Audit Template: A Modular, Interoperable Web-Based Platform for Building Energy Audits and Retrofit Planning

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ABSTRACT

Commercial buildings account for roughly 35% of U.S. energy use (EIA 2020), and improving their performance requires targeted retrofits supported by accurate, consistent, and interoperable audit data. Comprehensive energy audits are inherently data-intensive, capturing building characteristics, systems, schedules, utility data, and energy efficiency measures (EEMs). At scale, inconsistent formats and data quality often impede automated analysis, benchmarking, and program-level decision-making.

Audit Template (AT), a web-based platform initially developed to standardize audit data collection and reporting, has evolved into a flexible, modular system now adopted by multiple states and efficiency programs. Recent advancements include support for multiple audit levels (ASHRAE Level 1, Level 2, and a targeted audit pathway), a customizable template creator for energy efficiency programs, state and localities, scenario analysis and retrofit planning tools, automated validation and quality checks, and enhanced interoperability with data management platforms such as SEED, ENERGY STAR Portfolio Manager, and third-party applications via API. AT also integrates with DOE's Asset Score, enabling whole-building modeling and retrofit evaluation.

This paper highlights Washington State's implementation of AT to support its energy efficiency programs, including its Energy Efficiency Grants. By ensuring complete, consistent, and analysis-ready datasets across thousands of buildings, AT provides state and local governments with the infrastructure to administer programs efficiently while offering building owners and auditors streamlined workflows for retrofit planning.

Audit Template demonstrates how a flexible, interoperable platform can meet the dual needs of program implementation and building-level decision-making, helping building owners and program administrators accelerate energy efficiency and cost savings.

Introduction

Improving the performance of existing buildings represents one of the most significant and immediate opportunities to reduce overall energy use across the built environment. In most regions, the majority of buildings that will be standing for decades to come have already been constructed (Mills 2011), and many operate with aging equipment, outdated control systems, and suboptimal operational practices (Katipamula et al, 2005). While new construction baselines continue to advance, the scale and longevity of the existing building stock make it essential to focus on upgrades, operational improvements, and market interventions that address current facilities.

A broad ecosystem of energy efficiency programs has emerged to address these challenges. Energy audit and technical assistance programs play a critical role in identifying cost-effective opportunities, uncovering operational inefficiencies, and prioritizing capital investments. In parallel, retro-commissioning initiatives focus on optimizing existing systems—often delivering meaningful savings through improved controls, calibration, and scheduling with relatively modest capital outlays (Gunasingh et al 2019).

Within this landscape, structured energy audit programs that require comprehensive assessments, such as ASHRAE 211, have become particularly common. ASHRAE 211 establishes a consistent, transparent framework for commercial building energy audits, including defined levels of analysis, data collection requirements, site investigation procedures, and consistent reporting formats. By referencing this standard, programs ensure that building owners receive comprehensive and comparable assessments grounded in best practice. This approach reduces variability in audit quality, increases confidence among owners and financiers, and strengthens accountability by linking analysis to measurable performance outcomes. In doing so, these programs help bridge the persistent gap between identifying efficiency opportunities and realizing documented savings in practice.

Implementation of such programs is further strengthened by tools that systematize energy audit data collection and reporting. The U.S. Department of Energy's (USDOE) Audit Template (Goel et al 2022) provides a structured, consistent interface for data collection, analysis, and documentation. Data collected through Audit Template can be submitted directly to the energy efficiency program manager to demonstrate adherence with the program.

One such program supported by Audit Template is Washington State's Energy Efficiency Retrofits Grants program. This program provides competitive funding to public entities to support energy-saving upgrades in existing public buildings. Eligible projects include improvements such as HVAC replacements, lighting and insulation upgrades, and installation of high-performance thermal systems (WA 2026). This paper examines the industry need for consistent, structured energy audit data, demonstrates how Audit Template addresses that need through Washington State's energy efficiency programs, and shows how portfolio-level analysis of submitted data can enable program administrators to shift from reactive funding allocation to proactive, evidence-based building performance investment.

Audit Template: Overview

Audit Template is a web-based platform that enables auditors to document Level 1 and Level 2 energy audits and strategic long term capital assessments and report data for specific programs. It was developed to address the lack of a consistent, digital framework for capturing and managing energy audit data (Goel et al 2022). It supports tracking for utility program reporting and research-oriented data aggregation—while maintaining alignment with energy audit data exchange schema, BuildingSync XML (BuildingSync 2025, Long et al 2021).Table 1 summarizes tools commonly used to support different components of building assessment activities. Each tool is designed to perform a specific function within the assessment or data management process. However, these tools generally address only individual elements of data collection or reporting and are not designed to support standardized data collection and program implementation reporting.

ASHRAE 211 defines three audit levels, with **Level 2** being the most commonly required by programs for assessing building performance. It involves documenting equipment inventory, estimating energy use by end use and fuel type, and identifying efficiency opportunities. Auditors must analyze energy and utility data, evaluate energy efficiency measures (EEMs) with associated

costs, savings, and payback metrics, and interview key personnel to understand building operations and goals.

Audit Template includes the capability to document Level 2 audits and streamlines this process through five main reporting sections:

1. **Audit Details & Contacts** – key personnel and their qualifications, tailored to program requirements.
2. **Facility Description** – building use, envelope, lighting, HVAC, and service water heating details.
3. **Utility Data & Benchmarking** – metering setup, 12 months of energy data, and benchmarking results. AT supports importing utility data through ENERGY STAR Portfolio Manager (EPA 2025).
4. **Energy Use by End Use** – breakdown of energy consumption by fuel type and system.
5. **Energy Savings Opportunities** – analysis of potential EEMs with cost, savings, payback, and ROI.

Audit Template recently introduced an offline mode, enabling data collection in the field using mobile devices and seamless upload to the Audit Template server once an internet connection is available.

Table 1: Tools used for Data Collection and Reporting

Tool	Primary Users	Purpose/Application	API/Data Integration	Scalability Across Programs
Audit Template (AT)	Building owners; energy efficiency program managers; assessors	Data collection and reporting for commercial buildings to implement energy efficiency programs	Yes—full API support for data/customer relationship management platforms	Yes, designed for local, state, and federal use
ENERGY STAR Portfolio Manager	Building owners, cities, states	Benchmarking building energy/water performance	Partial—supports web services and utility data	Moderate, widely adopted but less customizable
SIMAP	Universities	Campus-level performance tracking and reporting	Limited	Low, niche audience
RETScreen Expert	Engineers, analysts	Feasibility studies, energy audit modeling, financial evaluation	No native API—stand-alone tool	Moderate, used globally but requires training
TREAT	Residential auditors	Residential audits and retrofit planning, especially in low-income and weatherization programs	No	Low, focused on weatherization

Scenario Analysis and Retrofit Planning: Beyond data collection, Audit Template incorporates analytical capabilities that support scenario-based retrofit planning. Users can combine multiple EEMs into cohesive retrofit packages and visualize projected outcomes, including energy and cost savings, implementation costs, and payback periods. These features allow auditors, program administrators, and building owners to assess trade-offs between performance improvement and financial feasibility within a single analytical environment.

Validation and Quality Control: Ensuring data quality at scale is central to the platform's design. Audit Template's validation mechanisms operate in real time. Field-level checks enforce completeness, unit consistency, and valid value ranges, while cross-field logic checks identify inconsistencies (for example, mismatches between heating fuel type and system configuration). This embedded quality-control framework minimizes the need for manual review, ensures that data are analysis-ready, and enhances confidence in datasets collected across large-scale energy programs.

Output Reports: Audit Template provides flexible options for exporting audit data in multiple formats, supporting both human-readable documentation and machine-readable interoperability. Audit Template provides PDF reports and Excel (XLSX) summaries dynamically from template-driven views. This template-based rendering allows each program to maintain its own formatting, required data fields, and program specific guidance while ensuring that the content structure remains consistent across submissions. Receiving data in these consistent formats reduces administration overhead for program managers required to review and approve these audit reports.

Beyond static reports, Audit Template also supports data exchange through RESTful APIs that deliver structured JSON responses. These exports include unique building identifiers including Unique Building Identifier (PNNL 2026) or any program specific building ID, timestamps, submitter metadata, and validation scores to facilitate reproducibility and traceability across systems. Audit Template supports export in BuildingSync XML (Long, N. et al, 2021)—This capability allows audit data to move seamlessly to and from other data platforms and tools, including the DOE SEED Platform (U.S. Department of Energy. 2020).

Tool Workflow

Audit Template platform has been adopted or piloted across a range of programs, each leveraging its configurable structure to meet program-specific objectives. Audit Template is currently used by over 15 energy efficiency programs, with more than 30,000 buildings analyzed, covering a total of 3.5 million ft².

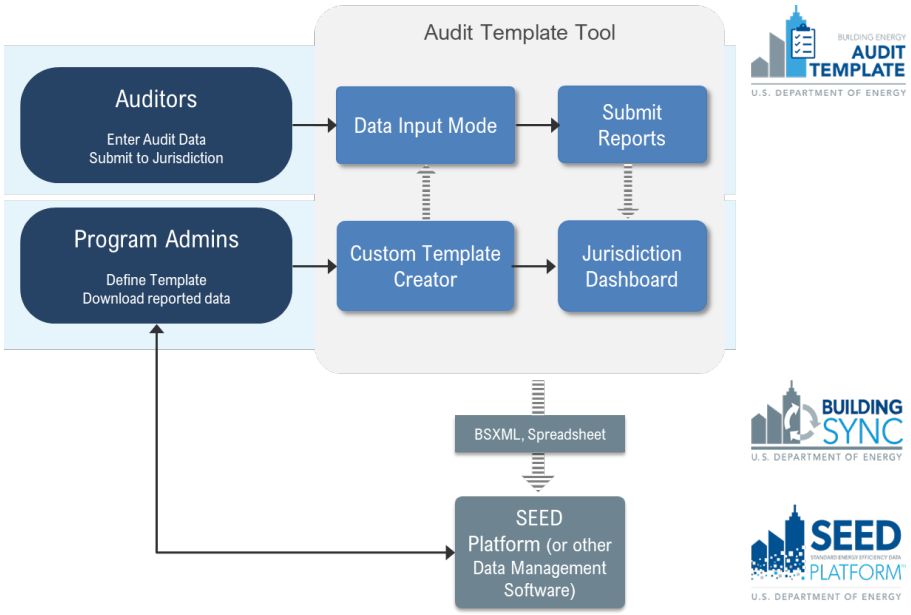


Figure 1: Audit Template Tool Workflow

Custom Template Creator

A defining feature of the platform is its Custom Template Creator (CTC), a graphical configuration interface that allows program administrators to define reporting templates tailored to program needs (Figure 1). Program administrators can start with any of the core reporting templates, add additional modules and then customize the reporting fields and validation requirements. This feature allows each implementing agency to adapt the platform to align with the program while preserving interoperability through consistent machine-readable data exchange formats. Once published, a reporting template is visible to auditors who can select the template that corresponds to the program they're collecting and reporting data for and submit the building data to the program administrator after meeting all the reporting requirements. A program administrator s able to use the program dashboard to view, review and download the submitted data in all the formats supported by Audit Template. CTC allows capabilities added for one program to be leveraged by another (Figure 1). CTC bridges the need for program-specific flexibility with the long-term objective of harmonizing building asset and performance data.

Program Implementation

Washington State requires reporting through the Audit Template for its Energy Efficiency Retrofits Grant Programs (WA 2026) to ensure that submitted audits meet established industry protocols, while maintaining consistent data formats across multiple funding recipients. The platform streamlines the collection and review of audit information, enabling efficient evaluation of energy-saving opportunities and facilitating centralized data management across state portfolios. The City of San Francisco uses Audit Template to manage audits for its Existing Building Energy Ordinance (SFE 2026). Customized modules have been developed to capture information on building characteristics, process loads, and end use breakdowns.

The program administrator is also able to view audit records for buildings across all previous implementation cycles. Through a AI-powered data visualization platform currently under development, a program administrator would be able to view and track building characteristics and performance changes over multiple implementation cycles. Audit Template interface will hence allow a program administrator to evaluate the effectiveness of energy efficiency programs and improvements across the building stock over time. New York City has been using Audit Template to support data collection associated with Local Law 87 (NYC 2009). The platform facilitates structured reporting of energy use and retrofit planning, allowing these programs to analyze building stock characteristics and prioritize technical assistance or financing mechanisms for underperforming segments.

Washington State Energy Efficiency Programs

Washington's Energy Efficiency Retrofits Grants provide competitive funding to public entities—including cities, towns, counties, special districts, public higher education institutions, K-12 public school districts, state agencies, and federally-recognized tribes—for retrofit projects that improve building performance and reduce operational energy use and costs. These grants are aimed at funding practical upgrades and improvements such as HVAC system replacements or upgrades, lighting enhancements, insulation and window improvements, high efficiency thermal systems installations, and other systems that increase energy savings and operational efficiency in existing facilities (WA 2026). The program is structured as a competitive solicitation, with public entities invited to submit applications for funding. In recent rounds, more than $14 million in total funding

has been made available, with individual projects eligible for awards generally ranging from $100,000 up to $1 million depending on project size and scope. While applicants were previously required to provide cost share, the Department of Commerce has removed this requirement to reduce barriers to participation in the program. The cost of an energy audit can be reimbursed if conducted after a program-specified date (Smart Buildings Center. 2024).

A key requirement of the program is that all projects must be supported by an energy audit—typically at Level 1 or Level 2—which documents existing building performance and identifies cost-effective retrofit measures and expected energy savings. This ensures that proposed retrofit investments are grounded in a technical assessment of potential energy performance improvements (WA 2026). The program requires the audit data to be submitted through Audit Template, where custom templates have been defined based on the program requirements for data collection and reporting.

The grants aim to drive measurable improvements in building efficiency, lower operational costs for public infrastructure, and benefit local neighborhoods. Funds have been awarded to dozens of public entities across the state, including school districts, counties, and municipal facilities, supporting projects with strong savings-to-investment ratios and operations and maintenance planning to sustain long-term benefits. A significant share of funding is often reserved for smaller cities and K-12 public school districts, supporting equitable distribution of resources (WA 2025a, WA 2026, WA 2025b).

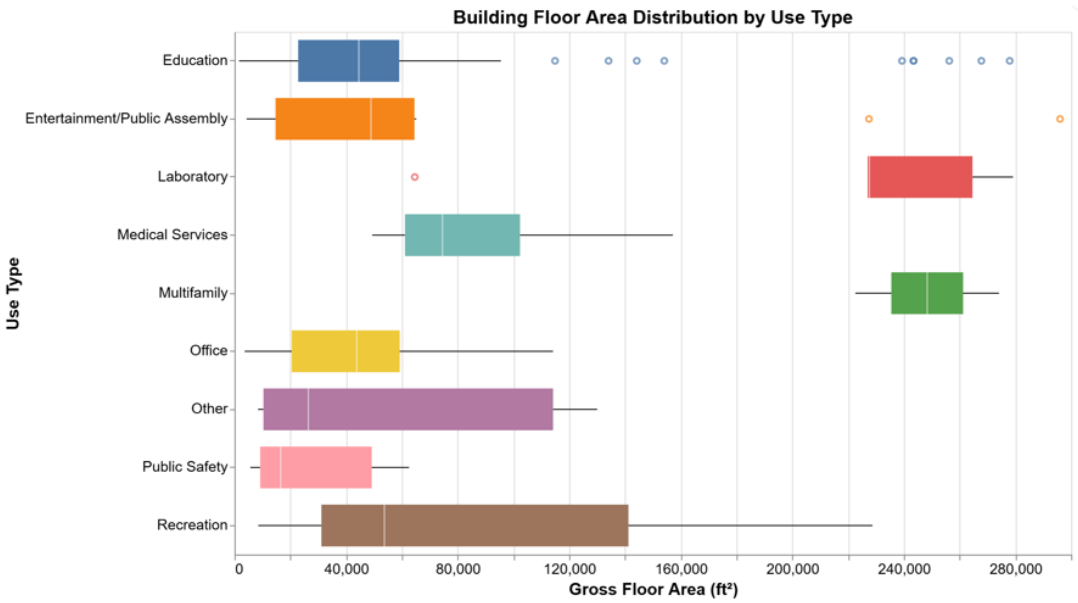
Overall, the Energy Efficiency Retrofits Grants program plays an important role in enabling public sector investment in energy performance improvements, helping building owners leverage technical evaluations and targeted funding to implement cost-effective upgrades that enhance energy performance and lower utility costs statewide.

Data Analysis

An analysis of the Washington Energy Efficiency Retrofits Grants audit submissions revealed a number of compelling trends in the characteristics of participating buildings and the energy efficiency measures recommended by auditors. While more than 200 building records were submitted in connection with the grant program, this analysis focuses exclusively on formally submitted buildings. Records with seemingly erroneous information, such as reported floor areas below 500 ft², were excluded to ensure data integrity. The resulting clean dataset comprises 124 buildings, the properties and trends of which are described below.

Building Size Distribution

The portfolio skews toward small- and mid-sized facilities, with the majority of buildings falling below 100,000 ft² (Figure 2). However, a secondary cluster of larger buildings is also evident, driven by a small number of laboratories, multifamily complexes, and university facilities. A subset of buildings did not fall within standard use-type categories. Space types such as warehouses, repair facilities, power stations, and other utility-related building types were flagged as “Other”.

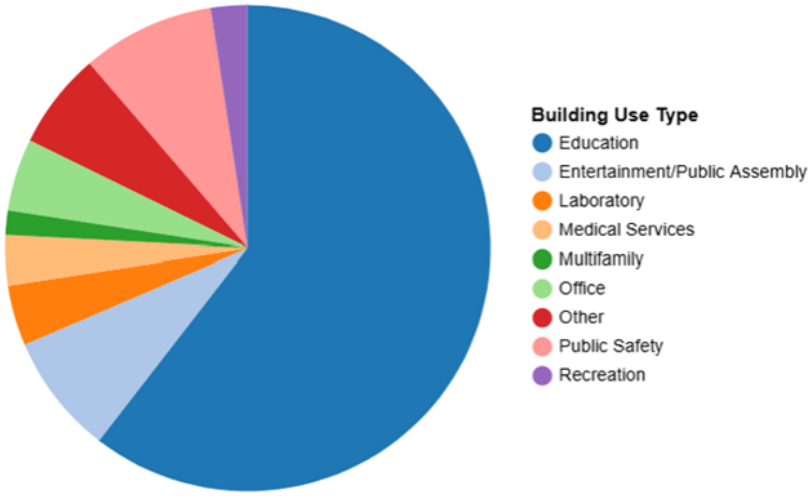


Square Footage Range	Percentage
< 10,000 sq ft	15%
10,000 - 25,000 sq ft	15%
25,000 - 50,000 sq ft	23%
50,000 - 100,000 sq ft	25%
100,000 - 250,000 sq ft	14%
250,000+ sq ft	10%

Figure 2: Floor area distributions for submitted WA Commerce Grant buildings

Building Use Types

Consistent with the eligibility requirements of the grant program, the portfolio is heavily weighted toward education and public service facilities (Figure 3). Schools, community centers, and government-operated buildings collectively represent the dominant share of submissions, aligning with the program's mandate to direct resources toward publicly owned and operated infrastructure. This composition reflects the broader program goal of improving energy performance in public facilities:

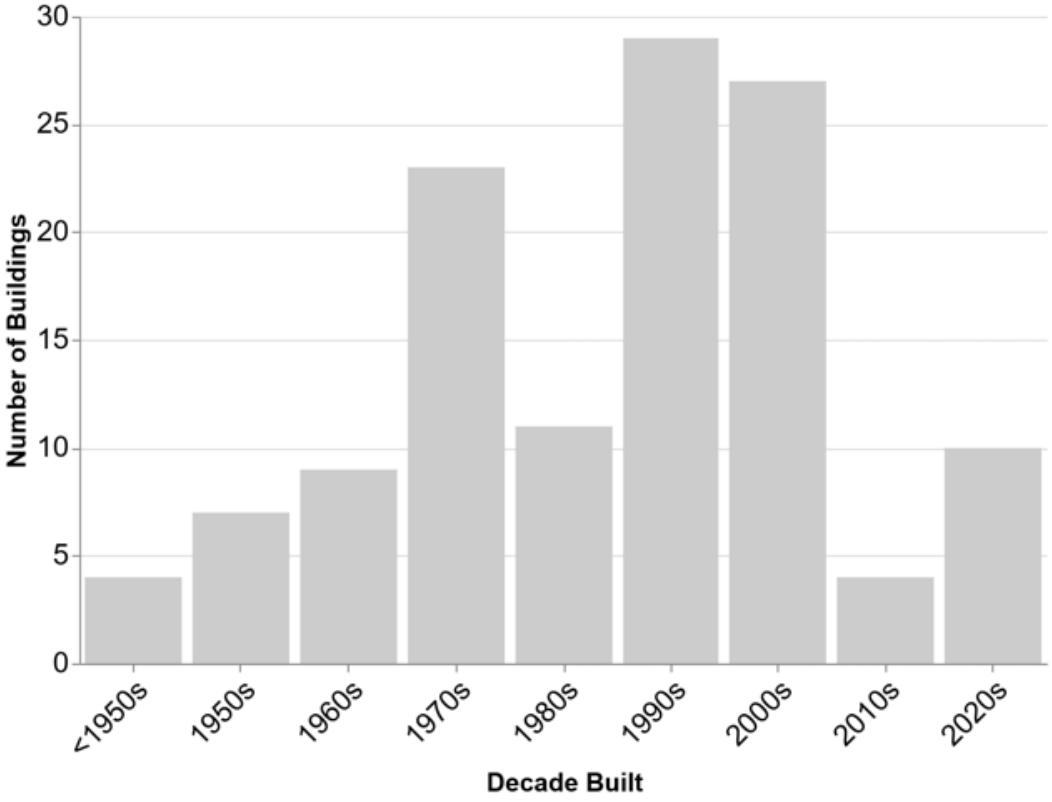


Use Type	Percentage
Education	60.5%
Public Safety	8.9%
Entertainment/ Public Assembly	8.1%
Other	6.5%
Office	4.8%
Laboratory	4.0%
Medical Services	3.2%
Recreation	2.4%
Multifamily	1.6%

Figure 3. Building use type distributions for submitted WA Commerce Grant buildings.

Year of Construction

The submitted buildings span a wide range of construction vintages, though approximately 45% were built between the 1990s and 2000s (Figure 4). This concentration is particularly significant from a retrofit planning perspective. Equipment installed during that era is now approaching or has exceeded its expected service life. Buildings built around 20-30 years ago are strong candidates for targeted replacement and upgrade investments.

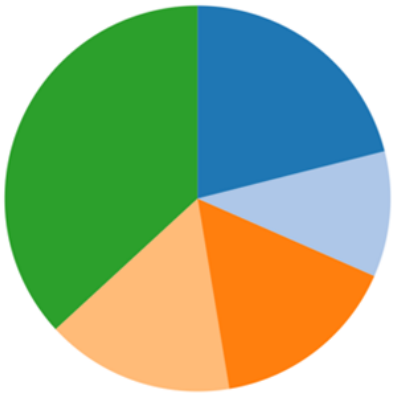


Decade	Percentage
1910s	0.8%
1920s	0.8%
1930s	0.8%
1940s	0.8%
1950s	5.6%
1960s	7.3%
1970s	18.5%
1980s	8.9%
1990s	23.4%
2000s	21.8%
2010s	3.2%
2020s	8.1%

Figure 4. Vintage distribution of submitted WA Commerce Grant Buildings. Note how many buildings were built in the 1990s and 2000s (~45% of buildings)

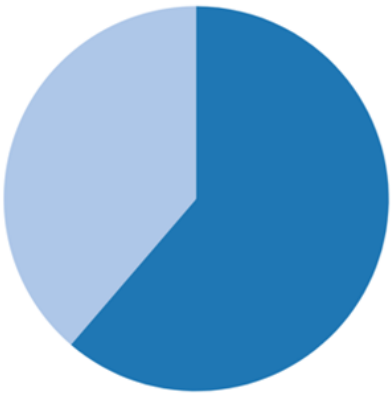
Heating and Cooling System Types

The WA Grants Program does not require reporting of HVAC system configuration, since it isn't required for an L1 energy audit. However, HVAC data was reported for ~30% of the buildings and the charts below (Figure 5) show the heating and cooling system type distribution for the smaller dataset. While the sample size limits add some uncertainty, the reported system types provide a preview of the heating and cooling distributions of system present in Washington's existing public building stock:



Heating System Type
- DX Heating
- Electric Resistance
- Furnace
- Mixed
- Plant

Heating System Type	Percentage
Plant	36.8%
DX Heating	21.1%
Mixed	15.8%
Furnace	15.8%
Electric Resistance	10.5%



Cooling System Type
- DX Cooling
- Plant

Cooling System Type	Percentage
DX Cooling	61.3%
Plant	38.7%

Figure 5: Heating and Cooling System Types distribution. Mixed use types imply more than one heating type was present in a given Audit Template record.

Recommended Energy Efficiency Measures

Across the 124-building portfolio, lighting and HVAC measures accounted for the largest share of recommended energy efficiency measures. The single most commonly recommended measure was LED lighting retrofit, identified in 65% of audited buildings, reflecting their favorable economics in terms of cost, payback period, and ease of implementation. Low-flow plumbing equipment installations (19%) and building automation system (BAS) additions or upgrades (16%) rounded out the top three, together suggesting that many facilities in the portfolio have significant opportunities to reduce energy use through system equipment upgrades.

The prevalence of equipment-related measures is consistent with the construction vintage analysis above. Buildings constructed in the 1990s and early 2000s have reached the point at which major mechanical equipment is due for replacement, and auditors appear to be identifying and recommending these investments at scale.

The distribution of measures for the portfolio can be found in Table 2.

Top Measures By Category

Measure Category	Measures Recommended	Percentage of Buildings with Measure Recommended
Lighting Improvements	Retrofit with light emitting diode technologies	65%
	Other	6%
	Upgrade exterior lighting	2%
	Clean and/or repair	1%
General HVAC	Replace or modify AHU	15%
	Repair leaks / seal ducts	6%
	Other distribution	5%
	Upgrade operating protocols, calibration, and/or sequencing	5%
	Replace package units	4%
	Install air source heat pump	3%
	Install demand control ventilation	3%
	Convert CV system to VAV system	2%
Building Automation Systems	Add or upgrade BAS/EMS/EMCS	16%
	Add or upgrade controls	9%
	Upgrade operating protocols, calibration, and/or sequencing	6%
	Other	2%
	Convert pneumatic controls to DDC	1%
Building Envelope Modifications	Increase wall insulation	10%
	Other	10%
	Replace windows	6%
	Increase roof insulation	1%
	Increase ceiling insulation	1%

Top 8 Measures Across Building Portfolio

Measure Name	Percentage
Retrofit with light emitting diode technologies	65%
Install low-flow plumbing equipment	19%
Add or upgrade BAS/EMS/EMCS	16%
Replace or modify AHU	15%
Upgrade operating protocols, calibration, and/or sequencing	11%
Increase wall insulation	10%
Add or upgrade controls	9%
Replace boiler	7%

Table 2: Top measures by both category and across the WA Commerce Grant's submitted building portfolio.

Conclusions

The analysis of 124 formally submitted audit records under the Washington Energy Efficiency Retrofits Grants program demonstrates both the value of standardized audit data collection and the significant retrofit opportunity embedded within Washington's public building stock. By filtering out erroneous entries and focusing on complete submissions, this study highlights how Audit Template can support actionable, program-relevant insights at the portfolio level. This structure transforms individual audit reports—traditionally static documents—into a dynamic dataset capable of supporting program evaluation, capital planning, and strategic investment prioritization. For example, the concentration of buildings constructed in the 1990s and 2000s (approximately 45% of the dataset) directly correlates with the prominence of HVAC and lighting upgrade recommendations, suggesting predictable equipment lifecycle-driven retrofit waves. Such insights would not be as readily apparent without a consistent, relational data framework.

Implications for Energy Efficiency Program Development

For program administrators, the findings demonstrate how structured audit data can inform evidence-based program design. Several program-relevant insights emerge:

1. **Lifecycle-Based Capital Planning:**
   The concentration of 20–30-year-old buildings suggests an impending peak in mechanical system replacement needs. Programs can proactively align grant funding, financing tools, or performance contracting programs with this lifecycle window to maximize cost-effectiveness and minimize deferred maintenance risks.
2. **Program Design Optimization:**
   The high frequency of LED lighting and HVAC recommendations confirms that these measures remain cost-effective entry points for broad-based public facility improvements. Program managers can streamline incentive offerings around high-impact, repeatable measures while also designing complementary programs to encourage deeper retrofits.
3. **Data-Driven Targeting:**
   The skew toward small- and mid-sized facilities, with a secondary cluster of larger institutional buildings, suggests differentiated program strategies may be warranted. Smaller facilities may benefit from simplified application pathways and turnkey solutions, while larger facilities may require more technical assistance and capital stacking mechanisms.
4. **Data Consistency Supports Program Infrastructure:**
   Perhaps most importantly, Audit Template itself functions as a form of program implementation mechanism. A consistent, relational database enables continuous improvement: programs can further leverage Audit Template to track program progress, identify under-addressed system types, monitor technology trends, and collect post-retrofit building performance data to evaluate program impact over time.

In sum, this analysis demonstrates that a well-designed reporting template can serve not only as a consistent data collection platform but also as a strategic planning instrument. By converting individual building audits into a coherent portfolio dataset, programs gain the ability to move from reactive funding allocation toward proactive, data-informed energy program development.

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References

ASHRAE. 2018. ASHRAE Standard 211-2018 (RA 2023): Standard for Commercial Building Energy Audits. Reaffirmed 2023.

BuildingSync. (2025). *BuildingSync® Version 2.7.0* [XML schema specification]. BuildingSync. Retrieved from https://buildingsync.net/releases

EIA 2020. "Annual Energy Outlook 2020 with Projections to 2050." Accessed June 10, 2026. https://www.eia.gov/outlooks/aeo/pdf/aeo2020%20full%20report.pdf

Goel, S. et al. (2022). Audit Template: Facilitating Data-Driven Decision Making for Jurisdictions. ACEEE Summer Study on Energy Efficiency in Buildings.

Gunasingh, S., Hackel, S., & Zhou, X. (2019). *Persistence in Energy Savings From Retro-Commissioning Measures*. ASHRAE Journal, December 2019.

Katipamula, S., & Brambley, M. R. (2005). Review Article: Methods for Fault Detection, Diagnostics, and Prognostics for Building Systems—A Review, Part II. HVAC&R Research, 11(2), 169–187. https://doi.org/10.1080/10789669.2005.10391133

Long, N., K. Fleming, C. CaraDonna, and C. Mosiman. 2021. "BuildingSync: A Schema for Commercial Building Energy Audit Data Exchange." *Developments in the Built Environment* 7 (February): 100054. https://doi.org/10.1016/j.dibe.2021.100054.

Mills, E. Building commissioning: a golden opportunity for reducing energy costs and greenhouse gas emissions in the United States. Energy Efficiency 4, 145–173 (2011). https://doi.org/10.1007/s12053-011-9116-8

NYC 2009. *Local Law 87 of 2009: Energy Audits and Retro-Commissioning of Base Building Systems*. PDF file. Accessed March 3, 2026. https://www1.nyc.gov/assets/buildings/local_laws/ll87of2009.pdf

PNNL 2026. Unique Building Identification. Pacific Northwest National Laboratory. https://www.pnnl.gov/unique-building-identification. Accessed March 3, 2026.

SFE 2026. "Existing Buildings Energy Performance Ordinance." Accessed March 3, 2026. https://www.sfenvironment.org/existing-buildings-energy-performance-ordinance

Smart Buildings Center. 2024. "Washington State Dept. of Commerce Energy Efficiency Retrofits Grant." *Smart Buildings Center*, September 12, 2024. Accessed March 3, 2026. https://smartbuildingscenter.org/washington-state-dept-of-commerce-energy-efficiency-retrofits-grant/

U.S. Department of Energy. 2020. "SEED Platform: Standard Energy Efficiency Data Platform™." *SEED Platform Website*. https://energy.gov/eere/buildings/standard-energy-efficiency-data-platform. Accessed February 25, 2026.

WA 2025a. "Commerce Grants over $14.3 Million for Energy Efficiency Retrofits in Public Buildings." *Washington State Department of Commerce*, January 16, 2025. Accessed March 3, 2026. https://www.commerce.wa.gov/commerce-grants-over-14-3-million-for-energy-efficiency-retrofits-in-public-buildings/

WA 2025b. "Commerce Grants over $14.3 Million for Energy Efficiency Retrofits in Public Buildings." *GovDelivery Bulletin*, January 16, 2025. Accessed March 3, 2026. https://content.govdelivery.com/accounts/WADOC/bulletins/3c7b9ab

WA 2026. "Energy Efficiency Grant Program." Accessed March 3, 2026. https://www.commerce.wa.gov/energy-incentives/energy-efficiency-grant-program/