High-Performance Measure Details

Measure Name
Refrigeration Heat Reclamation

Use Category
HR – Heat Recovery

Effective Date
June 15, 2025

End Date
December 31, 2025

Version
1

Measure Code
LM646

Table of Contents

Technology Summary

Refrigeration heat reclamation has been around for decades, with significant advancements in recent times. In the past, concerns over refrigeration leaks, coupled with moderate prices for fossil fuels, limited the growth of this technology until now, with the rise in decarbonization efforts. The introduction of more widely available, environmentally friendly low-GWP refrigerant options, such as CO2, has made AC/refrigeration heat recovery more attractive. While previous systems were only capable of partial heat recovery or recovery of only the "super heat" from a vapor compression cycle, refrigeration heat reclaim can now take advantage of full condensing and capture latent heat in addition to super heat, increasing recoverable heat capacity with the potential to offset space heating needs altogether. Although AC/refrigeration heat reclaim systems have been around for some time, their performance is not yet completely well understood.

Commercial refrigeration and AC reclamation may be applied to buildings including supermarkets, grocery stores, refrigerated distribution centers, convenience stores, restaurants, food processing plants, and ice rinks. Currently, refrigeration heat recovery is required in Title 24 for retail food or beverage stores with 8,000 sq. ft. or more of conditioned floor area and that utilize either refrigerated display cases or walk-in coolers and freezers. For additional code requirements and considerations, refer to the

Code Reference section on page 5.

Alignment with CEDA Program Goals

The CEDA program supports the implementation of energy efficiency measures that support Code Readiness's 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 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, which can result in projects implementing measures to achieve greater energy savings, reduced emissions, and overall improved building performance. As more buildings specify and install refrigeration heat reclamation technologies, this helps to increase the overall supply of heat recovery technologies 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 enable 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 listed below are intended to support the adoption of electrification in the current market by increasing energy efficiency, decreasing costs, and decreasing carbon emissions. Projects receive inducements based on market impacts, savings, and influence.

Projects must provide the required supporting documentation specified below and satisfy one of the system-level design requirements to be eligible for an inducement.

Inducement Requirements

- **System Design Requirements**
    - **Essential level:** Gas furnace or heat pump HVAC system with heat recovery
        - Design the HVAC system to provide space heating using mechanical heat recovery from commercial refrigeration system(s).

        - Each refrigeration system must provide a minimum of 50,000 Btu/h of design heat rejection for heat recovery.
        - Both gas/electric and heat pump-based HVAC systems are eligible to meet this requirement, provided they incorporate heat recovery for space heating as described.
    - **Advanced level:** Gas or heat pump water heating system with heat recovery
        - Provide a domestic/service water heating system that utilizes mechanical heat recovery from air conditioning or refrigeration system(s).
        - Each contributing system must provide a minimum of 50,000 Btu/h of design heat rejection for heat recovery.
        - Both gas-fired and heat pump water heating systems are eligible to meet this requirement, provided they incorporate heat recovery for water heating as described.
    - **Premium level:** Heat pump space and domestic/service water heating with heat recovery
        - Provide a heat pump HVAC system for space heating that captures and utilizes recovered heat from air conditioning or refrigeration system(s).
            - Each contributing system must provide no less than 50,000 Btu/h of design heat rejection to the heat recovery system.
        - Provide a heat pump domestic/service water heating system that also utilizes recovered heat from air conditioning or refrigeration system(s).
            - Each contributing system must provide no less than 50,000 Btu/h of design heat rejection to the heat recovery system.
        - Only heat pump systems are eligible to meet this requirement. Gas-fired water heaters, gas furnaces, and electric resistance water heaters are not permitted.
- **Supporting Documentation Requirements**
    - Provide engineered, stamped, and permitted construction plans demonstrating that the refrigeration heat reclamation system design fully complies with all state and local jurisdiction requirements and regulations.
    - Provide system start-up documentation confirming that start-up service was performed by a manufacturer-authorized representative.
    - Provide a sequence of operations for the AC/refrigeration heat reclamation system design.
    - Provide equipment submittals stamped and approved by the responsible engineer of record.
    - Provide equipment-cost information for the AC/refrigeration heat reclamation system design.

Code Readiness Objectives

While the energy code has some criteria as of T24 2022 for refrigeration heat reclamation, the market is not mature, and designs still lack consistent delivery of products. The information would help to specifically inform energy codes to:

- Support Market Transformation: Provide performance data to help update building energy codes and encourage wider adoption.
- Refine Performance Standards: Improve Title 24 and other energy codes by validating expected energy savings.
- Identify Barriers to Adoption: Understand technical and operational challenges to inform future policy adjustments.
- Demonstrate Cost-Effectiveness: Collect real-world data to validate lifecycle cost benefits and payback periods.

To support future code cycles, Code Readiness seeks to capture the following information:

- Information on how refrigerant heat reclamation can be used to cost-effectively provide space heating and/or hot water for nonresidential buildings.
- Identify operational efficiencies of specific configurations or controls.
- Determine efficiency criteria that can be established in building codes in addition to equipment ratings.
- Identify product availability and market readiness of contractors and equipment vendors, and first cost information.
- Identify any enhancements to the criteria used in the equipment test procedure for refrigerant heat reclamation, beyond what is currently required and or is useful for the specific building heating application.
- Assess how refrigerant heat reclamation interacts with electrification efforts, heat pumps, and other energy efficiency measures.

Site Metering Prerequisites

- Project must install a Building Automation System (BAS), Energy Management System (EMS), or similar building management system to facilitate the installation of advanced metering devices.
    - If selected for Code Readiness metering, equipment energy and performance data may be monitored at the site for a period of up to 12 months.

Data Benefits

- Confirm actual heat recovery rates compared to design expectations.
- Evaluate seasonal variations in heat recovery performance based on ambient conditions and operational loads.
- Assess system controls and automation effectiveness in optimizing heat utilization and minimizing waste heat rejection.
- Identify best practices for system configurations to maximize efficiency and cost-effectiveness.
- Determine appropriate efficiency criteria for integration into building codes, going beyond equipment ratings to system-level performance metrics.
- Quantify energy and cost savings by tracking reductions in fossil fuel-based heating and overall site energy consumption.
- Measure direct reductions in greenhouse gas emissions by offsetting fossil fuel heating loads with reclaimed heat.
- Identify maintenance needs and failure modes to improve long-term system reliability.

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 needs of the monitoring effort:

Data Points to Meter	Unit	Additional Specifications
Power Consumption	kW	The total energy use of each system
Heat Transfer	Btu/h	Average and Peak values
Operational Efficiency	COP	Efficiency is measured at each instance
Operational Efficiency	TMCOP	Efficiency of temperature maintenance
Supply Air/Water Flow	CFM/GPM	Average
Supply Air/Water Supply Temp	°F	Average
Supply Air/Water Return Temp	°F	Average
Supply Air/Water Load	Btu/h	Average
Outdoor Temperature	°F	Measured at the unit or site
Outdoor Air Moisture Level	% RH	Measured at the unit or site

Data Points to Meter	Unit	Additional Specifications
Indoor Temperature	°F	Average
Building Mode (Occupied Unoccupied)	-	Flag indicating status

Code Reference

2022 CA Title 24, Part 6, Section 120.6 – Mandatory Requirements for Covered Processes.

120.6(b) – Mandatory Requirements for Commercial Refrigeration:

> *Retail food or beverage stores with 8,000 square feet or more of conditioned floor area, and that utilize either refrigerated display cases, or walk-in coolers or freezers, shall meet all applicable State and federal appliance and equipment standards consistent with Section 110.1 or, for equipment not subject to such standards, the requirements of Subsections 1 through 4.*

120.6(b)4 – Refrigeration Heat Recovery:

> *A. HVAC systems shall utilize heat recovery from refrigeration system(s) for space heating, using no less than 25 percent of the sum of the design Total Heat of Rejection of all refrigeration systems that have individual Total Heat of Rejection values of 150,000 Btu/h or greater at design conditions.*
>
> > ***EXCEPTION 1 to Section 120.6(b)4A:*** *Stores located in Climate Zone 15.*
> >
> > ***EXCEPTION 2 to Section 120.6(b)4A:*** *HVAC systems or refrigeration systems that are reused for an addition or alteration.*
> >
> > ***EXCEPTION 3 to Section 120.6(b)4A:*** *Stores where the design Total Heat of Rejection of all refrigeration systems is less than or equal to 500,000 Btu/h.*
>
> *B. The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping shall be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity.*

Eligible Climate Zones and Building Types

Eligible Climate Zones

This measure is applicable in all California climate zones.

Eligible Building Types

This measure is applicable to supermarkets, grocery stores, refrigerated distribution centers, convenience stores, restaurants, food processing plants, ice rinks, or virtually any commercial, industrial, public, agricultural, or high-rise multi-family facility with substantial need for AC/refrigeration, space and/or hot water heating.

For retail food or beverage stores with 8,000 sq. ft. or more of conditioned floor area which utilize either refrigerated display cases or walk-in coolers and freezers, recovered heat must exceed 50,000 Btu/h of the design total heat of rejection for each individual refrigeration system that have individual Total Heat of Rejection (THR) values of 150,000 Btu/h or greater at design conditions.

Measure Exclusions

This high-performance measure excludes the following:

- Sites that are required to use refrigerant heat recovery/reclamation systems to meet code minimum requirements.
- Heat recovery chillers, or other water-side hydronic heat recovery technologies where their primary function is to produce chilled water for comfort cooling.

Reviewer Checklist

High-Performance Measure Review Checklist: Refrigeration Heat Reclamation

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:** _____

Essential Level Inducement Requirements	Comments
☐ Does the project have an HVAC system that utilizes recovered heat from refrigeration system(s) for space heating, using no less than 50,000 Btu/h of the design total heat of rejection per refrigeration system serving a commercial, industrial, public, agricultural, or high-rise multi-family building?	

Advanced Level Inducement Requirements	Comments
☐ Does the project have a water heating system that utilizes recovered heat from air conditioning or refrigeration system(s) for domestic/service hot water, using no less than 50,000 Btu/h of the design total heat of rejection per refrigeration system serving a commercial, industrial, public, agricultural, or high-rise multi-family building?	

Premium Level Inducement Requirements	Comments
☐ Does the project have a heat pump HVAC system and heat pump water heating system that utilizes recovered heat from air conditioning or refrigeration system(s) for space heating and domestic/ service hot water, using no less than 50,000 Btu/h of the design total heat of rejection per refrigeration system serving a commercial, industrial, public, agricultural, or high-rise multi-family building?	

Supporting Documentation Requirements for Inducement	Comments
☐ Were engineered, stamped, and permitted construction drawings provided?	
☐ Were equipment submittals, stamped and approved by the responsible engineer of record, provided?	
☐ Was equipment-cost information provided?	
☐ Was system start-up documentation provided, performed by a manufacturer-authorized representative?	
☐ Was a sequence of operations documentation provided for the design?	

Site Metering Prerequisite	Comments
☐ Did the project install a Building Automation System (BAS), Energy Management System (EMS), or similar building management system so that advanced metering devices can be installed?	

Version History Log

Version	Effective Date	End Date	Change Description
1	June 15, 2025	December 31, 2025	N/A