vijay Gopalakrishnan, DNV
Kevin LaFlamme, National Grid
Miranda Skinner, Cape Light Compact

ABSTRACT

As states in the Northeast advance their clean energy and grid resilience goals, automated demand response (auto DR) in the commercial and industrial (C&I) sector offers significant potential. However, persistent barriers hinder the integration of building management systems (BMS) to enable auto DR. This study examines these institutional, financial, and technical barriers across C&I facilities.

Multiple activities were undertaken to support this study, including a comprehensive review of DR program historical data, utility program interviews, BMS vendor interviews, Curtailment Service Provider (CSP) interviews, participating customer surveys, and interviews with customers who are not using BMS systems for DR. This paper delivers a strategic roadmap of recommendations and best practices for program implementation and customer engagement, with the goal of helping utility planners, policymakers, and building owners overcome adoption challenges and unlock scalable demand-side flexibility with reduced manual intervention.

By addressing systemic barriers, this work promotes equitable access to DR programs and accelerates the transition to a responsive, low-carbon energy system. The findings will be broadly applicable to other regions pursuing similar grid modernization initiatives.

Introduction

Grid operators across the Northeast are navigating electrification, increasing weather volatility, and the need to integrate variable renewable generation, all while maintaining reliability and controlling costs. Demand response (DR) is a proven tool for reducing peak demand and providing operational flexibility, but many commercial and industrial (C&I) programs still rely on manual curtailment actions that are labor-intensive, inconsistent, and difficult to scale. Building management systems (BMS)-based DR can address these limitations by translating event notifications into repeatable control actions that can be executed with minimal or no on-site intervention.

BMS are widely deployed to manage HVAC, lighting, and other building loads. They offer a practical pathway to scale DR offerings in the C&I sector. Modern BMS systems offer load management modules and open communications protocols that can support pre-programmed curtailment sequences, semi-automated operator workflows, or fully automated dispatch. Despite this technical readiness, BMS remains an underutilized resource in DR programs. Our interviews with Curtailment Service Providers (CSPs), program administrators (PAs), BMS vendors, and surveys with customers consistently indicated that technology availability is no longer the primary constraint. Instead, adoption is limited by customer understanding of participation pathways, perceived operational and cybersecurity risks, insufficient or misaligned incentives to justify added configuration and commissioning effort, and gaps in coordination among PAs, CSPs, and BMS providers.

This paper synthesizes evidence from various research activities to provide insights into BMS adoption for DR. By addressing key non-technical barriers, our study aims to help utilities, policymakers, CSPs, and building owners unlock scalable demand-side flexibility, reduce manual intervention, and advance clean energy and grid resilience goals in jurisdictions pursuing grid modernization initiatives.

Methodology

The study team analyzed historical PA performance data and employed primary research, secondary research, and analysis.

Historical Performance Analysis

A collection of DR PAs in New England provided participation data from an ongoing multi-PA DR program, covering the years 2019 through 2024. These datasets offered valuable insights into historical participation trends. Using the program tracking data from each PA, we examined participation rates and savings magnitudes by year to identify trends in activity over the past five years. The starting year varied across PAs, some starting in 2019, others in 2020.

PAs captured the "average reported reduction" for each customer annually. This customer average equaled the sum of the savings for each event divided by the number of events. Our analysis summed the customer average reductions to compute the total "average reported reductions" annually.

Two PAs captured the technology employed by the enrolled participant. With this attribute, our analysis determined reduction savings trends by technology and reduction strategy (i.e., process curtailment, BMS, HVAC, etc.), and customer segment.

Secondary Research

Our secondary research included a review of auto DR program materials to gather core knowledge of the strategies used to solicit participation and to identify potential gaps in outreach content or method. The program materials we reviewed included:

- Auto DR PA program manual, guidelines, and marketing materials
- Auto DR CSP program marketing materials
- 2019 Consolidated Demand Demonstration Project Evaluation Report (2019 Report)[1]

Other secondary research investigated:

- **Active auto DR/DR programs in New England,** including two state battery storage initiatives, and national studies (e.g., LBNL[2] and Stanford on California DR[3]). Focus areas of this review included barriers to energy efficiency (EE) and DR integration via BMS and BMS DR technology and modules.

[1] https://ma-eeac.org/wp-content/uploads/2019-Consolidated-Demand-Demonstration-Project-Evaluation-Report_04-15-2020_clean.pdf
[2] LBNL, "Opportunities, Barriers, and Actions for Industrial Demand Response in California"
[3] Stanford, "Case Study of Demand Response in California: Barriers, Policies and Business Models"

- **Barriers experienced elsewhere.** We researched DR initiatives using BMS for load reduction across the county,[4] with a focus on the barriers[5] encountered in their deployment, solutions and actions undertaken, and other jurisdictional information (policies, regulatory environment) that might provide insights for stakeholders in the region.

- **BMS DR modules and functionality and technology research.** We team reviewed studies from other national labs[6] pertinent to auto DR using BMS[7] and reviewed prior findings in the region from pilot studies pertinent to the use of BMS for DR.

From this effort, we gathered and synthesized quantitative and qualitative findings on market and customer barriers, program objectives, and trends.

Primary Research

The study team interviewed four program administrators, six active CSPs and aggregators, and five BMS vendors/implementers. Additionally, the study team administered web surveys with three PA customer cohorts.

Interviews with Program Administrators

The study team interviewed four PAs to gather their insights on the feasibility of various program design ideas and alternatives for auto DR programs. We conducted these interviews to better understand:

- Program trends and barriers that PAs are experiencing
- Future program goals and aspirations
- Plans with respect to the implementation of BMS DR modules
- The current and planned extent to which DR is promoted with BMS EE projects
- Improvements to partnerships with BMS vendors or other industry groups
- Any programmatic changes being considered and the reason for those possible changes

In the interviews, we reviewed which program documents and data were available to support the analysis. These included customer lists, segmentation details, dispatch strategies, nominated and program-calculated reductions, and dropout rates.

Interviews with the CSP Representatives

CSPs are key agents of program delivery and provide a unique technical and market perspective on the program. As with the PAs, we interviewed six CSPs to gather their perspectives on the feasibility of including auto DR in DR program.

---

[4] Demand Side Analytics, LLC, SCE 2024 Demand Response Executive Summary, April 2025
[5] Integrating Energy Efficiency and Demand Response Programs | Better Buildings & Better Plants Initiative, accessed 2025
[6] LBNL, Energy Efficiency and Demand Response Integration, June 2019
[7] Center for Sustainable Energy, ADR Project Implementation Guide for Electricians and Contractors, May 2018

Interviews with BMS Vendors

BMS vendors bring specialized expertise and lead many technological innovations, making them valuable sources of insight. We interviewed five vendors and implementors to assess the availability of demand response modules, understand how these modules integrate with new and existing equipment, and gather perspectives on customer adoption, market practices, program participation, barriers, support needs, and overall vendor outlook.

Surveys with PA Customers

The study team conducted surveys with three customer groups.

- **Program participants**: We surveyed 28 active DR program participants as part of this study. The sample included all active participants in the program being studied (i.e., a census approach), whether or not they enabled auto DR. Topics included motivations for joining the program, satisfaction with various program elements, and possible barriers to participating in called events.

- **Program dropouts**: Thirteen program dropouts were surveyed as part of this study. The sample included all dropouts (i.e., a census approach). Program dropouts are defined as customers that notified the PAs of dropping out or that have a kW nomination with zero performance across events during the season. This group of customers spoke to program barriers among those with the technical ability and intention to participate.

- **Non-participants**: We surveyed twenty-eight EE participants that did not participate in the DR program being studied to understand why they chose not to participate. Topics also included barriers to participation, awareness of the DR program, effectiveness of their BMS system on reducing energy use, consideration they have given to using their BMS for DR purposes, barriers to or ease of use with BMS functionality for DR purposes, and suggestions on how auto DR might dovetail with BMS installed for EE purposes.

Findings

Broadly, the secondary and primary research performed supported the notion that BMS-equipped participants perform reliably during DR events. Automated or semi-automated systems reduce operational burden and improve satisfaction for both participants and program administrators. BMS is widely regarded as an effective tool for DR, offering predictability and consistency, though high installation or upgrade costs remain a significant barrier. Approximately 75% of customers still relied on manual load shedding, which is less efficient and more labor-intensive. While automated notification systems are generally effective, customer fatigue can occur if too many events are scheduled. Event durations of two to three hours also present challenges for battery economics, requiring careful consideration in program design.

This section covers the key findings from this research.

Participation Pathways

Customer acquisition for the C&I DR program was led primarily by the CSPs, who recruited customers, supported enrollment, and assisted with curtailment planning and event participation. In addition to CSP outreach, some PAs conducted direct outreach through their C&I sales teams or account representatives, although this approach was not universal across all PAs. This mechanism was effective in recruiting and enrolling customers, particularly those with existing DR capabilities.

There are three distinct BMS participation pathways, each with different expectations, levels of automation, and strengths and weaknesses.

1) With manual DR, the facility staff manually adjust systems (e.g., adjusting HVAC setpoints, turning off equipment) in response to an event notification.
   - **Pros:** Highest operator control
   - **Cons:** Least predictable performance; highly staff-dependent

2) Semi-automated DR is the PAs' preferred participation pathway. This approach requires the participant to manually trigger preprogrammed sequences that exist within the BMS load management module when an event is called (typically via email).
   - **Pros:** Reduces labor while maintaining control; improves consistency
   - **Cons:** Still relies on staff presence and awareness

3) The third pathway is fully automated DR, though adoption remains limited due to high upgrade costs and control concerns. Research found that BMS usage and API-based automation are more common in technologically advanced sectors, such as data centers or crypto mining operations. With this pathway, the BMS automatically executes preprogrammed sequences when a DR signal is received electronically. Per the PA interviews, this pathway is not their current focus.
   - **Pros:** Most reliable and repeatable performance; lowest operational burden
   - **Cons:** Often perceived as risky; requires staff training and clear communication

BMS Capabilities

From a technological standpoint, BMS capability is not the limiting factor in its use for DR purposes. The barrier lies in how BMS-enabled DR is communicated, monitored, and supported.

Vendors and CSPs agreed that modern BMS platforms can respond to events with predefined curtailment sequences, supporting DR initiatives to reduce demand on the grid. Most BMS already support:

- DR modules
- Automated control sequences
- Cloud- or signal-triggered curtailment routines
- Preprogrammed load-shed strategies across HVAC, lighting, and process loads

Advances in open protocols (e.g., BACnet, Modbus) and the increased use of enterprise-level dashboards mean BMS platforms can already receive DR signals, initiate event actions, and

optimize curtailment sequences. Even legacy systems can often accommodate DR through software upgrades or add-on modules.

BMS Barrier 1: Loss of IT and System Control

Customers consistently reported concern about loss of control and IT security. While these concerns were typically described as perceptions rather than true technical risks by BMS vendors, they nonetheless influence enrollment decisions and willingness to pursue DR. Common security concerns include:

- External access to the BMS through cloud-based event signalling increases the risk of breaches. Note that vendors report BMS data remains on the customer's servers and reporting is encrypted, suggesting the customer should ideally not have IT security concerns.
- Programmed curtailment sequences override customer preferences or needs
- Temperature setpoints, safety constraints, or equipment behavior change unexpectedly or with little notice
- Inability to override or modify curtailment sequences

Control concerns are amplified when customers feel uncertain about the safeguards in place to maintain comfort or productivity. Newer BMS include load management modules with user-friendly interfaces that enable customers to pick and choose what they want to curtail and adjust with ease. Vendors noted the software programming is inexpensive compared to the systems and controls. Program modules also allow for staggered curtailment sequences, such as building by building, or hourly changes to temperature setpoints to maintain comfort. BMS vendors should work with customers periodically to optimize savings.

Despite the technical readiness and sophistication of BMS platforms, customers, CSPs, and BMS vendors expressed confusion about the available options for participating in the DR program. Across research activities, stakeholders indicated that participation options were not clearly or consistently communicated to customers. Many customers therefore incorrectly overestimated the above risks. These misconceptions directly inhibited adoption of auto DR strategies, even among customers with technically capable BMS platforms.

While C&I customers have larger and more flexible loads, businesses may be reluctant to participate in auto DR programs due to concerns about potential disruptions to operations or productivity. This concern can be particularly acute with the prospect of unexpected off-peak calls, notification frequency that might exceed expectations, or extended curtailment durations. In addition to lost productivity, the cost of implementing BMS solutions, such as advanced control systems and integration with existing energy management systems, can be costly. Auto DR in combination with BMS solutions often require customized, technically complex systems that can be difficult to deploy and maintain.

BMS Barrier 2: Sales within EE Context

From the vendor perspective, they cannot cost-effectively, with minimal risk to the BMS project, introduce DR concepts during the sales process, system design, or installation because customers lack DR knowledge and information. Vendors consistently stated that the current incentive (up to $3,000 to the customer in this case) is not sufficient to justify the additional

time, sales complexity, customer education, or commissioning work required to educate the customer and implement auto DR curtailment capabilities.

Vendors lead with selling and installing BMS to support building management and EE. DR is treated as an optional add-on rather than a central value proposition. All vendors noted DR discussions often slow down BMS sales and installation timelines, discouraging vendors from introducing them and resulting in customers receiving minimal exposure to DR opportunities during BMS sales, design, installation, or commissioning.

Without adjusting incentives and/or offering customer education about DR, the program will likely continue to miss opportunities to enroll newly BMS-equipped facilities capable of reliable curtailment performance.

BMS Barrier 3: Coordination and Collaboration Among Stakeholders

Although PAs, CSPs, and BMS vendors work directly with the same customer base and each plays a central role in enabling successful BMS-enabled participation in the DR program, they largely do not collaborate or coordinate. This lack of coordination results in missed opportunities to educate customers, expand the market, and support effective load-shed strategies.

As discussed above, BMS customer acquisition leads with EE, and vendors highlighted that certain building types, including municipal buildings, office spaces, big box stores, and schools, represent strong target markets for auto DR. Vendors typically focus sales efforts on new BMS installations and upgrades to their existing customer base, leaving untapped market potential with customers with legacy BMS. They noted this is a difficult market to tap without visibility into customer characteristics, such as the legacy BMS vendor, the potential performance value of curtailment, or customer's knowledge of and interest in DR.

BMS vendors did not have access to utility meter interval data and noted that CSPs currently had access to the necessary utility meter data. Coordination between BMS vendors and CSPs would eliminate the need for them to install a new meter, reducing installation costs and improving performance.

CSPs also often lacked visibility into which facilities had DR-capable BMS platforms, which vendors were active at specific customer sites, and what level of operator training was needed for the facility to successfully implement automated or semi-automated curtailment. This lack of transparency sometimes led CSPs to overlook BMS-equipped candidates or to engage these facilities without a clear understanding of their existing controls environment. CSPs also noted that customers were frequently unclear on the distinctions among manual, semi-automated, and automated DR, leading to misconceptions that complicated enrollment conversations. This was reflected in customer surveys, with non-participants much less familiar with curtailment strategies than participating customers.

PA EE staff, who were often the most frequent point of contact for customers undertaking building improvements and BMS installation, generally lacked training on DR concepts, BMS capabilities, and the specific opportunities to integrate auto DR during EE or BMS project timelines. As a result, many customers completing BMS installations or major control upgrades receive no auto DR education at precisely the moment when they would be best positioned to adopt the solution. Without PA involvement, the potential synergy between EE, BMS modernization, and auto DR remains underleveraged.

For execution of BMS controls projects, final decision making requires the consent and collaboration of multiple stakeholders at a site (e.g., executives, facility management, BMS

contractors). Our primary research noted that involving and educating all key stakeholders was a time-consuming endeavor. Even when there was a consensus among decision makers, it took time for the project to be approved at multiple levels of management. We also identified an often-unmet need for dedicated trained resources on-site to monitor the programmed event curtailment sequences and revise the sequences as necessary to optimize savings and business requirements such as environment (comfortable work environment) and productivity.

BMS Barrier 4: Customer Awareness

Customer awareness of DR remained limited, as customers rarely requested DR functionality when installing or upgrading BMS. In many cases, it was unclear whether this stemmed from a lack of awareness of DR opportunities or from DR being a low priority. BMS vendors confirmed that DR was not a prominent part of their sales approach; instead, they focused on the core BMS product (i.e., BMS equipment and software). They led with building controls, energy savings, and participation in the EE program. Introducing DR during the sales process could complicate the customer conversation and did not meaningfully increase vendor revenue or significantly change the customer's return on investment. Even though DR participation can help customers reduce energy costs, the available enrollment incentive (approximately $3,000) did not provide a strong enough financial driver for vendors to actively promote it. This dynamic contributed to a market environment where DR was acknowledged but rarely emphasized, often appearing only as a secondary "add-on" rather than a strategic opportunity for customers.

Education and training needs further compounded these challenges. While vendors provided documentation, demonstrations, and both in-person and classroom training to support BMS operation, there remains a clear need for more structured training and feedback mechanisms to help customers fully utilize BMS-enabled capabilities. If DR functionality is added, customers also require foundational education on what DR is, how it affects building operations, and how automated or semi-automated curtailment strategies can be integrated into existing processes.

BMS Barrier 5: Market Barriers to the Integration of Auto DR within DR Programs

Common barriers across all customer segments included the lack of transparent pricing and incentives and the lack of clear and actionable market signals. Effective participation depended on a customer's understanding of the financial benefits of participating in the DR program. This requires clear, consistent, and timely market signals from PAs and CSPs.

Conclusions

Overall, BMS integration represents a promising pathway for improving the consistency, scalability, and performance of BMS systems within DR programs. BMS technology is technically capable of supporting auto DR, but adoption remains limited. Interviews with a sample of five BMS vendors, including three large national vendors, suggest that DR is not typically emphasized during the BMS sales process, as vendors generally focus on broader system efficiency, operational control, and energy management benefits rather than DR participation opportunities. Customers expressed moderate interest in leveraging BMS for DR but were hesitant to invest without a clearer value proposition. In addition, some customers

remain concerned about loss of operational control, often due to the misconception that curtailment actions are initiated externally rather than triggered or approved by site staff.

Given the central role of incentives across stakeholder groups, PAs should continue to review incentive adequacy. Any increases in automation expectations, event frequency, or participation complexity should be paired with incentive structures that clearly offset added effort and perceived risk.

Education is a foundational element in overcoming these barriers. Program administrators, curtailment service providers, and BMS vendors should provide clear and consistent messaging about participation pathways to potential auto DR program participants. Proactive communication and educational materials will help address customer concerns by outlining risks, benefits, and expectations. Websites and program manuals also support customer education and should be accurate and up-to-date. Opportunities to strengthen messaging for prospective participants include sharing building-owner success stories with emphasis on event flexibility, opt-out options, and realistic expectations, helping customers understand DR without fearing operational loss, clearly defining roles and expectations, and addressing risks and mitigation strategies. Vendors also emphasized the value of improved visibility into which BMS platforms are installed at customer sites and proactively sharing that information with vendors and CSPs when DR opportunities arise, enabling a more centralized and streamlined outreach process.

References

Eversource, National Grid, Unitil, and Cape Light Compact. 2026. "MA25DR01-E-C&I - Barriers Study for MA C&I Active Demand Reduction Initiatives." https://ma-eeac.org/wp-content/uploads/MA25DR01-E-CI-MA-ADR-Initiative-Barriers-Study-Report_FINAL.pdf.

TechTarget. 2024. "Building Management System." https://www.techtarget.com/searchdatacenter/definition/building-management-system.

MassSave. 2023. "Offering Materials for ConnectedSolutions for Commercial / Industrial Customers." https://www.masssave.com/-/media/Files/PDFs/Business/CI-ConnectedSolutions-Offering-Materials_June-2023.pdf.

Eversource. 2019. "Consolidated Demand Demonstration Project Evaluation Report." https://ma-eeac.org/wp-content/uploads/2019-Consolidated-Demand-Demonstration-Project-Evaluation-Report_04-15-2020_clean.pdf.

Eversource, National Grid, and Unitil. 2019. "Cross-State C&I Active Demand Reduction Initiative Summer 2019 Evaluation Report." https://ma-eeac.org/wp-content/uploads/Cross-State-CI-DR-S19-Evaluation-Report_04-15-2020_clean.pdf.

LBNL. "Opportunities, Barriers, and Actions for Industrial Demand Response in California."

Stanford. "Case Study of Demand Response in California: Barriers, Policies and Business Models."

Demand Side Analytics, LLC. 2025. "SCE 2024 Demand Response Executive Summary.

Better Buildings & Better Plants Initiative. “Integrating Energy Efficiency and Demand Response Programs.” Accessed 2025. https://betterbuildingssolutioncenter.energy.gov/resources/integrating-energy-efficiency-and-demand-response-programs.

LBNL. 2019. “Energy Efficiency and Demand Response Integration.” https://www.pge.com/content/dam/pge/docs/about/doing-business-with-pge/LBNL-EE-DR-Integration.pdf.

Center for Sustainable Energy. 2018. “ADR Project Implementation Guide for Electricians and Contractors.” https://energycenter.org/sites/default/files/docs/microsites/apr/ADR%20Project%20Implementation%20Guide%20for%20Electricans%20and%20Contractors.pdf