High-Performance Measure Details

Measure Name

High-Performance Data Center and Computer Room Cooling Systems

Use Category

HVAC – Data Center / Computer Room Cooling

Effective Date

October 28, 2026

Version

1.1

Measure Code

LM401

Measure Stage

Early Adoption & High Priority Data Collection

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Technology Summary

High-Performance Data Center and Computer Room Cooling Systems remove heat from information technology equipment (ITE) and maintain reliable environmental conditions for servers, networking equipment, storage systems, and high-density compute loads. This measure applies to **dedicated data centers, computer rooms, and qualifying ITE spaces** in commercial, public, institutional, and industrial facilities where cooling systems are designed specifically to serve continuous or high-intensity IT loads. For CEDA, this HPM supports **above-code cooling approaches** that reduce cooling energy intensity while maintaining thermal reliability, including variable-capacity DX or chilled-water systems, variable-speed fans and pumps, elevated economizer capability, heat recovery where useful heating loads exist, grid-interactive cooling controls, and advanced rack-level cooling strategies such as in-row cooling, rear-door heat exchangers, direct-to-chip cold plates, coolant distribution units (CDUs), immersion cooling, and hybrid air/liquid systems.

This measure matters because data center and computer room loads are growing rapidly in California, driven by artificial intelligence, high-performance computing, cloud services, and increasingly dense rack configurations. Traditional air-cooled systems can remain appropriate for lower-density computer rooms and general-purpose data halls, but they can become inefficient or physically constrained as rack densities increase. **Hybrid and liquid-cooling approaches** can improve heat removal at the source, reduce fan energy, support higher rack densities, enable

warmer facility water temperatures, expand economizer hours, and create opportunities for useful heat recovery or chiller-free operation where project conditions support it. A technology-neutral new construction structure allows projects to pursue the cooling pathway that best fits the ITE load, facility constraints, and project scope while still emphasizing **above-code efficiency, system integration, operational verification, and Code Readiness learning**.

Common real-world performance gaps this HPM is designed to address include oversized or constant-speed cooling equipment that operates inefficiently at part load; economizers that are disabled, poorly commissioned, or limited by conservative setpoints; air-cooled systems with poor supply-to-return temperature differential; chilled-water pumping systems with unnecessary throttling losses or triple-duty valves that undermine variable-flow operation; high-density rack designs that are not matched with appropriate cooling architecture; liquid-cooling systems with incomplete coordination between cold plates, CDUs, Technology Cooling System (TCS) loops, facility water loops, leak detection, and controls; heat-recovery systems applied where there is little useful or coincident heating demand; and demand-management controls that provide monitoring but do not actively sequence, stage, or shift cooling loads during peak conditions.

Relevant standards and references include **2025 Title 24, Part 6** computer room and covered process requirements; **ANSI/ASHRAE Standard 90.4**; **ASHRAE TC 9.9 Thermal Guidelines for Data Processing Environments**; **ASHRAE Standard 127**; **TIA-942**; and **Open Compute Project** liquid-cooling and immersion-cooling guidance.

Alignment with CEDA Program Goals

The CEDA program supports the implementation of energy efficiency measures that support Code Readiness' Long Term Tactical Plan (LTTP) to drive the goals of electrification, decarbonization, and load reduction.

Projects must meet one of the CEDA Inducement Requirements identified in the next section to receive an inducement on the equipment and will be evaluated for level of interest in metering to support Code Readiness Objectives.

This measure meets the CEDA program goals as follows:

- **Building partnerships with market stakeholders** by consulting on innovative technologies and best practices in energy efficiency which can lead to the development of more effective solutions and accelerate the adoption of new technologies. As teams adopt the measure, this increases the volume of engineers able to design the equipment, contractors capable of installing the equipment, and owners able to operate the equipment.
- **Increasing the supply of high-performance measures** by resulting in projects implementing measures to achieve greater energy savings, reduced emissions, and overall improved building performance. As more buildings specify and install high-performance data center and computer room cooling systems, this helps to increase the overall supply of data center and computer room cooling systems in the market for others to use, including beyond new construction.
- **Increasing the demand for high-performance measures** by driving technological advancements, supporting economic growth opportunities through innovation, and raising awareness of the benefits of energy-efficient cooling approaches to increase consumer adoption. As demand in the market increases for newer technologies, the long-term benefit is increased demand for manufacturers and suppliers to provide additional options available in the market.
- **Advancing new high-performance measure technology** by raising public awareness about new technologies and their benefits, helping build acceptance and demand through market support advocacy efforts that can influence stakeholder decisions that enable technological innovation.
- **Providing Codes & Standards with projects of interest** to collect metered data that will inform future California energy codes.

CEDA Inducement Requirements

This measure addresses the gap between **2025 Title 24 minimum computer room cooling requirements** and the higher-performance cooling strategies needed for modern data centers, computer rooms, and high-density information technology equipment (ITE) applications. Projects may comply with code while still relying on conservative setpoints, inefficient part-load operation, limited economizer use, or cooling architectures that are not well matched to the ITE load. This HPM is intended to support **above-code cooling system design**, improved controls, and better operational performance.

This measure is **technology-neutral for new construction** and may apply to high-performance air-cooled systems, chilled-water systems, hybrid air/liquid systems, direct-to-chip cooling, rear-door heat exchangers, coolant distribution units, immersion cooling, heat recovery where useful heating demand exists, and demand-management controls. The intent is not to prescribe one preferred cooling technology, but to ensure the selected approach is efficient, controllable, appropriate for the project's ITE density, and useful for **Code Readiness learning**.

For **new construction**, inducement eligibility is based on the highest tier for which all requirements are met: **Essential, Advanced, or Premium**. Tiers are dependent: **Advanced requires full compliance with Essential, and Premium requires full compliance with Advanced**. Essential establishes the first above-code cooling package; Advanced adds higher-performance integration through useful heat recovery, liquid or hybrid cooling performance, or grid-interactive cooling controls; and Premium recognizes the highest-value designs that provide deeper heat recovery or high-temperature liquid/hybrid cooling operation.

For **additions and alterations**, this measure uses a **separate single-level pathway** focused on practical improvements to existing or expanded ITE cooling systems. Eligible additions and alterations must improve the affected cooling scope through applicable measures such as inverter-driven DX equipment, variable-speed chilled-water compressors or chillers, variable-speed fans, chilled-water pumping and valve modernization, airflow management improvements for air-cooled systems, updated controls, and available trend data. All eligible projects must include a dedicated data center or computer room with an ITE load density of at least **20 W/ft²** and total installed ITE load of at least **35 kW**, with cooling systems dedicated to serving ITE loads.

Measure Eligibility (ME) – All Projects

1. Project includes a dedicated computer room or data center with:
   1.1. Information technology equipment (ITE) load density ≥20 W/ft², and
   1.2. Total installed ITE load ≥35 kW, approximately equivalent to 10 tons of cooling capacity.
2. Cooling systems claimed under this measure shall be specifically designed to serve qualifying ITE loads.
   2.1. Where a central plant or shared cooling system serves both ITE and non-ITE loads, the project shall identify the portion of cooling capacity, controls, and supporting equipment dedicated to or allocated for the ITE load.
3. Eligible project scopes include:
   3.1. New construction projects with qualifying computer room or data center cooling systems; and
   3.2. Additions or alterations that install, replace, expand, or materially modify cooling systems serving qualifying ITE loads.
4. Projects shall demonstrate compliance with applicable 2025 Title 24, Part 6 requirements and all applicable state and local codes. CEDA HPM requirements are intended to be **above-code** and do not replace code compliance obligations.
5. Projects shall submit engineered construction documents, equipment submittals, design setpoints, control sequences, and other supporting information sufficient to verify compliance with the selected design tier and measure scope.

System Design Level Requirements (SDLR) – New Construction

1. **Essential Level:** High-Efficiency Data Center and Computer Room Cooling System

Projects must implement all of the following **above-code** high-efficiency cooling strategies:

1.1. Cooling systems serving ITE loads shall include variable-capacity cooling, including **one or more** of the following:

1.1.1. Inverter-driven or variable-speed DX compressors;

1.1.2. Variable-speed chilled-water compressors or chillers serving ITE loads; or

1.1.3. Liquid or hybrid cooling systems with variable-speed Technology Cooling System (TCS) coolant pump control and/or Coolant Distribution Unit (CDU) capacity modulation, where applicable.

1.2. All cooling system fans serving ITE loads shall be variable speed with turndown capability to ≤66% of maximum design speed.

1.3. Mechanical cooling systems shall be capable of serving 100% of the qualifying ITE cooling load through economizer operation at outdoor conditions above the applicable Title 24 baseline, including:

1.3.1. >65°F outdoor dry-bulb temperature; and

1.3.2. >50°F outdoor wet-bulb temperature, where applicable for adiabatic or water-side economizer systems.

1.4. Projects with design rack densities ≥30 kW/rack in any qualifying ITE area shall utilize advanced cooling technologies appropriate for the rack density, including **at least one** of the following:

1.4.1. Active in-row cooling;

1.4.2. Rear-door heat exchangers;

1.4.3. Direct-to-chip or cold-plate liquid cooling;

1.4.4. Immersion cooling; or

1.4.5. Other engineered hybrid air/liquid cooling strategy designed for the proposed ITE density.

2. **Advanced Level:** Higher-Performance Cooling Integration

Projects must meet all Essential Level requirements and implement **at least one** of the following Advanced pathways (2.1, 2.2, or 2.3):

2.1. **Heat Recovery Pathway**

Install a heat recovery system capable of capturing and transferring ≥25% of the peak cooling system heat rejection to useful on-site or campus heating loads, up to the available coincident heating demand.

2.1.1. Useful heating loads may include space heating, domestic/service water heating, process heating, campus heating loops, or other documented heating end uses.

2.1.2. Heat recovery is required only where there is a meaningful useful heating load. Projects with limited useful heating demand may use Pathway 2.2 or 2.3 instead.

2.2. **Liquid or Hybrid Cooling Performance Pathway**

For projects utilizing liquid or hybrid liquid cooling systems, the liquid cooling system shall support 100% economizer operation for the applicable liquid-cooled ITE load at:

2.2.1. ≥70°F outdoor dry-bulb temperature; and

2.2.2. ≥60°F outdoor wet-bulb temperature, where applicable for adiabatic or water-side economizer systems.

2.2.3. Liquid or hybrid cooling systems shall include design provisions for CDU control, coolant temperature monitoring, flow monitoring, leak detection, and safe isolation of liquid-cooled equipment.

2.3. **Grid-Interactive Cooling Controls**
Implement a demand-management control strategy that enables active reduction or shifting of cooling loads during real-time or scheduled peak demand periods, including **one or more** of the following:

2.3.1. Thermal energy storage integrated with cooling systems, including chilled water, ice storage, phase-change material, or other high-density thermal storage;

2.3.2. Battery energy storage integrated with cooling system demand-management controls;

2.3.3. Data Center Infrastructure Management (DCIM), Building Management System (BMS), or Energy Management System (EMS) integration enabling centralized monitoring, sequencing, and active control of cooling equipment;

2.3.4. Automated demand response capability, such as OpenADR or equivalent; or

2.3.5. Control strategies that adjust cooling capacity, equipment staging, redundancy staging, or temperature and humidity setpoints within manufacturer-allowable and ASHRAE TC 9.9-recommended operating ranges.

3. **Premium Level:** Highest-Performance Integrated Cooling System

Projects must meet all Essential Level requirements and the applicable Advanced Level pathway requirements. Projects must also implement **at least one** of the following Premium enhancements (3.1 or 3.2):

3.1. **Deeper Heat Recovery**
Install a heat recovery system capable of capturing and transferring ≥50% of the peak cooling system heat rejection to useful on-site or campus heating loads, up to the available coincident heating demand.

3.2. **High-Temperature Liquid or Hybrid Cooling Operation**
For projects utilizing liquid or hybrid liquid cooling systems, the liquid cooling system shall support 100% economizer operation for the applicable liquid-cooled ITE load at:

3.2.1. ≥75°F outdoor dry-bulb temperature; and

3.2.2. ≥75°F outdoor wet-bulb temperature, where applicable for adiabatic or water-side economizer systems.

System Design Level Requirements (SDLR) – Additions and Alterations

Eligible additions or alterations to existing computer rooms or data centers shall implement **all of the following** applicable requirements below for the affected scope:

1. Cooling systems serving modified, replaced, or expanded ITE loads shall include inverter-driven DX equipment or variable-speed chilled-water compressors/chillers, as applicable to the affected scope.
2. All associated cooling fans serving modified, replaced, or expanded ITE loads shall be variable speed with turndown capability to ≤66% of maximum design speed.
3. Chilled-water systems serving the altered ITE cooling scope shall eliminate triple-duty valves at chilled-water pumps where affected by the project scope and replace them with:
   3.1. Separate isolation valves and non-slam check valves; and
   3.2. Variable-speed pumping, differential-pressure control, or equivalent flow-control strategies.
4. Air-cooled systems serving ITE shall implement airflow management improvements sufficient to increase the design supply-to-return air temperature differential to ≥20°F under design load conditions.

5. Projects shall provide control sequences and design setpoints for modified cooling systems, including fan speed control, pump speed control, economizer operation, and supply/return air or chilled-water temperature control, as applicable.
6. Projects shall provide trend data for key modified system parameters, where available, to support review and potential Code Readiness data collection.

Supporting Documentation Requirements (SDR)

Documentation already included in the project drawings, schedules, submittals, control sequences, Title 24 compliance package, or cost estimate does not need to be duplicated. The intent of this section is to identify the minimum information needed to verify measure eligibility, the claimed tier or pathway, and the above-code design features.

1. All Projects

All projects claiming this HPM shall provide the following:

1.1. **Measure eligibility summary** identifying the project scope, qualifying computer room or data center areas, ITE load density in W/ft², total installed ITE load in kW, and claimed tier or pathway.

1.2. **Mechanical design documentation** showing the cooling systems serving qualifying ITE loads, including applicable equipment, distribution systems, economizers, pumps, fans, heat rejection equipment, heat recovery systems, liquid-cooling components, and controls.

1.3. **Equipment and controls documentation** sufficient to verify the claimed requirements, including applicable equipment schedules, submittals, control sequences, design setpoints, turndown capabilities, staging, reset strategies, alarms, and trend logging where applicable.

1.4. **Title 24 compliance documentation** or code compliance summary showing that the project meets applicable 2025 Title 24, Part 6 computer room cooling requirements. CEDA HPM documentation shall demonstrate performance beyond code minimums.

1.5. **Cost documentation** showing the basis for incremental cost, such as project estimate, bid summary, vendor quote, equipment pricing, or design team cost narrative, sufficient to support the claimed HPM scope and tier/pathway.

2. New Construction – Tier-Specific Documentation

2.1. **Essential Level Documentation**

Projects claiming Essential shall provide documentation confirming the following, where applicable to the system type:

2.1.1. Variable-capacity or variable-speed operation for cooling equipment serving qualifying ITE loads.

2.1.2. For liquid or hybrid cooling systems, variable-speed Technology Cooling System (TCS) coolant pump control and/or Coolant Distribution Unit (CDU) capacity modulation, where applicable.

2.1.3. Variable-speed fan operation and required fan turndown capability.

2.1.4. Economizer type, control approach, operating thresholds, and above-code economizer capability.

2.1.5. Advanced cooling technology selected for any qualifying ITE area with rack densities ≥30 kW/rack.

2.2. **Advanced Level Documentation**

Projects claiming Advanced shall provide Essential documentation and the applicable documentation for the claimed Advanced pathway only:

2.2.1. **Heat Recovery Pathway:** heat recovery narrative or calculation showing recoverable heat, useful heating load served, and available coincident heating demand.

2.2.2. **Liquid or Hybrid Cooling Performance Pathway:** liquid or hybrid cooling narrative showing CDU/coolant system design, liquid temperature setpoints, flow monitoring, leak detection, safe isolation, and economizer capability for the liquid-cooled load.

2.2.3. **Grid-Interactive Cooling Controls Pathway:** demand-management controls narrative showing how the system can reduce, shift, or manage cooling loads during peak demand periods, including thermal storage, battery integration, automated demand response, DCIM/BMS/EMS control capability, or other active control strategy where applicable.

2.3. **Premium Level Documentation**

Projects claiming Premium shall provide Essential documentation, applicable Advanced pathway documentation, and the applicable documentation for the claimed Premium enhancement only:

2.3.1. **Deeper Heat Recovery:** heat recovery calculation showing the higher heat recovery target, useful heating loads served, and coincident load basis.

2.3.2. **High-Temperature Liquid or Hybrid Cooling Operation:** liquid or hybrid cooling documentation showing economizer capability at the required high-temperature operating conditions.

3. Additions and Alterations – Single-Tier Documentation

Projects claiming the additions and alterations pathway shall provide the following for the affected scope only:

3.1. Existing and proposed mechanical drawings or narrative identifying the modified, replaced, or expanded cooling systems serving qualifying ITE loads.

3.2. Documentation confirming inverter-driven DX equipment or variable-speed chilled-water compressors/chillers for the modified or expanded cooling scope, as applicable.

3.3. Documentation confirming variable-speed fan operation and required fan turndown capability for associated cooling fans serving the modified or expanded ITE load.

3.4. For chilled-water systems, documentation showing triple-duty valve removal where applicable and replacement with separate isolation valves, non-slam check valves, variable-speed pumping, differential-pressure control, or equivalent flow-control strategy.

3.5. Airflow management documentation showing the design approach used to improve supply-to-return temperature differential for the affected air-cooled ITE cooling scope.

3.6. Updated control sequences and setpoints for modified cooling systems, including fan speed control, pump speed control, economizer operation, and air or chilled-water temperature control where applicable.

3.7. Available trend data for key modified system parameters, where available, to support review and potential Code Readiness data collection.

Incremental Measure Cost

The Incremental Measure Cost (IMC) represents the typical additional cost associated with implementing the **High-Performance Data Center and Computer Room Cooling Systems** HPM relative to a code-minimum or standard-practice cooling system serving qualifying information technology equipment (ITE) loads. Because this measure applies to a wide range of data center and computer room cooling configurations, including air-cooled, chilled-water, hybrid, and liquid-cooling systems, IMC values are expressed using a normalized unit rather than project-specific total cost.

These IMC values are intended to support **CEDA inducement calibration and market transformation planning**. They are not intended to serve as a bid estimator, cost guarantee, or project reconciliation tool. Actual project costs may vary based on facility size, rack density, redundancy level, cooling architecture, existing infrastructure, controls integration, labor conditions, and owner reliability requirements.

Base Case

The base case represents a **2025 Title 24-compliant computer room or data center cooling system** consistent with current standard practice for qualifying ITE loads. Typical base-case systems may include air-cooled or chilled-water CRAC/CRAH equipment, code-minimum economizer capability, code-required fan control, conventional air-based rack cooling, standard chilled-water pumping and balancing arrangements, and basic building or equipment-level controls.

The base case is assumed to meet applicable state and local code requirements but does not include the full package of HPM above-code features, such as enhanced part-load cooling performance, elevated economizer capability, intentional high-density rack cooling design, liquid or hybrid cooling readiness, heat recovery beyond code-minimum applicability, grid-interactive cooling controls, or targeted pumping and airflow modernization beyond standard practice.

Measure Case

The measure case represents cooling systems designed to meet this HPM's applicable system design requirements. The measure case varies by project scope and tier, but the incremental cost is generally driven by equipment premiums, added controls capability, integration labor, design coordination, commissioning effort, and supporting infrastructure needed to achieve above-code performance.

For **new construction**, the measure case includes the following tiered scope:

- **Essential Level:** High-efficiency above-code cooling package, including variable-capacity cooling, variable-speed fans with required turndown, elevated economizer capability, and advanced cooling technology where required for high-density racks.
- **Advanced Level:** Essential Level requirements plus one applicable higher-performance pathway, such as useful heat recovery, liquid or hybrid cooling performance, or grid-interactive cooling controls.
- **Premium Level:** Essential and applicable Advanced requirements plus a high-performance enhancement, such as deeper heat recovery or high-temperature liquid/hybrid cooling operation.

For **additions and alterations**, the measure case represents a single-tier retrofit pathway focused on practical improvements to existing or expanded ITE cooling systems. Typical incremental scope may include inverter-driven DX equipment, variable-speed chilled-water compressors or chillers, variable-speed fan upgrades, chilled-water pumping and valve modernization, triple-duty valve removal where applicable, airflow management improvements, updated control sequences, and available trend data.

Incremental Measure Cost (IMC)

The normalized cost basis for this HPM is **$/ton of qualifying ITE design cooling load**. This unit is intended to scale the IMC to the cooling load serving the qualifying computer room, data center, or ITE space.

For projects with dedicated ITE cooling systems, the qualifying tonnage shall be based on the design cooling load serving the qualifying ITE load, capped by the installed cooling capacity dedicated to that ITE load.

For projects with shared central plants or shared cooling infrastructure serving both ITE and non-ITE loads, the qualifying tonnage shall be based only on the portion of the design cooling load allocated to the qualifying ITE load, capped by the installed cooling capacity dedicated or allocated to that ITE load. Oversized capacity, redundant capacity, backup capacity, or capacity serving non-ITE loads shall not be included in the IMC basis unless it is clearly documented as part of the active design capacity serving the qualifying ITE load.

Project Scope / Tier	Normalized IMC Value	What Drives the Incremental Cost
New Construction – Essential	**$150/ton**	Variable-capacity or variable-speed cooling equipment, variable-speed fan capability, elevated economizer setup, controls coordination, and advanced rack-level cooling where required for high-density racks
New Construction – Advanced	**$350/ton**	Essential scope plus heat recovery integration, liquid/hybrid cooling performance controls and safeguards, or grid-interactive cooling controls
New Construction – Premium	**$550/ton**	Advanced scope plus deeper heat recovery or high-temperature liquid/hybrid cooling operation
Additions and Alterations – Single Tier	**$200/ton**	Retrofit labor, inverter-driven DX or variable-speed chilled-water compressor/chiller upgrades, variable-speed fan upgrades, pumping and valve modernization, triple-duty valve removal, airflow management, and controls updates

These values are representative program-calibration inputs and are intentionally rounded to reflect typical market conditions rather than project-specific pricing. For projects using advanced liquid, immersion, two-phase, or highly customized cooling architectures, actual incremental costs may be materially higher or lower depending on the selected equipment configuration, server/rack compatibility, facility water availability, redundancy requirements, and controls integration scope.

Sources

IMC values are informed by a combination of publicly available market pricing references, industry cost references, and market characterization studies. Sources are intended to support cost reasonableness for public-facing HPM documentation and do not replace project-specific estimates, bids, or vendor quotes. Representative sources include:

- RSMeans Data – 2026 Mechanical Costs Book, for HVAC, plumbing, piping, and mechanical construction cost benchmarking.
- RSMeans Data Online, for construction cost estimating, equipment, material, and labor reference data.

- DOE / Berkeley Lab Best Practices Guide for Energy-Efficient Data Center Design, for data center cooling, air management, controls, heat recovery, and efficiency best practices.
- CalNEXT Datacenter Liquid Cooling Market Characterization Final Report, for current liquid, hybrid, direct-to-chip, rear-door heat exchanger, coolant distribution unit, and immersion cooling market characterization.
- ANSI/ASHRAE Standard 90.4-2022 Fact Sheet, for data center energy performance context, including mechanical and electrical performance framing.
- ASHRAE Data Center Resources / Datacom Series, for data center thermal guidelines, design guidance, and operational references.
- Open Compute Project – Cooling Environments, for liquid cooling, warm-water cooling, and data center cooling integration guidance.
- Open Compute Project – Coolant Distribution Unit Subproject, for CDU integration guidance and industry collaboration context.
- Silicon Valley Power Data Center Rebate Program, for data-center-specific efficiency program benchmarking and verified-savings program context.
- Silicon Valley Power 2025–2026 New Construction Data Center Rebate Application, for current California data center program structure and new construction rebate documentation context.

Code Readiness Objectives

This measure supports CEDA's Code Readiness efforts by collecting performance, cost, and market data for high-performance data center and computer room cooling systems. Data centers are a growing source of electric load in California, and future code development will need better field evidence on how cooling system design, rack density, controls, economizer operation, heat recovery, and liquid or hybrid cooling strategies affect real-world energy use, peak demand, reliability, and cost-effectiveness.

This HPM is intended to support future Title 24, Title 20, ASHRAE 90.4, and compliance software pathways by identifying practical, enforceable, and cost-effective requirements for computer room and data center cooling systems. The objectives include the following:

- Evaluate how variable-capacity cooling, variable-speed fans, and variable-speed pumping affect cooling energy use and part-load performance in real operating conditions.
- Identify economizer strategies and operating thresholds that can be reliably designed, commissioned, and maintained across different cooling system types and California climate zones.
- Compare performance and implementation considerations for air-cooled, chilled-water, hybrid air/liquid, direct-to-chip, rear-door heat exchanger, coolant distribution unit, and immersion cooling systems.
- Assess whether rack density, total ITE load, or cooling architecture should be used to define future code thresholds for high-density data center and computer room cooling requirements.
- Evaluate the practical value of heat recovery from data center cooling systems, including when useful heating loads are available and when heat recovery is not cost-effective or operationally meaningful.
- Evaluate demand-management and grid-interactive cooling strategies, including thermal storage, battery integration, automated demand response, DCIM/BMS/EMS integration, and control sequences that reduce or shift peak cooling demand.
- Collect cost and market-readiness data, including equipment availability, design complexity, contractor capability, commissioning needs, serviceability, and barriers to broader adoption.
- Support future improvements to Title 24 compliance modeling and ACM/CBECC-Com assumptions for data center cooling systems, including liquid, hybrid, economizer, controls, and heat recovery modeling capabilities.

Code Readiness Site Monitoring

If selected for Code Readiness monitoring, equipment energy consumption and mechanical cooling system performance may be monitored on-site for a period of up to 12 months. To support performance evaluation and data collection, projects shall provide reasonable access for the installation and operation of temporary metering, sensors, data loggers, and communication equipment.

Projects equipped with a Building Automation System (BAS), Building Management System (BMS), Energy Management System (EMS), Data Center Infrastructure Management (DCIM) platform, or equivalent system should enable integration of advanced metering devices through the existing platform where feasible to facilitate data collection and remote access. For projects without a BAS, BMS, EMS, or DCIM platform, the Code Readiness team may install temporary stand-alone data loggers, sensors, and communication equipment as needed to monitor system performance for the duration of the monitoring period.

Instrumentation may be installed or supplemented, where necessary, to measure key system and equipment parameters sufficient to evaluate cooling system performance, control behavior, energy use, peak demand, economizer operation, heat recovery, liquid-cooling performance, and operational characteristics. All monitoring equipment will be temporary and installed in a manner that minimizes disruption to normal building operations.

Data Benefits

Collected data will help support the following:

- Quantify real-world cooling system energy use, peak demand, and part-load performance for qualifying ITE cooling systems.
- Improve understanding of how rack density, total ITE load, and cooling system type affect cooling efficiency and code applicability.
- Validate economizer performance, availability, lockout conditions, and hours of economizer operation.
- Evaluate whether liquid and hybrid cooling systems enable higher facility water temperatures, reduced fan energy, improved heat rejection efficiency, or expanded economizer operation.
- Document pumping, fan, CDU, heat rejection, and controls-related parasitic energy use.
- Assess the practical feasibility and cost-effectiveness of heat recovery from data center cooling systems where useful heating loads exist.
- Evaluate demand-management performance, including whether cooling loads can be reduced, shifted, staged, or optimized during peak demand periods without compromising ITE reliability.
- Support future Title 24 prescriptive requirements, acceptance testing criteria, performance compliance options, and ACM/CBECC-Com modeling improvements.
- Support potential future Title 20 or federal equipment standards related to data center equipment, controls, or energy reporting.
- Provide market feedback on design, installation, commissioning, serviceability, and owner/operator acceptance of high-performance cooling strategies.

Sample Data Points

A sample set of data points that may be considered for Code Readiness monitoring is provided below for reference. The final data collection plan will be developed for each project based on system configuration, site infrastructure, monitoring feasibility, and Code Readiness research needs.

Data Points to Meter	Unit	Additional Specifications
ITE load	kW	Average, peak, and operating profile
Cooling equipment power	kW	CRAC/CRAH, chiller, DX unit, or liquid-cooling equipment
Fan power	kW	CRAH/CRAC fans, row coolers, or associated cooling fans
Pump power	kW	Chilled-water, condenser-water, or facility-water pumps
CDU power	kW	Where liquid cooling or hybrid cooling is installed
Supply air temperature	°F	Average and range at ITE cooling supply
Return air temperature	°F	Average and range at ITE cooling return
Supply liquid temperature	°F	Chilled water, facility water, or coolant supply
Return liquid temperature	°F	Chilled water, facility water, or coolant return
Liquid flow rate	GPM	Chilled water, facility water, or coolant loop
Economizer status	On/Off or %	Operating mode, lockout status, and hours of operation
Outdoor air temperature	°F	Measured at site or nearest reliable weather point
Outdoor air wet-bulb or dew point	°F	Used for economizer and climate correlation
Heat recovery rate	Btu/h or kWth	Where heat recovery is installed
Demand-management event status	Flag	Event timing, control mode, and load reduction response

Code Reference

This HPM is intended to exceed the applicable 2025 California Energy Code requirements for computer rooms, data centers, and cooling systems serving qualifying information technology equipment (ITE) loads. The references below establish the baseline code context for computer room cooling systems, economizers, airflow management, UPS efficiency, demand-responsive controls, additions and alterations, and relevant industry standards for data center energy performance.

Applicable Codes and Standards

CODE	APPLICABLE CODE REFERENCE	EFFECTIVE DATE	CODE REVIEW DATE
2025 California Energy Code, Title 24, Part 6	§120.6(j) – Mandatory Requirements for Computer Rooms. Establishes mandatory computer room requirements for reheat prevention, adiabatic humidification, and fan control. This HPM builds above these minimum requirements through enhanced variable-capacity cooling, variable-speed fan operation, economizer performance, controls integration, and monitoring.	January 1, 2026	June 2026
2025 California Energy Code, Title 24, Part 6	§140.9(a) – Prescriptive Requirements for Computer Rooms. Applies to computer rooms with power density greater than 20 W/ft² and includes requirements for economizers, fan power, air containment, and alternating current-output UPS efficiency. This HPM uses these requirements as the code baseline and adds higher-performance tiered pathways for new construction.	January 1, 2026	June 2026
2025 California Energy Code, Title 24, Part 6	§141.1(b) – Requirements for Covered Processes in Additions and Alterations: Computer Rooms. Establishes requirements for newly installed computer room cooling systems and UPS systems in additions and alterations, including references to §120.6(j), §140.9(a)2, §140.9(a)4, and computer room economizer requirements. This HPM builds on this baseline through a separate additions and alterations pathway focused on variable-speed equipment, pumping/valve modernization, airflow management, and controls.	January 1, 2026	June 2026
2025 California Energy Code, Title 24, Part 6	§110.2 – Mandatory Requirements for Space-Conditioning Equipment. Establishes minimum efficiency and test-procedure requirements for applicable HVAC equipment, including commercial unitary air conditioners, chillers, and heat pump or heat recovery chiller packages. This reference is relevant where the HPM scope includes DX cooling, chilled-water systems, heat rejection equipment, or heat recovery chillers serving ITE loads.	January 1, 2026	June 2026

CODE	APPLICABLE CODE REFERENCE	EFFECTIVE DATE	CODE REVIEW DATE
2025 California Energy Code, Title 24, Part 6	§110.12 – Mandatory Requirements for Demand Management. Establishes requirements for demand responsive controls where demand responsive controls are installed or required, including OpenADR-capable control pathways and centralized demand shed capability for applicable nonresidential HVAC systems. This reference supports the Advanced Grid-Interactive Cooling Controls pathway and demand-management strategies.	January 1, 2026	June 2026
2025 California Administrative Regulations, Title 24, Part 1	§10-103 – Permit, Certificate, Informational, and Enforcement Requirements. Establishes compliance documentation requirements, including Certificates of Compliance, Installation, Acceptance, and Verification, where applicable. This reference supports the HPM documentation requirement for Title 24 compliance documents, engineered plans, equipment submittals, control sequences, and acceptance information.	January 1, 2026	June 2026
California Appliance Efficiency Regulations, Title 20	Sections 1601–1609 – Appliance Efficiency Regulations. Establishes appliance efficiency, test procedure, certification, marking, and enforcement requirements for state- and federally regulated appliances sold or offered for sale in California. This reference may apply to regulated HVAC, cooling, UPS, or other equipment included in the project scope.	Current Edition	June 2026
ANSI/ASHRAE Standard 90.4	ANSI/ASHRAE Standard 90.4-2022 – Energy Standard for Data Centers. Provides data-center-specific energy performance requirements and design context for mechanical and electrical systems. This HPM references ASHRAE 90.4 to support above-code performance alignment, particularly for standalone data centers and advanced controls/performance pathways.	Current Edition	June 2026
ASHRAE TC 9.9	Thermal Guidelines for Data Processing Environments. Provides industry guidance for allowable and recommended environmental operating ranges for ITE and data center spaces. This reference supports HPM requirements related to supply/return temperature setpoints, airflow management, liquid/hybrid cooling design, and demand-management strategies that maintain ITE reliability.	Current Edition	June 2026
Open Compute Project	OCP Cooling Environments Guidance, including liquid cooling, coolant distribution unit, immersion cooling, door heat exchanger, and heat reuse guidance. Provides industry guidance and emerging best practices for high-density data center cooling infrastructure. This reference supports the HPM's technology-neutral treatment of direct-to-chip, rear-door heat exchanger, CDU, immersion, and hybrid cooling strategies.	Current Edition	June 2026

Eligible Climate Zones, Building Types, and Project Scopes

Eligible Climate Zones

This high-performance measure applies statewide in **California Climate Zones 1–16**. Applicants must identify the project's Title 24 climate zone in the project submittal.

Eligible Building Types

This high-performance measure applies to **dedicated computer rooms, data centers, and qualifying ITE spaces** that meet the measure eligibility requirements, including ITE load density of at least **20 W/ft²** and total installed ITE load of at least **35 kW**.

Eligible building types may include:

- **Standalone data centers**, including enterprise, colocation, high-performance computing, artificial intelligence, cloud computing, and similar dedicated data center facilities.
- **Commercial, public, institutional, and industrial facilities** with dedicated computer rooms or data centers, such as offices, education, healthcare, laboratories, civic buildings, manufacturing facilities, warehouses, research facilities, and campus central utility facilities.
- **Mixed-use buildings or campuses** where the qualifying computer room or data center is clearly identified and the cooling capacity, controls, and supporting equipment serving the ITE load can be documented separately from non-ITE loads.
- **Permanent modular or edge data center installations** where the installation is permitted as part of a permanent building or site improvement and meets all measure eligibility, documentation, and code compliance requirements.

For buildings with shared central plants or shared cooling infrastructure, only the portion of cooling capacity and supporting equipment dedicated to or allocated for qualifying ITE loads may be claimed under this measure. Projects must document the ITE load allocation, applicable equipment, controls, and metering or monitoring approach.

Eligible Project Scopes

This high-performance measure applies to the following project scopes:

- **New Construction:** New computer rooms, data centers, or qualifying ITE spaces with dedicated cooling systems designed to meet the Essential, Advanced, or Premium Level requirements.
- **Additions:** Expansion of existing computer rooms, data centers, or ITE loads where new or expanded cooling systems are installed to serve the added qualifying ITE load.
- **Alterations and Major Retrofits:** Replacement, expansion, or material modification of cooling systems serving qualifying ITE loads, including CRAC/CRAH equipment, DX systems, chilled-water compressors/chillers, pumps, fans, economizers, chilled-water pumping and valve modernization, airflow management measures for air-cooled systems, or associated controls.

For projects with **shared central plants or shared cooling infrastructure**, only the portion serving qualifying **ITE loads** may be claimed. Shared infrastructure is eligible only when it supports a qualifying **new construction, addition, alteration, or major retrofit** scope and meets the applicable HPM requirements.

This measure excludes **minor maintenance**, **like-for-like replacement**, **temporary systems**, and **small IT support spaces** that do not meet the minimum ITE load and density thresholds. See **Measure Exclusions** for additional out-of-scope applications.

Measure Exclusions

The following system types, applications, and project conditions are not eligible for this HPM:

1. **Eligibility and Scope Exclusions**
   - 1.1. Projects that do not meet the minimum measure eligibility thresholds, including **ITE load density less than 20 W/ft²**, **total installed ITE load less than 35 kW**, or cooling systems that are not dedicated to or clearly allocated for qualifying ITE loads.
   - 1.2. **General comfort cooling systems** serving offices, support spaces, equipment rooms, storage areas, or other non-ITE loads, unless the portion serving qualifying ITE loads is clearly documented and separately allocated.
   - 1.3. **Small IT closets, telecom closets, IDF/MDF rooms, security equipment rooms, network rooms**, or similar support spaces that do not meet the minimum ITE load and density requirements.
   - 1.4. **Shared central plant, heat rejection, pumping, or control system upgrades** where the project cannot reasonably document the portion of the scope serving qualifying ITE loads.
2. **Project Type and Code-Baseline Exclusions**
   - 2.1. Projects limited to **minor maintenance, service work, repairs, controls tuning, recommissioning, software-only changes, or like-for-like equipment replacement** that do not materially improve the cooling system serving qualifying ITE loads.
   - 2.2. **Code-minimum projects** that only comply with applicable 2025 Title 24 requirements and do not meet the above-code system design requirements for the claimed tier or pathway.
   - 2.3. **Temporary, portable, rental, mobile, or event-based cooling systems**, including portable spot coolers, temporary containerized cooling equipment, and non-permanent modular compute installations.
   - 2.4. **Additions and alterations** that attempt to claim the **new construction tier structure** without meeting the new construction requirements. Qualifying existing facility projects shall use the additions and alterations pathway unless the project scope is reviewed and approved as a qualifying new construction scope.
3. **Out-of-Scope Systems and Applications**
   - 3.1. **Standalone IT, electrical, or power-distribution upgrades** that do not directly improve the cooling system serving qualifying ITE loads, including server replacements, rack replacements, virtualization, workload management, UPS-only replacements, PDU upgrades, or IT equipment efficiency measures.
   - 3.2. **Refrigeration, industrial process cooling, laboratory process cooling, cold storage, manufacturing cooling, or other non-ITE process cooling systems**, unless the project includes a separately documented qualifying data center or computer room cooling scope.
4. **Tier and Pathway-Specific Exclusions**
   - 4.1. **Heat recovery systems** that do not serve a documented useful heating load, do not have a reasonable coincident load basis, or are installed only to satisfy the measure without a practical on-site, campus, or process use.
   - 4.2. **Demand-management or grid-interactive controls** that provide monitoring only and do not include active control capability for cooling equipment staging, sequencing, setpoint adjustment, load shifting, or demand reduction.
   - 4.3. **Liquid, hybrid, or immersion cooling systems** that are not coordinated with the facility cooling infrastructure, controls, leak detection, flow/temperature monitoring, or safe isolation requirements needed to support the claimed tier or pathway.
5. **Documentation and Double-Counting Exclusions**
   - 5.1. Projects that cannot provide sufficient documentation to verify **measure eligibility, claimed tier or pathway, above-code design features, incremental cost basis, and applicable code compliance**.
   - 5.2. Projects claiming the same equipment, incremental cost, or energy savings under another **CEDA HPM, custom measure, utility incentive, or third-party program**, unless the project clearly separates the claimed scope, cost basis, and savings attribution to avoid double counting.

Reviewer Checklist

HPM Reviewer Checklist: LM401 – Data Center and Computer Room Cooling Systems – V1.1

Checklist Description: This checklist captures the elements that must be present in the project design to be eligible for the high-performance measure inducement or consideration for additional site metering.

Project Name: _____ **Review Date:** _____

Assessment:

☐ Approved

☐ Not approved

Notes:

Reviewer: _____ **Signature:** _____

Reviewer Checklist – High-Performance Measure Requirements

Use this checklist to confirm that the submitted project scope, design documents, and supporting documentation demonstrate compliance with the claimed HPM tier or pathway. Review only the items applicable to the claimed project scope.

All Projects – Measure Eligibility (ME) and Documentation

☐ **Eligibility thresholds:** Project includes a qualifying computer room, data center, or ITE space with ITE load density ≥20 W/ft² and total installed ITE load ≥35 kW. (§ ME, 1)

☐ **ITE-serving cooling scope:** Cooling systems claimed under the HPM are dedicated to qualifying ITE loads, or the ITE-serving portion of shared cooling infrastructure is clearly allocated. (§ ME, 2)

☐ **Project scope and pathway:** Project scope is identified as new construction, addition, or alteration, and the claimed tier or pathway is clearly stated. (§ ME, 3)

☐ **Above-code compliance:** Title 24 compliance documentation is provided, and the claimed HPM scope is above applicable 2025 Title 24 minimum requirements. (§ ME, 4; § SDR, 1.4)

☐ **Verification package:** Mechanical drawings, equipment schedules/submittals, control sequences, design setpoints, and cost documentation are sufficient to verify the claimed HPM scope. (§ SDR, 1.1–1.5)

New Construction (NC) – Essential Level

☐ **Variable-capacity cooling:** Cooling equipment serving qualifying ITE loads includes an eligible variable-capacity or variable-speed cooling strategy. (§ NC, 1.1)

☐ **Liquid/hybrid cooling controls:** Liquid or hybrid cooling systems include variable-speed Technology Cooling System (TCS) coolant pump control and/or Coolant Distribution Unit (CDU) capacity modulation, where applicable. (§ NC, 1.1.3)

☐ **Variable-speed fans:** Cooling system fans serving qualifying ITE loads are variable speed and meet the required fan turndown capability. (§ NC, 1.2)

☐ **Above-code economizer capability:** Economizer design exceeds the applicable Title 24 baseline thresholds for the qualifying ITE cooling load. (§ NC, 1.3)

☐ **High-density rack cooling:** Projects with rack densities ≥30 kW/rack include an appropriate advanced cooling strategy for the high-density ITE load. (§ NC, 1.4)

New Construction (NC) – Advanced Level

☐ **Essential prerequisite:** Project meets all Essential Level requirements. (§ New Construction, 2)

☐ **Advanced pathway:** Claimed Advanced pathway is identified as Heat Recovery, Liquid or Hybrid Cooling Performance, or Grid-Interactive Cooling Controls. (§ NC, 2.1–2.3)

HPM Reviewer Checklist: LM401 – Data Center and Computer Room Cooling Systems – V1.1

☐ **Heat Recovery Pathway:** Documentation confirms recoverable heat, useful heating load served, and reasonable coincident heating demand. (§ NC, 2.1; § SDR, 2.2.1)
☐ **Liquid or Hybrid Cooling Performance Pathway:** Documentation confirms liquid/hybrid cooling design, CDU or coolant system controls, temperature/flow monitoring, leak detection, safe isolation, and economizer capability. (§ NC, 2.2; § SDR, 2.2.2)
☐ **Grid-Interactive Cooling Controls Pathway:** Documentation confirms active demand-management capability through controls, storage, automated demand response, or equivalent load-management strategy. (§ NC, 2.3; § SDR, 2.2.3)

New Construction (NC) – Premium Level

☐ **Advanced prerequisite:** Project meets all Essential Level requirements and the applicable Advanced Level pathway requirements. (§ NC, 3)
☐ **Premium enhancement:** Claimed Premium enhancement is identified as Deeper Heat Recovery or High-Temperature Liquid or Hybrid Cooling Operation. (§ NC, 3.1–3.2)
☐ **Deeper Heat Recovery:** Documentation confirms the higher heat recovery target, useful heating load served, and coincident load basis. (§ NC, 3.1; § SDR, 2.3.1)
☐ **High-Temperature Liquid or Hybrid Cooling Operation:** Documentation confirms economizer capability at the required high-temperature operating conditions. (§ NC, 3.2; § SDR, 2.3.2)

Additions and Alterations (A&A) – Single Tier

☐ **Affected scope:** Existing and proposed scope clearly identifies the modified, replaced, or expanded cooling systems serving qualifying ITE loads. (§ A&A, 1; § SDR, 3.1)
☐ **Cooling equipment:** Modified or expanded cooling equipment includes inverter-driven DX equipment or variable-speed chilled-water compressors/chillers, as applicable to the affected scope. (§ A&A, 1)
☐ **Variable-speed fans:** Associated cooling fans serving the affected ITE load are variable speed and meet the required fan turndown capability. (§ A&A, 2)
☐ **Chilled-water modernization:** Chilled-water systems remove triple-duty valves where applicable and include appropriate valve, pumping, or flow-control modernization. (§ A&A, 3)
☐ **Airflow management:** Air-cooled systems include airflow management improvements for the affected ITE cooling scope. (§ A&A, 4)
☐ **Controls and trend data:** Updated control sequences, setpoints, and available trend data are provided for the modified cooling systems, where applicable. (§ A&A, 5–6; § SDR, 3.5–3.7)

Exclusions and Program Review

☐ **Measure exclusions:** Project does not fall under the listed exclusions, including code-minimum-only work, minor maintenance, like-for-like replacement, temporary systems, non-ITE cooling, or unsupported shared infrastructure claims. (§ Measure Exclusions, 1–5)
☐ **No double-counting:** Claimed equipment, costs, and savings are not double-counted under another CEDA HPM, custom measure, utility incentive, or third-party program unless the scope and savings attribution are clearly separated. (§ Measure Exclusions, 5.2)
☐ **Reviewer confirmation:** Submitted documentation is sufficient to verify eligibility, claimed tier or pathway, above-code design features, incremental cost basis, and applicable code compliance. (§ SDR, 1–3; § Measure Exclusions, 5.1)

Version History Log

Version	Effective Date	End Date	Change Description
1	July 13, 2026	October 27, 2026	Initial release of the High-Performance Data Center and Computer Room Cooling Systems HPM, including eligibility criteria, new construction tier pathways, additions and alterations requirements, supporting documentation, IMC basis, code references, and Code Readiness monitoring objectives.
1.1	October 28, 2026	Active	HPM has been updated with LM code 401 for the HVAC application, and general formatting changes have been applied.

The version identified as 'Active' is the current published version and remains in effect until superseded by a subsequent published version. CEDA may update, replace, or retire High-Performance Measures without prior notice. End dates are assigned to prior versions once superseded.