High-Performance Measure Details

Measure Name
Commercial Clothes Dryer Exhaust Heat Recovery

Use Category
Clothes Drying Electrification

Effective Date
April 28, 2025

Version
1

Measure Code
LM646

Measure Stage
Early Adoption & High Priority Data Collection

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Technology Summary

Heat recovery systems for commercial clothes dryers capture and reuse exhaust waste heat generated during the drying process to preheat incoming ambient air entering the dryer or preheat water for washer systems in combined laundry setups, improving energy efficiency and reducing operational costs. These systems address the significant energy consumption of commercial laundry facilities, where dryers typically expel hot, humid air often exceeding 120°F–180°F, wasting thermal energy. By recovering this heat, facilities can lower energy bills, reduce environmental impact, and comply with sustainability regulations.

Key Technologies

Heat Exchangers:

1. Air-to-Air Heat Exchangers: These systems transfer heat from the dryer's exhaust air to preheat incoming fresh air. Plate or tube heat exchangers are common, offering high efficiency (up to 60-80% heat recovery).
2. Heat Pipe Systems: Utilize sealed tubes with a working fluid to transfer heat from exhaust to inlet air, with minimal maintenance and no cross-contamination.
3. Thermal Wheel (Rotary) Exchangers: Rotating wheels transfer heat and sometimes moisture, suitable for high-volume operations, but require regular cleaning.

Condensing Systems:

1. Condense moisture from exhaust air, capturing latent heat released during condensation. The recovered heat is used to preheat dryer intake air or water for other laundry processes.
2. Based on the 2013 CEC study, integrating condensing systems with heat pumps can enhanced efficiency, achieving energy savings of 20-50%.

Heat Pump Dryers:

1. Use a closed-loop system where a refrigerant absorbs heat from the exhaust air and transfers it to the drying chamber. These systems can reduce energy consumption by up to 60% compared to conventional dryers.
2. Best suited for facilities with moderate drying volumes due to higher upfront costs.

Integrated Heat Recovery Systems:

1. Combine heat exchangers and heat pumps for maximum efficiency, tailored to high-throughput commercial settings.
2. Can recover both sensible (temperature) and latent (moisture) heat, achieving overall energy savings of 40-70%.

Benefits

- Energy Savings: Reduces energy consumption by 20-70%, depending on the system, lowering utility costs.
- Environmental Impact: Decreases greenhouse gas emissions by reducing reliance on fossil fuel-based heating.
- Regulatory Compliance: Supports adherence to energy efficiency standards and sustainability mandates.

Challenges

- Upfront Costs: Installation of heat recovery systems can be expensive, with payback periods ranging from 2-5 years depending on usage and energy prices.
- Maintenance: Systems like thermal wheels require regular cleaning to prevent lint buildup and maintain efficiency.
- Space Requirements: Retrofitting existing dryers may be constrained by available space in laundry facilities.
- Compatibility: Not all dryers are easily retrofitted, requiring custom engineering for older models.

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 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 dryer exhaust heat recovery 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 encouraging the adoption of energy-efficient heat recovery technologies in commercial laundry facilities, exceeding California's Title 24 energy code requirements. Two tiers are proposed: an essential level tier for exhaust heat recovery systems and a higher premium level tier incorporating heat pump technology. 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.

<u>Inducement Requirements</u>

- **System Design Requirements**
    - **Essential level**: This tier incentivizes the installation of exhaust heat recovery systems that capture and reuse waste heat from dryer exhaust, surpassing the minimum efficiency requirements of Title 24.
        - Provide an exhaust heat recovery system(s), such as an air-to-air heat exchanger, heat pipe system, or rotary thermal wheel, to capture waste heat from dryer exhaust.

- System(s) must achieve a minimum heat recovery efficiency of 50%, transferring at least 50% of the recovered exhaust waste heat to preheat incoming air or water.
- System(s) must prevent cross-contamination between exhaust and inlet air to maintain indoor air quality.

- **Premium level**: This tier incentivizes the adoption of advanced heat pump dryers combined with exhaust heat recovery, targeting maximum energy efficiency and decarbonization.
  - Provide a heat pump clothes dryer system(s) that uses a closed-loop refrigerant cycle to recycle heat within the drying process, paired with an exhaust heat recovery system(s) (e.g., air-to-air heat exchanger or condensing unit).
  - The heat pump dryer(s) must be ENERGY STAR-certified or meet equivalent efficiency standards (e.g., Combined Energy Factor ≥ 4.5 for commercial units).
  - The exhaust heat recovery system(s) must achieve a minimum heat recovery efficiency of 50%, as in the essential level tier.
  - Additional supporting documentation needed:
    - Provide ENERGY STAR certification(s) or equivalent efficiency metrics for the heat pump clothes dryer(s).

- **Supporting Documentation Requirements**
  - Provide engineered, stamped, and permitted construction plans demonstrating that the commercial clothes dryer waste exhaust heat recovery system design fully complies with all state and local jurisdiction requirements and regulations.
  - Provide a sequence of operation for the waste heat recovery system design.
  - Provide equipment submittals stamped and approved by the responsible engineer of record.
  - Provide equipment-cost information for the waste heat recovery system design.

Code Readiness Objectives

The proposed inducement requirements for commercial clothes dryer heat recovery—essential level tier (exhaust heat recovery exceeding code) and premium level tier (heat pump integration)—supports the Code Readiness team's goals by advancing efficiency, decarbonization, and market transformation in commercial laundry facilities.

Based on PG&E's broader energy efficiency and code compliance initiatives, the Code Readiness team's key objectives include:

1. **Advancing Energy Efficiency**: Identify and promote technologies that exceed current Title 24 requirements to inform future code cycles.
2. **Decarbonization**: Support measures that reduce greenhouse gas emissions, particularly through electrification and reduced fossil fuel use.
3. **Market Readiness**: Address barriers (e.g., cost, awareness, technical expertise) to ensure technologies are viable for widespread adoption.
4. **Data Collection and Validation**: Gather performance data through pilots and demonstrations to justify code updates and incentive programs.
5. **Equity and Accessibility**: Ensure energy-efficient technologies are accessible to disadvantaged communities, small businesses, and multifamily facilities.
6. **Stakeholder Engagement**: Collaborate with manufacturers, utilities, and regulators to align technologies with market and policy needs.

Site Metering Prerequisites

- The project must provide dedicated circuit(s) for the dryer system(s) 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

- Validates energy savings (e.g. 20% savings for essential level, 50% savings for premium level tier) to justify including heat recovery or heat pump dryers in future Title 24 code cycles (e.g., 2028 or 2031).
- Demonstrates cost-effectiveness and reliability, encouraging manufacturers to scale production and reduce costs.
- Highlights operational benefits, such as shorter cycle times or reduced maintenance costs.

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
Total Energy Consumption	kWh (electric) or therms (gas)	Measure per dryer cycle or per pound of laundry
Heat Recovery Efficiency	%	Calculate as a ratio of heat transferred to incoming air/water vs. total exhaust heat
Temperature Differential	°F or °C	Measure exhaust air and preheated inlet air temperatures; ±1°F accuracy
Energy Savings	% or kWh/therms	Target ≥20% reduction vs. baseline; calculate per cycle or annually
Dryer Cycle Duration	Minutes	Record per cycle to assess throughput impact
Exhaust Air Flow Rate	Cubic feet per minute (CFM)	Measure with anemometers (±5% accuracy)
Exhaust Air Humidity	% relative humidity	Measure to assess the moisture content affecting heat recovery
Maintenance Events	Count or hours	Log frequency/duration of cleaning or inspections (e.g., quarterly); use manual or automated logs; track downtime (hours/year).
Emissions Reduction	kg CO2e	Calculate based on reduced energy use and California grid emission factors (e.g., 0.2 kg CO2e/kWh)

Code Reference

2022 CA Title 24, Part 6, Section 140.4(q) Exhaust air heat recovery.

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 Hotel/Motel, High-Rise Multifamily, Hospital, Nursing Homes, Student Housing, Fitness Centers, and Commercial Laundromat facilities.

Measure Exclusions

There are no exclusions for this measure.

Reviewer Checklist

HPM Review Checklist: LM646 – Commercial Clothes Dryer Exhaust Heat Recovery – V1

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
☐ Was a commercial clothes dryer exhaust heat recovery system(s), such as an air-to-air heat exchanger, heat pipe system, or rotary thermal wheel provided?	
☐ Do the system(s) achieve a minimum heat recovery efficiency of 50%, transferring at least 50% of the recovered exhaust waste heat to preheat incoming air or water?	
☐ Do the system(s) prevent cross-contamination between exhaust and inlet air to maintain indoor air quality?	

Premium Level Inducement Requirements	Comments
☐ Was a heat pump clothes dryer system(s) provided with an exhaust heat recovery system(s) (e.g., air-to-air heat exchanger or condensing unit)?	
☐ Are the heat pump clothes dryer(s) ENERGY STAR-certified or meet equivalent efficiency standards (e.g., Combined Energy Factor ≥ 4.5 for commercial units)?	
☐ Do the system(s) achieve a minimum heat recovery efficiency of 50%, transferring at least 50% of the recovered exhaust waste heat to preheat incoming air or water?	
☐ Do the combined system(s) support electrification, operating fully or primarily on electricity to reduce reliance on onsite natural gas?	
☐ Were ENERGY STAR certification(s) or equivalent efficiency metrics for the heat pump clothes dryer(s) provided?	

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 sequence of operations documentation provided for the design?	

Site Metering Prerequisite	Comments
☐ Did the project provide dedicated circuit(s) for the dryer system(s) to facilitate the installation of advanced metering devices?	

Version History Log

Version	Effective Date	End Date	Change Description
1	April 28, 2025	Active	N/A

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.