

High-Performance Measure Details

Measure Name Very High Efficiency DOAS	Use Category HVAC – Space Heating Electrification
Effective Date March 2, 2026	Version 1.2
Measure Code LM447	Measure Stage Early Adoption & High Priority Data Collection

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Technology Summary

Dedicated Outdoor Air Systems (DOAS) are HVAC configurations that decouple ventilation from space heating and cooling by delivering 100 percent outdoor air through a dedicated air-handling unit, separate from zone sensible-conditioning equipment. In typical applications, a DOAS conditions, dehumidifies, and filters outdoor air before delivering it directly to occupied spaces or downstream terminal units, while parallel systems such as VRF, heat pumps, or fan coils manage sensible loads. Within the California Energy Design Assistance (CEDA) program—which supports electrification, decarbonization, and grid resilience in new construction—DOAS represents a design strategy that enables all-electric HVAC architectures while improving ventilation control, load management, and compatibility with high-performance building envelopes. DOAS is commonly applied in offices, education buildings, multifamily common areas, healthcare, and other nonresidential facilities where ventilation loads are significant relative to sensible cooling.

DOAS matters for California decarbonization because ventilation air often drives peak heating loads and increases fan energy when treated through conventional mixed-air systems. By separating latent and ventilation loads from zone-level sensible conditioning, DOAS allows electrified heating systems to be sized more accurately and operated more efficiently. When paired with heat recovery, DOAS can reduce heating energy use associated with high outdoor air fractions, particularly in climate zones with significant seasonal temperature swings. Operationally, the system’s effectiveness depends on coordinated airflow control, energy recovery integration, and interaction with zone equipment rather than equipment efficiency alone.

In practice, real-world performance gaps are common. These include: oversizing of DOAS airflow beyond required ventilation rates; failure to properly integrate or commission energy recovery bypass controls; excessive fan energy due to poor duct design or lack of turndown capability; unintended simultaneous heating and cooling caused by supply air temperature setpoints; and control sequences that do not effectively reduce downstream fan or terminal operation during ventilation-only modes. Without careful implementation, projects may not realize the expected efficiency and decarbonization benefits.

Relevant industry standards and certifications include AHRI 920 (DX DOAS Units), AHRI 1060 (Air-to-Air Energy Recovery Ventilation Equipment), ASHRAE Standard 62.1, and the 2025 California Title 24, Part 6 Building Energy Efficiency Standards.

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 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 and all-electric buildings** by combining electrification with energy efficiency that can result in projects implementing measures to achieve greater energy savings, reduced emissions, and overall improved building performance. As more buildings specify and install Very High Efficiency DOAS, this helps to increase the overall supply of efficient DOAS in the market for others to use, including beyond new construction.
- **Increasing the demand for high-performance measures and all-electric buildings** by pushing for electrification that drives the need for technological advancements, supporting economic growth opportunities through innovation, and raising awareness of the benefits of electrification 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 enables technological innovation.
- **Providing Codes & Standards with projects of interest** to collect metered data that will inform future California energy codes.

CEDA Inducement Requirements

The inducement requirements for this measure are intended to address a persistent market and quality gap in the implementation of DOAS. While DOAS is increasingly specified in electrified and high-performance buildings, field outcomes often vary due to inconsistent ventilation sizing, incomplete energy recovery integration, and control sequences that do not fully coordinate with downstream heating and cooling systems. In many cases, systems are labeled as DOAS but operate similarly to conventional mixed-air systems, resulting in higher-than-expected fan energy, simultaneous heating and cooling, or underperforming heat recovery. Because performance is highly sensitive to design rather than equipment selection alone, targeted incentives help encourage intentional system architecture and coordinated controls that align with CEDA's decarbonization objectives.

This high-performance measure is structured to promote DOAS applications that improve ventilation efficiency and support all-electric HVAC configurations in new construction. By reducing implementation risk and clarifying performance expectations, the inducement framework supports projects that advance measurable reductions in site energy use and operational greenhouse gas emissions relative to conventional ventilation approaches.

Inducement eligibility is determined based on demonstrated compliance with the measure's system design criteria and is evaluated using projected energy savings impacts and associated carbon dioxide equivalent (CO₂e) emissions reductions relative to a baseline code-compliant system. Inducement amounts may be normalized by conditioned floor area or gross square footage, as applicable, to reflect the scale of ventilation energy impact within the project.

System Design Requirements

The following system criteria specific to the ventilation unit and ventilation duct design are required for the efficiency measure:

1. **Decoupled Ventilation Design**: Ventilation and heating/cooling system fans must be controlled separately. Ventilation air from the HRV/ERV unit is supplied to each occupied space, either directly through dedicated supply air outlets/diffusers or through heating/cooling ductwork when the ventilation supply air is delivered downstream of the zone terminal heating/cooling coils.
2. **High Efficiency Heat/Energy Recovery Ventilator (HRV/ERV)** - *select one of the following options*:
 - a. Select a product from the BetterBricks qualified projects list for NEEA's VHE DOAS Program.
 - b. Design Requirements Path: Demonstrate compliance with Design Requirements column of HRV/ERV Minimum Requirements Table in NEEA's VHE DOAS specification, Appendix A with equipment selected at design conditions using AHRI 1060 certified software with HRV/ERV sensible effectiveness $\geq 82\%$.
3. **HRV/ERV Fan Control Capabilities**
 - a. HRV/ERV should include variable speed fans, with inputs capable of controlling fan speed based on time-of-day scheduling, and inputs for CO₂ and duct static pressure at a minimum.
4. **HRV/ERV Bypass Control Capabilities**
 - a. Include through use of variable damper control or wheel speed control.
5. **HRV/ERV System Fan Power Consumption**
 - a. The total fan power of the supply and exhaust fans for ventilation systems shall be less than 0.8 W/CFM or fan power allowances specified in Title 24, Part 6, 2025, whichever is lower. This can be achieved by:
 - i. Reduced internal pressure of HRV/ERV components.
 - ii. Larger ductwork distribution, sizing ducting at no greater than 0.08 inches water gauge pressure loss per 100 feet of straight duct.
 - iii. Higher efficiency fans.

Incremental Measure Cost

The Incremental Measure Cost (IMC) values presented below are program calibration inputs used to support CEDA inducement calculations and portfolio-level cost-effectiveness screening. They are intended to represent typical incremental first costs associated with implementing a high-performance DOAS configuration in new construction relative to a code-minimum baseline ventilation approach. These values are not intended to serve as bid estimates, project-specific budgeting tools, or reconciliation mechanisms for contractor invoices.

Actual project costs will vary based on building type, climate zone, ventilation load, system integration complexity, controls architecture, and market conditions. The IMC values below reflect normalized deltas derived from industry cost data, manufacturer pricing, published studies, and program experience, and are intended to represent reasonable market conditions rather than project-specific pricing outcomes.

Base Case

The Base Case assumes a Title 24–compliant mixed-air ventilation strategy integrated into packaged rooftop units (RTUs), VAV air handlers, or split-system air handlers. Ventilation air is introduced through the primary space-conditioning unit, with economizer capability as required by code. Energy recovery, if present, meets minimum prescriptive requirements but does not include enhanced turndown capability, advanced integration with downstream equipment, or dedicated ventilation fan optimization beyond code minimums.

The Base Case assumes conventional fan power, standard controls integration, and no intentional decoupling of latent and sensible loads through a standalone dedicated outdoor air unit.

Measure Case

The Measure Case includes installation of a Dedicated Outdoor Air System (DOAS) that fully decouples ventilation air from space-conditioning equipment and incorporates enhanced airflow turndown, energy recovery integration (where applicable), and coordinated control strategies to reduce simultaneous heating and cooling and downstream fan energy use.

The incremental cost delta primarily reflects:

- Dedicated ventilation air-handling equipment
- Additional duct distribution for 100% outdoor air
- Enhanced fan controls and multi-speed or VFD capability
- Integration and commissioning of DOAS-to-zone equipment control sequences
- Design and coordination effort beyond standard mixed-air systems

The delta does not assume wholesale duplication of central cooling equipment; rather, it reflects the incremental cost above a code-compliant mixed-air system.

IMC Values & Normalization

Recommended normalization: **\$/ton of total system cooling capacity served by DOAS**

Rationale:

- DOAS costs scale most directly with ventilation airflow (CFM) rather than cooling tons or total building floor area. However, ventilation airflow is not consistently available in early design documentation across project types.

- Cooling tons correlate reasonably well with required ventilation airflow in typical office, education, multifamily common area, and nonresidential buildings, and provide a scalable and easily verifiable normalization method

Representative Size Class & Pricing Anchors

Typical cost relationships observed in market data:

- Packaged RTU mixed-air system: \$2,500–\$3,500/ton installed
- Dedicated DOAS unit with ERV: \$3,200–\$4,200/ton equivalent ventilation capacity
- Incremental installed delta: \$500–\$900/ton

Program experience suggests a moderate premium reflecting additional ducting, controls integration, and commissioning effort.

Proposed Singular IMC Value

- **IMC** = \$750/ton of total system cooling capacity served by DOAS

Example Calculation

20-ton building HVAC system

*20 tons × \$750/ton = **\$15,000 incremental measure cost***

Sources

IMC values are informed by a combination of publicly available market pricing, industry cost references, and program experience, and are intended to reflect typical market conditions in new construction rather than project-specific pricing, including:

- RSMeans Mechanical Cost Data (2024–2025 editions)
- AHRI 920 DOAS manufacturer pricing literature
- California Title 24 CASE Reports (2025 cycle, Nonresidential HVAC sections)
- Pacific Northwest National Laboratory (PNNL) DOAS performance studies
- ASHRAE Advanced Energy Design Guides
- Recent California market pricing from RTU, DOAS, and ERV manufacturer representatives

Code Readiness Objectives

This measure supports CEDA's Code Readiness efforts by collecting performance and market data to inform future Title 24 improvements related to high-efficiency Dedicated Outdoor Air Systems (DOAS). The data will help determine the most cost-effective, scalable ventilation configurations compared to conventional mixed-air systems or code-minimum DOAS installations. The objectives include the following:

- Define prescriptive DOAS configurations suitable for inclusion in future energy code updates, including ventilation decoupling strategies and enhanced energy recovery thresholds.
- Evaluate fan energy performance, airflow turndown capability, and control sequencing under real-world operating conditions.
- Identify duct design practices, system integration approaches, and downstream equipment interactions that most influence ventilation energy use and heating/cooling offsets.
- Assess market readiness, including equipment availability, physical space considerations, incremental cost, and contractor familiarity with high-efficiency DOAS configurations.
- Recommend potential enhancements to efficiency metrics, modeling assumptions, and equipment rating procedures beyond current minimum standards.

Code Readiness Site Monitoring

If selected for Code Readiness monitoring, equipment energy consumption and mechanical system performance may be monitored on-site for a period of up to 24 months. To support performance evaluation and data collection, projects shall provide reasonable access for the installation and operation of metering, sensors, and communication equipment.

Projects equipped with a Building Automation System (BAS), Energy Management System (EMS), or equivalent platform should enable integration of advanced metering devices through the existing system to facilitate data collection and remote access. For projects without a BAS or EMS, 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 system 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 ventilation fan energy use, heat/energy recovery effectiveness, and part-load performance of DOAS units under varying California climate conditions.
- Document airflow turndown capability, fan power intensity (W/cfm), and the impact of duct design and static pressure on real-world performance.
- Provide insight into system integration impacts, including interactions between DOAS operation and downstream heating and cooling equipment, control sequencing effectiveness, and simultaneous heating/cooling avoidance.
- Evaluate incremental cost, space requirements, equipment availability, and contractor familiarity to assess market scalability of high-efficiency DOAS configurations.
- Support future Title 24 prescriptive criteria, performance modeling refinements, and potential optional efficiency credits for advanced DOAS systems in upcoming code cycles.

Sample Data Points

A sample set of data points that would ideally be collected is provided below for reference. This list will be re-developed for each project based on the infrastructure and need of the monitoring effort:

Data Points to Meter	Unit	Additional Specifications
System Unit Power	kW	Maximum and minimum values
Thermal Load Provided	BTU	Average and Peak values
Integrated Seasonal Moisture Removal Efficiency (ISMRE2)	lb of moisture /kWh	Efficiency measured at each instance
Moisture Removal Capacity	lb of moisture /hr	Maximum and minimum values
Supply Air Ventilation Rate	CFM	Maximum and minimum values
Exhaust Air Ventilation Rate	CFM	Maximum and minimum values
Supply Air Temperature	°F	Measured at unit
Supply Air Dewpoint	°F	Measured at unit
Outdoor Air Temperature	°F	Measured at unit or site
Outdoor Air Dewpoint	°F	Measured at unit or site
Indoor Air Temperature	°F	Average
Building Mode (Occupied Unoccupied)	-	Flag indicating status

Code Reference

2025 CA Title 24, Part 6, Section 140.4– Prescriptive Requirements for Space-Conditioning Equipment

140.4(p) Dedicated Outdoor Air Systems (DOAS):

HVAC systems that utilize a dedicated outdoor air system (DOAS) such as a DX-DOAS, HRV or ERV unit to condition, temper, or filter 100 percent outdoor air separate from local or central space-conditioning systems serving the same space shall meet the following criteria:

1. *DOAS unit fan systems with input power less than 1 kW shall not exceed a total combined fan power of 1.0 W/cfm. DOAS with fan power greater than or equal to 1 kW shall meet the requirements of Section 140.4 (c).*

Exception to Section 140.4(p)1: *DOAS complying with Section 140.4(a)3E.*

2. *The DOAS supply air shall be delivered directly to the occupied space or at the outlet of any terminal heating or cooling coils and shall cycle off any zone heating and cooling equipment fans, circulation pumps and terminal unit fans when there is no call for heating or cooling in the zone.*

Exception 1 to Section 140.4(p)2: *Active chilled beam systems.*

Exception 2 to Section 140.4(p)2: *Sensible-only cooling terminal units with pressure-independent variable-airflow regulating devices limiting the DOAS supply air to the greater of latent load or minimum ventilation requirements.*

Exception 3 to Section 140.4(p)2: *Any configuration where a DOAS unit provides ventilation air to a downstream fan (a terminal box, air handling unit or other space-conditioning equipment) where the total system airflow can be reduced to ventilation minimum or the downstream fan power is no greater than 0.12 watts per cfm when space temperatures are within the thermostat deadband (at low speed per manufacturer’s literature).*

3. *DOAS supply and exhaust fans shall have a minimum of three speeds to facilitate system balancing.*
4. *DOAS with mechanical cooling providing ventilation to multiple zones and operating in conjunction with zone heating and cooling systems shall not use heating or heat recovery to warm supply air above 60F when representative building loads or outdoor air temperature indicates that the majority of zones require cooling.*

140.4(q) Exhaust air heat recovery:

Fan systems designed to operate to the criteria listed in Table 140.4-J, Table 140.4-K, or where required by Section 140.4(a)3, shall include an exhaust air heat recovery system that meets the following:

1. *A sensible energy recovery ratio of at least 60 percent or an enthalpy recovery ratio of at least 50 percent for both heating and cooling design conditions and a rating in accordance with AHRI 1060.*

Exception 1 to Section 140.4(q)1: *Compliance is not required for sensible recovery ratio at heating design conditions for Climate Zone 15*

Exception 2 to Section 140.4(q)1: Compliance is not required for sensible recovery ratio at heating design conditions for Climate Zone 1

2. Energy recovery bypass or control to disable energy recovery and to directly economize with ventilation air based on outdoor air temperature limits specified in Table 140.4-G. For energy recovery systems where the transfer of energy cannot be stopped, bypass shall prevent the total airflow rate of either outdoor air or exhaust air through the energy recovery exchanger from exceeding 10 percent of the full design airflow rate.

Exception to Section 140.4(q)2: For DOAS units with the capability to shut off when a separate space-conditioning system serving the same space meets the economizer requirements in Section 140.4(e)1A.

Exception 1 to Section 140.4(q): Systems meeting Section 140.9(c), Prescriptive requirements for laboratory and factory exhaust systems.

Exception 2 to Section 140.4(q): Systems serving spaces that are not cooled and that are heated to less than 60F.

Exception 3 to Section 140.4(q): Where more than 60 percent of the outdoor air heating energy is provided from site-recovered energy in Climate Zone 16.

Exception 4 to Section 140.4(q): Where the sum of the airflow rates exhausted and relieved within 20 feet of each other is less than 75 percent of the design outdoor airflow rate, excluding exhaust air that is either:

1. Used for another energy recovery system,
2. not allowed by the California Mechanical Code (Title 24, Part 4) (CMC) for use in energy recovery systems with leakage potential, or
3. of Class 4 as specified in Section 120.1(g).

Exception 5 to Section 140.4(q): Systems expected to operate less than 20 hours per week.

Eligible Climate Zones, Building Types, & Project Scopes

Eligible Climate Zones

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

Eligible Building Types

This high-performance measure applies to:

- **Nonresidential: Commercial, public, agricultural, and industrial** facilities (e.g., offices, retail, education, healthcare, food service, warehouses, manufacturing, civic buildings).

Eligible Project Scopes

This high-performance measure applies to:

- **New construction, additions, and major alterations/retrofits** to systems served by the measure.

This high-performance measure does not apply to (not in scope):

- **Low-rise residential** (single-family and multifamily ≤ 3 habitable stories above grade).
- **High-Rise Multifamily:** Buildings with four (4) or more habitable stories above grade.

Measure Exclusions

The following systems, configurations, and project conditions are not eligible for inducement under this measure.

Ineligible System Types

The following do **not** qualify:

- Packaged rooftop units (RTUs) using economizers or mixed-air ventilation without a true dedicated outdoor air unit
- 100% outdoor air units without qualifying high-efficiency total energy recovery
- Exhaust-only or supply-only ventilation systems
- Residential (low-rise) ventilation systems
- Industrial/process ventilation systems (labs, manufacturing, hazardous exhaust)
- Data center cooling systems without defined occupant ventilation
- Temporary or portable ventilation equipment
- Like-for-like replacements that do not exceed 2025 Title 24 requirements

Ineligible Performance / Certification Cases

Projects are not eligible if they:

- Use equipment without AHRI (or equivalent) certification
- Fail to meet minimum energy recovery effectiveness thresholds
- Rely solely on economizer performance to claim efficiency

- Lack documented design calculations or performance verification
- Do not implement and verify required control sequences
- Fail to complete required commissioning

Systems must exceed 2025 Title 24, Part 6 prescriptive minimums to qualify.

Ventilation Decoupling Requirement

This measure applies only to **true DOAS configurations** that:

- Decouple ventilation from space heating/cooling
- Provide independently controlled outdoor air delivery
- Include measurable and verifiable ventilation airflow

Systems that do not demonstrate ventilation decoupling are ineligible.

Anti-Double-Dip Provisions

The same equipment, heating capacity, energy recovery device, or control sequence may **not** receive inducements under multiple CEDA High-Performance Measures. Specifically:

- DOAS equipment cannot also claim inducements under Hydronic Heat Pump, VRF, Heat Recovery Chiller, or BMS HPMs for overlapping scope.
- Energy recovery components integral to the DOAS may not be separately incentivized.
- Electrified ventilation heating capacity cannot be claimed under both this HPM and another electrification HPM.
- Required controls and metering under this measure cannot be separately claimed under BMS or Monitoring HPMs unless clearly incremental.

If overlap is identified, the applicant must elect a single applicable HPM.

Project Scope Exclusions

The following are not eligible:

- Controls-only or retro-commissioning-only projects
- Projects outside CEDA service territory
- Projects not compliant with applicable permitting and code requirements

Reviewer Checklist

HPM Reviewer Checklist: LM447 – Very High Efficiency DOAS – V1.2

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:** _____

High-Performance Measure Requirements

Comments

System Eligibility

- System is a Dedicated Outdoor Air System (DOAS) providing 100% outdoor air and decoupled from space-conditioning equipment (§140.4(p))
- Ventilation and heating/cooling system fans are controlled separately (decoupled ventilation design)
- System serves eligible building type (nonresidential)

Documentation Requirements

- Mechanical plans identify required outdoor ventilation rates (§120.1(c)3; §160.2)
- Equipment submittals confirm DOAS unit configuration and applicable AHRI certification (AHRI 920; AHRI 1060 if ERV)
- Control sequence documentation demonstrates coordinated DOAS-to-zone system integration (§140.4(p)2)

Efficiency Requirements

- DOAS fan power complies with §140.4(p)1 (≤ 1.0 W/cfm for small units or meets §140.4(c) for larger units)
- DOAS supply and exhaust fans include minimum three-speed or variable-speed capability (§140.4(p)3).

Version History Log

Version	Effective Date	End Date	Change Description
1	February 23, 2023	March 1, 2026	N/A
1.2	March 2, 2026	Active	Updated measure to the current CEDA HPM format, IMC, and added reviewer checklist

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.