The State of ASHRAE Guideline 36: Promise, Progress, Challenges, and Ongoing Activities

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ABSTRACT

The commercial building sector accounts for roughly 35% of U.S. electricity use, with HVAC systems representing the largest end-use. ASHRAE Guideline 36, published in 2018, standardizes high-performance HVAC control sequences to improve efficiency, simplify commissioning, and reduce variability in building control implementation. Although California field demonstrations have shown whole-building electricity savings of 11–35% and HVAC savings up to 58%, adoption has been slow and uneven across regions. This paper reports market research from a Minnesota field demonstration and examines the Guideline's original intent, progress since publication, implementation barriers, and ongoing efforts to accelerate adoption.

The Minnesota demonstration showed that successful implementation depends on proper engineering oversight, experienced controls contractors, thorough commissioning, and HVAC system compatibility. In one small library retrofit, incomplete sequence implementation and limited tuning contributed to increased post-retrofit energy use, underscoring the risks of applying Guideline 36 without adequate technical support. Despite these challenges, awareness of Guideline 36 continues to grow, major BAS manufacturers have developed compliant programming libraries, and California's 2025 Title 24 code is expected to drive broader adoption through mandatory compliance for selected applications. Ongoing work by stakeholders including ASHRAE and CalNEXT is focused on standardized functional testing, control programming library conformance validation, and tools that reduce deployment risk.

Introduction

The commercial building sector accounts for approximately 35% of total U.S. electricity consumption, with HVAC systems representing the largest single end-use category. Despite decades of technological advancement in building automation systems (BAS), many commercial buildings continue to operate with suboptimal control strategies that waste energy while failing to maintain consistent occupant comfort. Traditional building control design relies heavily on individual engineering judgment, resulting in significant variability in control sequence quality, implementation complexity, and operational performance across projects.

ASHRAE Guideline 36, *High-Performance Sequences of Operation for HVAC Systems*, was published in 2018 to address these challenges by standardizing proven control strategies for commercial buildings. The guideline provides detailed, prescriptive control sequences for air-handling units (AHUs), variable air volume (VAV) terminal units, and central plants, incorporating best practices such as dynamic supply air temperature and static pressure resets, demand-controlled ventilation, and optimized economizer operation. Guideline 36 aims to simplify design, reduce implementation errors, improve commissioning efficiency, and deliver consistent energy savings across diverse building types and climate zones.

However, since its publication, industry adoption has been uneven. Understanding the real-world challenges and opportunities associated with Guideline 36 deployment is critical for utility energy efficiency programs, building owners, and controls industry stakeholders seeking to accelerate market adoption. This paper presents findings from the market research of ASHRAE Guideline 36 adoption in a Minnesota ASHRAE Guideline 36 field demonstration project (Zhou, et al. 2026). It summarizes the original intent of the Guideline, progress made since its publication in 2018, challenges still remined in real-world implementation of the Guideline, and ongoing activities addressing these challenges.

Background And Context

The Traditional Building Controls Industry Challenge

The traditional building controls industry has long suffered from fragmented expertise and entrenched proprietary practices that undermine building energy performance. For decades, each BAS manufacturer deploys its own control sequence logic in programming libraries or templates tied to proprietary control programming software tools or platforms. Mechanical engineers often do not have access to these proprietary programming or software tools and won't be able to interpret the control sequences without proper training by the BAS manufacturers. This often resulted in control specifications written by mechanical engineers that were typically high-level, vague, and subject to wide variation in controls contractor interpretation and implementation quality.

Controls contractors routinely copy sequences from previous projects or rely on manufacturer templates without adequate adaptation, and project success varies widely—largely dependent on individual field building controls contractor skill rather than a systematic quality framework. Timeline pressure encourages building control contractors to complete projects quickly and move on, discouraging the careful tuning and testing that high-performance control sequences require. For small and medium-sized building projects—which represent a significant share of the commercial building stock—engineering oversight and third-party commissioning are often omitted entirely, further reducing the likelihood of achieving optimized system performance.

ASHRAE Guideline 36 Overview

ASHRAE Guideline 36 represents a paradigm shift in how building control sequences are specified and implemented. The guideline provides standardized, detailed control logic incorporating measures including, but not limited to:

- Multiple control modes (Occupied, Cooldown, Setup, Warmup, Setback, Unoccupied)
- Dynamic supply air temperature resets based on zone cooling requests
- Trim and respond static pressure control with minimum setpoint limits
- Demand-controlled ventilation using CO_2 sensors
- Optimized economizer operation coordinated with mechanical cooling
- Advanced VAV terminal unit control with dual-maximum logic
- Automated fault detection and diagnostics (AFDD) capabilities

The guideline was developed through extensive industry collaboration and has been adopted as a reference in California's Title 24 energy code. Major BAS manufacturers including Johnson Controls, Siemens, Trane, Honeywell, Schneider Electric, and Automated Logic have developed full or partial programming libraries to facilitate implementation.

Benefits of Guideline 36

By providing standardized, pre-engineered, rule-based control sequences, Guideline 36 enables BAS to operate HVAC equipment at optimized efficiency across all load conditions. A simulation study (Zhang, et al. 2022) shows that for a medium-sized commercial building, Guideline 36 sequences deliver an average HVAC energy savings of 31% through retrofitting existing VAV systems. California field demonstrations (Cheng, Singla and Paliaga, 2022) consistently documented whole-building electricity savings of 11–35% and HVAC-specific savings of up to 58% in properly implemented projects. Beyond energy savings, the guideline enhances HVAC system reliability by minimizing equipment wear and tear, eliminating simultaneous heating and cooling, and incorporating built-in AFDD logic that makes troubleshooting faster and more systematic.

For the design and construction process, standardized sequences are supposed to reduce the time and effort required for control software specification, programming, and commissioning relative to traditional approaches, and give mechanical design engineers a clear reference for specifying control requirements. The guideline also directly supports compliance with ASHRAE Standards 90.1, 62.1, and 55. For building operators, the structured logic—combined with standardized trend data and fault detection outputs—makes day-to-day system monitoring more accessible.

Incorporating ASHRAE Guideline 36

Implementing Guideline 36 typically involves several key stakeholders and sequential steps. The process begins with a mechanical engineer specifying applicable sequences during design, followed by controls contractor programming using manufacturer-provided libraries or custom code, commissioning to verify correct operation and address parameter tuning, and concluding with operator training and acceptance.

This approach differs from conventional building control projects in important ways. Traditional projects often lack detailed control sequence specifications, whereas Guideline 36 provides extensive prescriptive logic. Commissioning requirements are more rigorous, including verification of dynamic reset algorithms and automated fault detection. The learning curve for controls contractors is steeper, requiring familiarity with complex interdependent control loops.

Current state of industry adoption

Since its initial publication in 2018, awareness of ASHRAE Guideline 36 has grown steadily, yet the building controls industry has been slow to translate awareness into actual project implementation. Education and outreach efforts have been substantial. Members of the ASHRAE Standing Guideline Project Committee (SGPC 36), who maintain and advance Guideline 36, have conducted many seminars and workshops at local chapter meetings. ASHRAE provides short courses and virtual trainings at ASHRAE winter and annual conferences[1]. Free online trainings are also offered by BAS manufacturers[2&3], engineering firms, the Department of Defense[4&5], the Pacific Energy Center[6], and the BEST Center[7].

Despite these efforts, many building owners, mechanical design engineers, and controls engineers have heard of the guideline but have not yet applied it in any project, largely because it is a voluntary guide rather than a mandatory building code. Most major BAS manufacturers have developed Guideline 36-compliant programming libraries, but the validation of these libraries is not yet fully standardized, and there is a notable disconnect between manufacturers who develop the libraries and contractors who must apply them in the field.

A significant market inflection point is approaching. In the California's 2025 Title 24 energy code prescriptive approach compliance path, it requires the use of a partial set of specific ASHRAE Guideline 36 sequences in new and retrofit non-residential buildings. BAS manufacturers will be required to self-certify the compliance of their programming libraries — a mandate expected to substantially accelerate adoption and drive improvements in training and library quality. ASHRAE Guideline 36 is also referenced in the Washington State Energy Code and in GSA's P100 facility standard for the public buildings service[8]. Outside of California, adoption remains limited, particularly in states like Minnesota, where specialized expertise and engineering oversight are less consistently available.

Field Demonstrations – Successes, Challenges, and Lessons Learned

California Field Demonstrations: Success with Proper Implementation

California field demonstrations conducted under previous research programs (Cheng, Singla and Paliaga, 2022) provide important context for understanding implementation prerequisites. Proper engineering oversight, experienced controls contractors, and thorough commissioning enabled Guideline 36 to achieve substantial verified energy savings. Full hardware and software retrofits delivered 15–35% whole-building electricity savings with simple paybacks of 6–8 years. Software-only retrofits achieved 11–24% electricity savings with 2–8 year paybacks.

Minnesota Field Demonstration: Challenges in Industry Adoption

In the Minnesota field demonstration project (Zhou, et al. 2026), two field demonstration participants were simply asked to incorporate ASHRAE Guideline 36 into their existing building control retrofit/upgrade projects. One demonstration site was a small, single-story, 8,500-square-foot community library with a single VAV air-handling unit, seven VAV terminal units, and a gas boiler and air-cooled chiller. The other was an 83,000-square-foot, four-story historic

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[1] Guideline 36: Best in Class HVAC Control Sequences
[2] https://youtu.be/sE73bwbzTVI?si=rlSg3MXyQ8abKNOG
[3] Trane Engineers Newsletter Live: System Controls for Applying ASHRAE® Guideline 36
[4] WBDG - Introduction to ASHRAE Guideline 36
[5] WBDG - ASHRAE Guideline 36 Field Demonstration
[6] Advanced HVAC Controls in Commercial Buildings (2 Part Series) (Previously Recorded) - PG&E Energy Education Classes
[7] https://youtu.be/g2bvUCDKGEU?si=boI1hAZwoFp_dmOB
[8] https://www.gsa.gov/system/files/P100%202024%20Final%20%281%29.pdf

building with a complex mix of HVAC systems. However, only one of the floor's HVAC equipment were variable-air-volume and was suitable for Guideline 36 application.

For the small library, the building owner directly hired a controls contractor to incorporate ASHRAE Guideline 36 into an existing control system upgrade without a mechanical engineering firm involved. This is not uncommon for small building control upgrade project in practice. Most Guideline 36 sequences were programmed, but several key modes—including optimal start/stop and all setback and warmup modes—were never enabled or effectively tuned. While the supply air temperature reset functioned properly during cooling season, it failed to execute correctly during heating season, and static pressure reset parameters required repeated adjustments throughout commissioning conducted by an independent commissioning agent. The primary cause was a pre-existing HVAC constraint: insufficient zone-level reheat capacity forced operators to maintain unusually high AHU supply air temperatures (up to 90°F in winter), directly contradicting Guideline 36's operating intent. Without a mechanical engineering firm involvement, the controls contractor assumed both design and field implementation responsibilities, significantly increasing project time and effort. Energy study results showed that the weather-normalized post-retrofit energy use increased by 2.8% for electricity —outcomes that do not reflect the a properly implemented Guideline 36 retrofit.

For the larger library, an energy consultant was hired to incorporate ASHRAE Guideline 36 into the new control sequence design during an existing control system retrofit project. He also served as the commissioning agent for this project. However, the seasoned consultant only specified a simplified sequences he was familiar with, rather than the applicable Guideline 36, citing complexity.

Lessons Learned from the Minnesota Study

In the Minnesota field study (Zhou, et al. 2026), interviews with contractors, facility operators, and commissioning agents revealed consistent themes. One controls contractor reported significantly more engineering and programming time compared to typical projects, particularly for tuning dynamic reset algorithms and navigating complex interdependent control loops—even when BAS manufacturer Guideline 36 libraries were used.

Facility operators appreciated the intent of Guideline 36 but lacked sufficient training to confidently monitor system performance or troubleshoot issues without risking inadvertent disabling of energy-saving features. Both building owners highlighted the need for simplified operational documentation written for facility staff rather than controls engineers.

The commissioning agent for the small library noted that verifying Guideline 36 implementation requires more rigorous functional testing than conventional projects, demanding specialized BAS trend analysis skills and more time than is currently standard practice in the Minnesota market. The energy consultant for the larger library also served as the commissioning agent, however, neither the control sequence design nor the commissioning followed ASHRAE Guideline 36.

Based on the two Minnesota field demonstrations, with one site not fully implementing Guideline 36, the results suggest several practical barriers that may limit utility program participation and measured savings in these specific project contexts. The improperly implemented small-library retrofit created challenges for the local utility energy efficiency program, including failure to meet cost-effectiveness thresholds, a tedious custom application process, and a lengthy technical review. More broadly, the two case studies indicate that system complexity, limited controls contractor familiarity with Guideline 36, gaps in engineering oversight, aging HVAC equipment in existing buildings and incompatibility with standard

ASHRAE Guideline equipment type and system configurations, and constrained commissioning resources can all complicate implementation. It is worth to mention that these findings should be interpreted as illustrative of the implementation challenges observed in this limited set of demonstrations rather than as broadly representative of all Guideline 36 projects.

Guideline 36 Ongoing Activities

ASHRAE SGPC 36 activities

The current ASHRAE SGPC 36 active working groups include:

- **Heat pump systems working group** developing control sequences for air-source, central plant, and condenser water loop configurations
- **Laboratory systems working group** focused on sequences involving stringent temperature, humidity, pressure, and ventilation requirements in laboratory systems
- **Cold-climate working group** addressing freeze protection, VAV systems with radiant panels, preheat and heat recovery, and winter pressurization issues—topics of direct relevance to Minnesota and similar northern climates
- **Data center working group** identifying and prioritizing various data center mechanical systems and their operational requirements, and then discussing specific control sequences among stakeholders

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To address one of the challenges in industry adoption of Guideline36, a group of volunteers is developing standardized functional testing scripts to be used to verify that BAS manufacturers' programming libraries correctly implement Guideline 36 sequences—an effort aligned with the California Title 24 self-certification requirement taking effect in 2026. A new ASHRAE Standard Project Committee (SPC) 236 was formed in 2025. The proposed standard is titled "Method of Test for Control Programming Conformance with HVAC Sequences of Operation." Its purpose is to ensure complex HVAC control sequences—specifically those in Guideline 36—are implemented accurately to maximize energy efficiency, improve indoor air quality, and enhance controllability.

CalNEXT-funded research

CalNEXT, California's statewide emerging technology program designed to "identify, test, and grow electric technologies and delivery methods to support California's decarbonized future", has sponsored several recently completed projects related to ASHRAE Guideline 36:

- **Standardized HVAC Control Sequence Savings Estimation Calculator** (DeBlois, et al. 2024) developed an ASHRAE Guideline 36 energy savings estimation calculator that is flexible enough to account for building and system characteristics but simpler than a custom energy modeling approach. The team also determined the 13 parameters with the greatest impact on measure performance.
- **ASHRAE Guideline 36 Open Source Supervisory Control Technology Development and Demonstration** (Tharanga, et al. 2025) developed an open-source supervisory control framework using standardized Control Description Language (CDL) for programming logic and Brick ontology for mapping to existing BAS points. Field tests of hydronic system sequences showed 4–10% energy savings at hot

water plants ($0.065–$0.156 per square foot per year) and 19% savings at a chilled water plant ($0.28 per square foot per year).

- **Automated Guideline 36 Validation** (Cheng, Kiriu, et al. 2026) developed a draft method of test and demonstrated an automated, repeatable bench-scale validation approach to confirm that control programming conforms to G36 sequences of operation, enabling scalable quality control, supporting codes and standards, and reducing deployment risk.

A few new CalNEXT-sponsored projects are currently ongoing:

- **Simplified HVAC Control Retrofits** (CalNEXT - ET25SWE0013 n.d.) is developing simplified implementation steps and control logic for high-impact measures tailored to existing buildings; scheduled for completion in 2026.
- **ASHRAE Guideline 36 Using ASO** (CalNEXT - ET25SWE004 n.d.) is validating energy savings and cost effectiveness of using automated system optimization (ASO) approach to implement ASHRAE Guideline 36 control sequences. ASO uses a separate supervisory control platform to optimize existing BAS operations in real-time.

Conclusions

The California and Minnesota ASHRAE Guideline 36 field demonstration projects indicated that realizing ASHRAE Guideline 36's energy-saving potential depends critically on project planning, building selection, and technical expertise throughout the implementation process. Successful traditional Guideline 36 implementation requires mechanical engineering review, experienced controls contractors with guideline-specific training, and thorough commissioning—elements frequently absent in typical retrofit projects. When these prerequisites are met—as evidenced by California field demonstrations—Guideline 36 delivers excellent whole-building energy savings. On the other side, incomplete implementation, limited engineering involvement, non-standard HVAC configurations, and inadequate commissioning can prevent any savings from being realized. Guideline 36's complexity makes it difficult for small buildings with outdated or non-standard HVAC systems without simplified implementation approaches and tools. Awareness is growing, driven by California's Title 24 energy code mandate and expanding availability of implementation tools. The building controls industry are addressing these challenges through ongoing education, training, new standards, and research.

Recommendations

For Utility Energy Efficiency Programs:

- Expand utility custom energy efficiency program coverage related to building controls with high-priority Guideline 36 measures
- Leverage Guideline 36 Lite - simplified implementation steps and control logic - once available (CalNEXT - ET25SWE0013 n.d.)
- Require certified or trained contractors as prerequisite for program participation
- Focus on low-complexity, high-impact measures to improve cost-effectiveness

- Use data analytics for customer screening
- Provide or fund early engineering design support
- Establish tiered M&V requirements scaled to project complexity

For Controls Industry Stakeholders:

- Expand training specifically focused on Guideline 36 implementation
- Develop simplified tools and pre-configured templates for common small-building HVAC configurations. Utility energy efficiency program adoption of ASHRAE Guideline 36 high-impact measures could incentivize BAS manufacturers to start building these tools and templates
- Improve BAS manufacturer programming libraries based on field implementation feedback

For Building Owners and Facility Managers:

- Conduct pre-implementation assessments to verify HVAC system compatibility
- Engage a mechanical engineer in retrofit projects. In some simple control retrofit/upgrade projects this is not required. However, with the complexity of ASHRAE Guideline 36, this is necessary and should be the first step in any ASHRAE Guideline 36 retrofit projects
- Budget adequately for commissioning and parameter tuning
- Invest in facility staff training. Education and awareness of ASHRAE Guideline 36 and its benefits is important in facility staff buy-in to adopt the guideline

For Future Research:

- Conduct ASO field demonstrations with rigorous third-party M&V
- Develop and test Guideline 36 Lite packages targeting small buildings
- Establish long-term persistence monitoring
- Develop economic models comparing total cost of ownership for traditional retrofits versus ASO approaches

References

CalNEXT - ET25SWE0013. n.d. *Simplified HVAC Control Retrofits.* Accessed 6 1, 2026. https://calnext.com/approved-projects/.

CalNEXT - ET25SWE004. n.d. *ASHRAE Guideline 36 Using ASO.* Accessed 6 1, 2026. https://calnext.com/approved-projects/.

Cheng, Hwakong, R. Kiriu, B. Eubanks, J. Breda, and G. LaPalme. 2026. *Automated Guideline 36 Validation.* Technical Report, CalNEXT. https://calnext.com/wp-content/uploads/2026/04/ET24SWE0019_Automated-Guideline-36-Validation_Final-Report.pdf.

Cheng, Hwakong, Rupam Singla, and Gwelen Paliaga. 2022. *Demonstrating Scalable Operational Efficiency Through Optimized Controls Sequences and Plug-and-Play Solutions.* Technical Report, California Energy Commission.

DeBlois, Justin, R. Singla, T. Jayarathne, and B. Varcin. 2024. "Standardized HVAC Control Sequence Savings Estimation Calculator." Technical Report. Accessed 6 1, 2026. https://calnext.com/wp-content/uploads/2024/05/ET22SWE0043_Standardized-HVAC-Control-Sequence-Savings-Calculator_Final-Report.pdf.

Tharanga, Jayarathne, R. Singla, C. Duarte, A. Zou, P. Raftery, H. Cheng, and R. Kiriu. 2025. *ASHRAE Guideline 36 Open Source Supervisory Control Technology Development and Demonstration.* Technical Report, CalNEXT. https://calnext.com/wp-content/uploads/2025/11/ET22SWE0039_ASHRAE-Guideline-36-Open-Source-Supervisory-Control-Technology-Development-and-Demonstration_Final-Report.pdf.

Zhang, K., D. Blum, H. Cheng, G. Paliaga, M. Wetter, and J. Granderson. 2022. "Estimating ASHRAE Guideline 36 energy savings for multi-zone variable air volume systems using Spawn of EnergyPlus." *Journal of Building Performance Simulation* 15(2), 215–23.

Zhou, Xiaohui, C. Battisti, R. Singla, G. LaPalme, G. Paliaga, and B. Eubanks. 2026. *Field Demonstration of ASHRAE Guideline 36 High-Performance Sequences of Operation for HVAC Systems.* Technical Report, Minnesota Department of Commerce.

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