CalNEXT Knowledge Sharing Webinar

Foodservice, Grocery, and Multifamily Buildings

November 17, 2026



CalNEXT ENERGIZING CALIFORNIA'S FUTURE

Energy Solutions, TRC, VEIC, ASK Energy

Program paid for by ratepayers

Agenda

Introduction	Energy Solutions	4 min
1:04 – 1:12 p.m. | Commercial Kitchen Hot Water System Decarbonization Market Needs Study		9 min
1:13 – 1:21 p.m. | Multifamily Domestic Hot Water Recirculation Survey		9 min
1:22 – 1:30 p.m. | Double Duct Packaged Terminal Heat Pump Field Demonstration		9 min
1:31 – 1:39 p.m. | Market and Technical Evaluation of Combination Washer-Dryer Units for Multifamily Buildings		9 min
1:40 – 1:48 p.m. | Packaged Propane Refrigeration Market Analysis		9 min
1:49 – 1:57 p.m. | Modeling CO_2 System Refrigeration Loads		9 min
Wrap-up: Additional Q&A if needed	Energy Solutions	2 min

Presenters



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CalNEXT Partners













Presentations

1. Project Summary
2. Study Objectives
3. Stakeholders
4. Demonstration Sites
5. Summary of Savings
6. Summary of Findings
7. Conclusions and Next Steps

All presentations and completed projects' final reports are available at calnext.com/approved-projects

CalNEXT Knowledge Sharing Webinars will return in 2027!

On tap for the first months of next year (dates TBD):

- Electrifying Large Commercial Central Plants
- Simplified HVAC Control Retrofits
- Laboratory Testing of *both* Micro Heat Pumps *and* Variable Capacity Heat Pumps
- A Controlled Environment Horticulture grouping including:
  - Humidity Control for Indoor Farms
  - SmartAg Controls: Incentivizing Efficiency & Yields
  - Electrification of Greenhouse Heating Systems

Previous CalNEXT Knowledge Sharing Webinars Available Online

Visit calnext.com/events

TUESDAY
SEPTEMBER
22
2026
11:00 A.M. – 12:00 P.M. PT

WEBINAR

Knowledge Sharing Webinar

Industrial Solutions

The third CalNEXT Knowledge Sharing Webinar focused on industrial solutions. We showcased five completed CalNEXT projects and shared their results and supporting research.

- Missed the event? Watch the recording.
- View the presentation slides.

Questions Encouraged

Ask the presenters your questions via the Zoom Q&A panel at any time during the webinar!

- Presenters will monitor the Q&A as possible after their presentations.
- The hosts will read and answer questions as time allows during each presenters' time slot and in the final minutes of the hour.
- The CalNEXT team will poll the audience during the second half of the webinar to ask what you would like to see in future emerging technology presentations.

Commercial Kitchen Hot Water System Decarbonization Market Needs Study

Project Outcomes and Tech Transfer



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Wendy Liu, TRC Companies

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Commercial Kitchen Hot Water System Decarbonization Market Needs

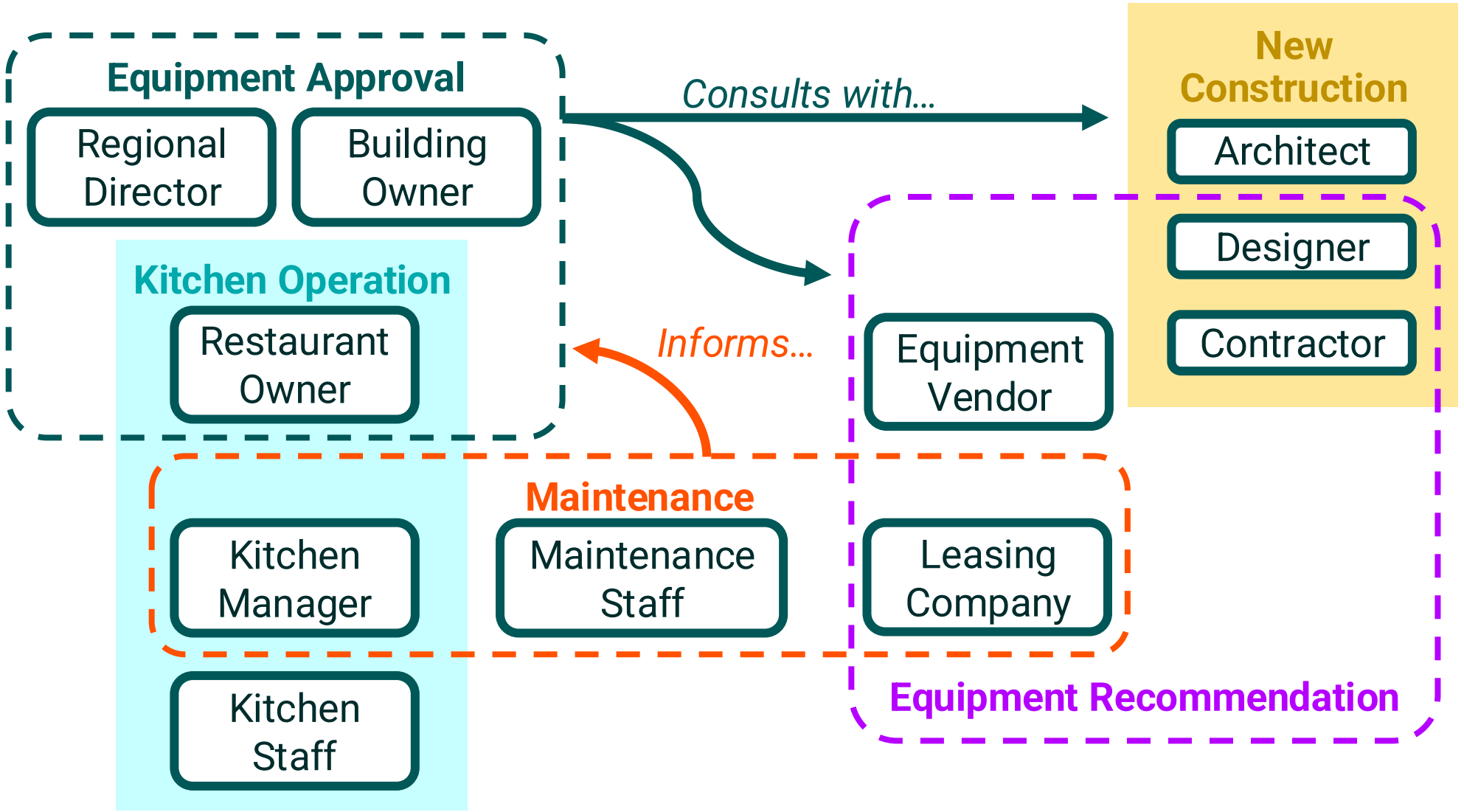
- Understand the people, priorities, and decision-making processes that shape hot water system investments in commercial kitchens.
- Identify the resources and communication strategies that help stakeholders evaluate and adopt decarbonization solutions.
- Provide utilities and program administrators with actionable recommendations to better support decision makers through clear, practical guidance and tools.

Why Commercial Kitchen?

- **High natural gas use**: Commercial foodservice water heating in California consumes approximately 340 million therms of natural gas annually, accounting for about 16% of statewide commercial gas consumption (CalMTA, 2025).
- **Challenging sector to decarbonize**: Commercial kitchens face unique barriers, including tight operating margins, high staff turnover, and stringent health and safety requirements.
- **Mission-critical hot water**: Reliable hot water is essential to daily kitchen operations, making water heating a key focus for decarbonization efforts.



Overview of Stakeholder Roles



Findings – Barriers to Adoption

- **Upfront costs:** Small and independent restaurants are price sensitive.
- **Regulations:** Restaurant owners seek minimum compliance. Outdated regulations constrain adoption.
- **Availability:** New construction timelines demand equipment availability. Leasing companies may carry limited options.
- **Confidence:** Contractors and kitchen owners need to trust equipment.
- **Education and awareness:** Technology awareness and proper operation are important.

Findings – Equipment Repair

- **Operators tolerate intermittent operational issues** such as running out of hot water or slow recharge times.
- **When complete failure occurs, repair and replacement must move quickly**. Maintenance professionals often service equipment or arrange for replacement the same day.
- **Code requires hot water and temperature thresholds**. No access to hot water can be a safety concern, result in slowdowns, or impact customer experience.

Findings – Equipment Replacement

- The restaurant owner's primary focus is food and customer experience. When equipment needs to be replaced, they usually are drawn to the easiest solution.
- Most equipment is **replaced on failure.**
- **Like for like replacement is common.** Installation speed and familiarity is more important that proactive energy savings.
- Decision makers typically rely on vendor, leasing company, or manufacturer **recommendations**.

Findings – Dishwasher Considerations

Low Temp Dishwashers

- Use lower water temperature and more detergent to clean and sanitize dishes.
- Common for smaller operations.
- Leased by leasing companies.

High Temp Dishwashers

- Use higher water temperature and less detergent. Water is heated with a booster.
- More common for high-capacity operations.
- Potential synergies with **heat recovery and heat pump water heaters**.

Next Steps and Recommendations

- Establish **clear approval pathways** by incorporating HPWH sizing methods into health department guidelines and supporting code updates that streamline electrification approvals.
- Strengthen market and program support by **engaging distributors and leasing companies**, and simplifying access through **multilingual outreach** and small-business-friendly programs.
- **Reduce upfront cost barriers** through point-of-sale incentives, support for electrical upgrades, and promotion of space-efficient equipment solutions.
- Focus early electrification efforts on **institutional kitchens**, which are more likely to consider lifecycle cost savings and sustainability goals.
- Provide practical **decision-support tools** such as equipment comparison guides, cost calculators, and case studies to help owners make fast, informed choices.



Thank You!

Project Final Report

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Multifamily Domestic Hot Water Recirculation Survey

Project Outcomes and Tech Transfer



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M M Valmiki, ASK Energy

Program paid for by ratepayers

Project Summary

This study examined domestic hot water recirculation loads and distribution design in the multifamily market.

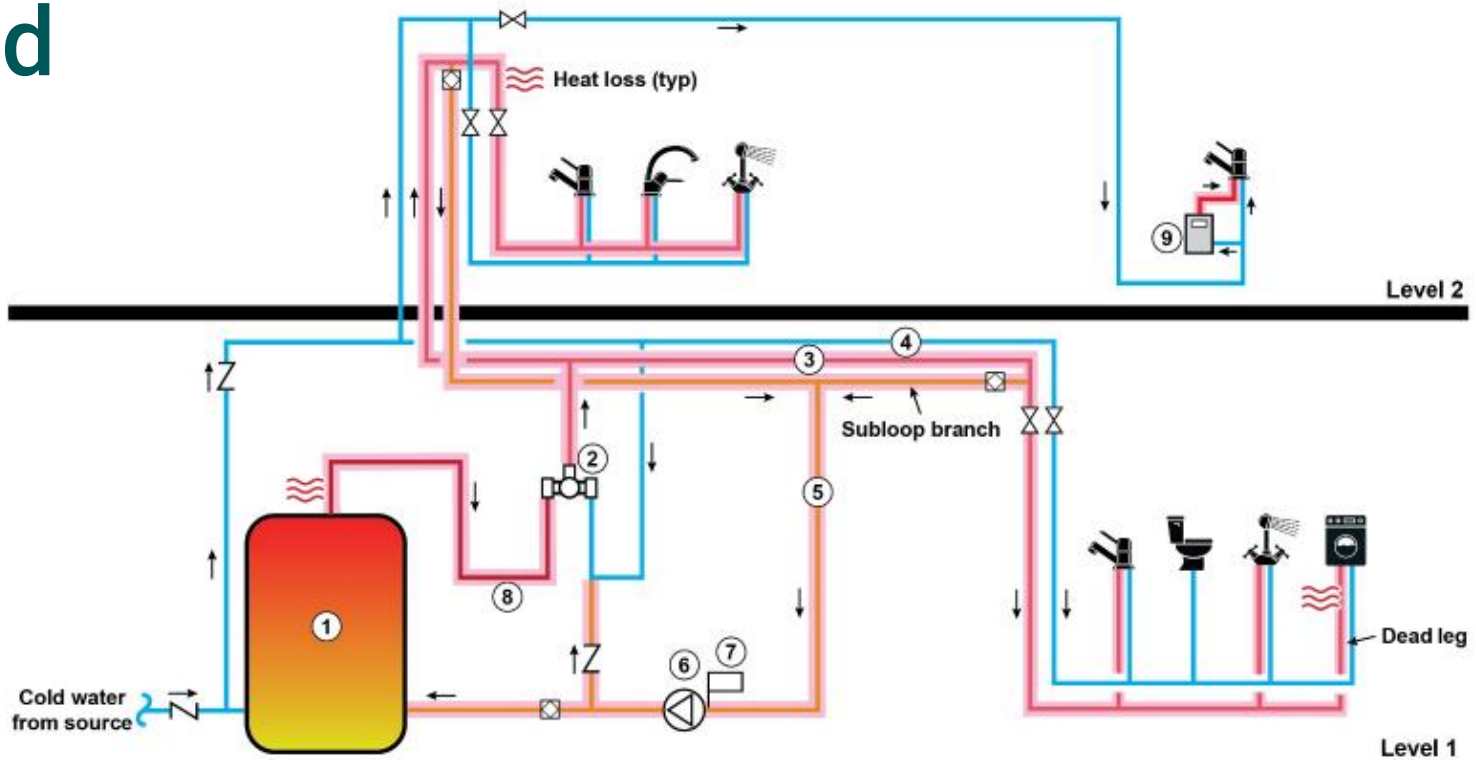
Information was gathered through existing building surveys, subject matter expert interviews, and modeling of recirculation loads.

The team provided some conclusions and recommendations on distribution system remediation practices and implications on central heat pump water heater design.

Implementers and future research could use these findings to inform program design.



Background



Source: (PNNL 2021)



Source: (Kintner and Larson 2019)

Objectives

How are temperature maintenance loads influenced by building characteristics and as-built plumbing conditions?

How to improve and adapt sizing tools and design guidelines for CHPWHs to incorporate an increased understanding of recirculation systems.

Support the advancement and development of appropriately sized CHPWHs in various configurations for more efficient, lower-cost market transformation.





Stakeholders

15 Multifamily Buildings

- Varying datasets (plans, field walks, measurements)
- Both gas and HPWH systems

Subject Matter Experts

- Plumbers
- CHPWH designers
- DHW researchers

Impacted Stakeholders

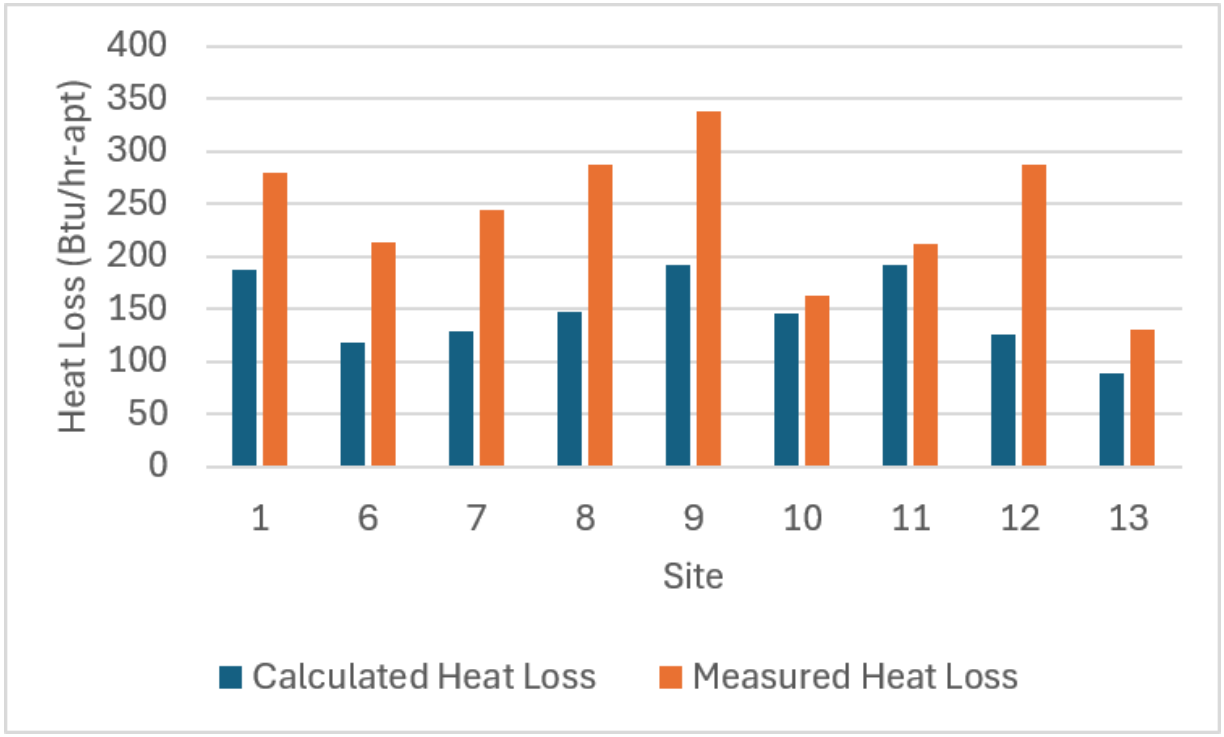
- Program implementers
- CHPWH designers
- Plumbing service providers
- Building maintenance

Results Summary

Recirculation loads were modeled for each site with enough available data (plumbing plans).

Measured and modeled recirculation loads did not match! Why?

- Pipe insulation
- Crossover



Results Summary

Insulation gap analysis

Site	Calculated Heat Loss (Btu/hr)	Measured Heat Loss (Btu/hr)	Bare % to Match
1	20,704	30,708	12%
6	6,582	11,942	20%
7	7,201	13,648	22%
8	1,185	2,300	21%
9	1,536	2,700	19%
10	1,168	1,300	3%
11	1,536	1,700	3%
12	1,009	2,300	28%
13	5,237	7,694	11%

Crossover gap analysis

Site	Gap (Btu/hr)	Occupants	Crossover (gal/day)	Gal/day per occupant
1	10,004	93	482	5.2
6	5,360	100	292	2.9
7	6,447	107	352	3.3
8	1,115	30	60	2.0
9	1,164	12	64	5.3
10	132	30	7	0.2
11	164	12	9	0.8
12	1,291	24	68	2.8
13	2,457	75	129	1.7

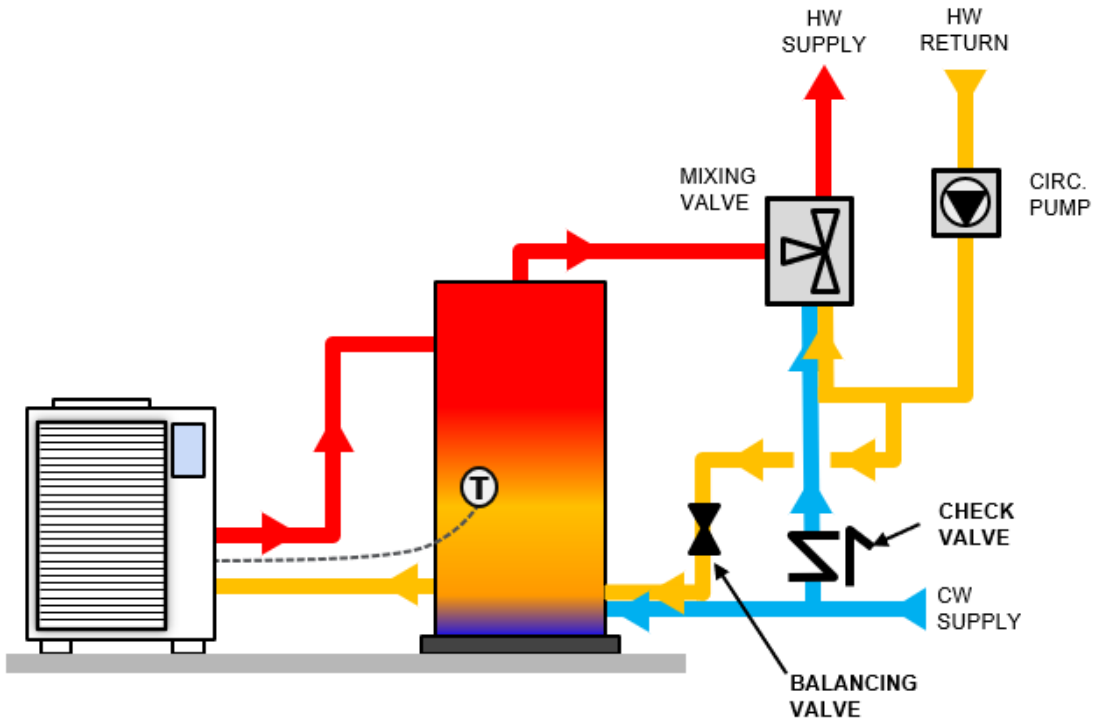
Results Summary

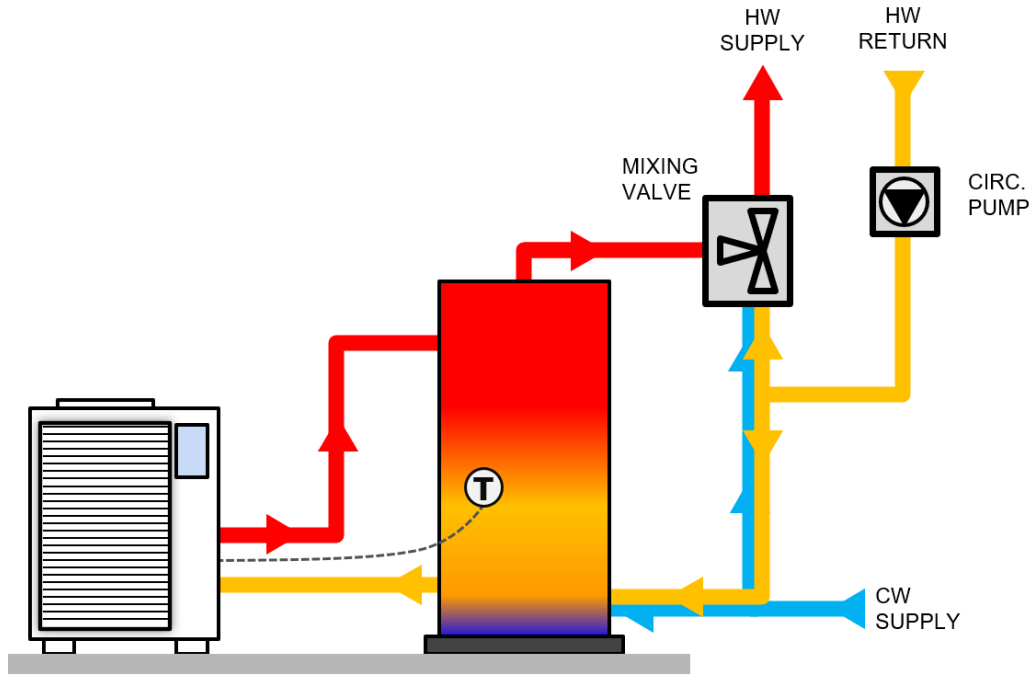
New construction impacts of pipe sizing and insulation levels

Efficiency Measure	Site 1	Site 6	Site 7	Site 8 & Site 10	Site 9 & Site 11	Site 12	Site 13
Total as-built heat loss (Btu/hr)	20,704	6,582	7,201	1,185	1,536	1,009	5,237
Total code baseline heat loss	14,160	5,632	6,206	993	1,260	830	4,470
Appendix M sizing	5.2%	2.3%	2.6%	9.7%	8.9%	9.9%	6.3%
Appendix M + 0.5" on 3/4" & 1-1/4"	12.4%	9.7%	10.1%	15.0%	13.9%	15.2%	11.8%
+0.5" on 3/4" & 1-1/4"	2.5%	5.5%	5.8%	8.2%	6.0%	8.5%	6.1%
+0.5" every pipe size	12.4%	13.7%	14.0%	14.1%	13.6%	14.3%	13.0%

CHPWH Design and Program Implications

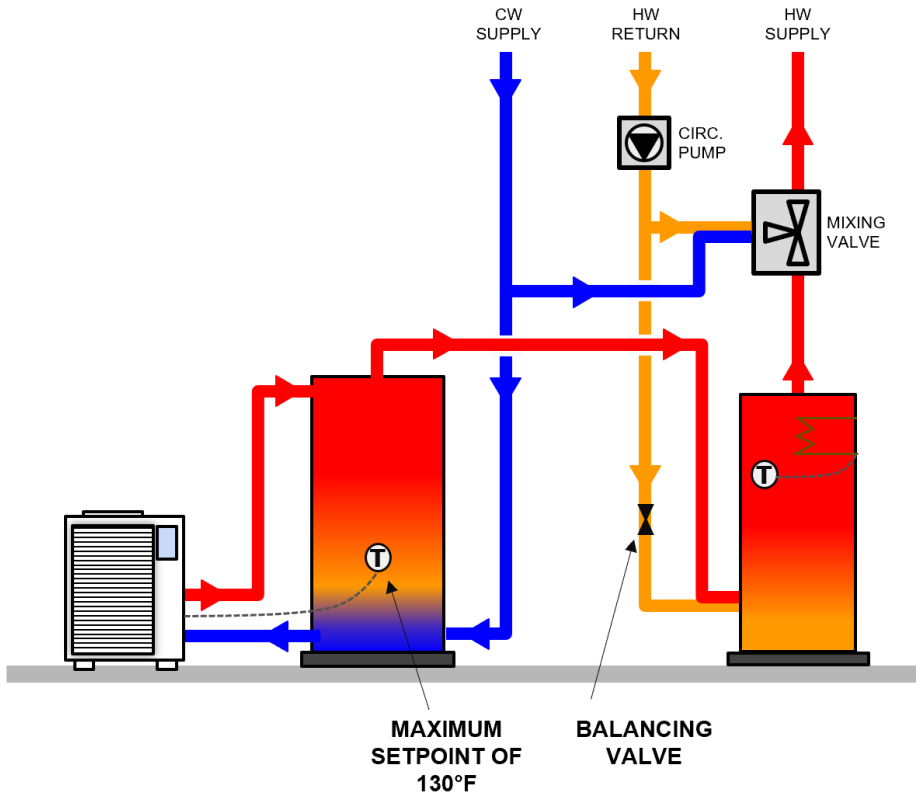
Recirculation loads, crossover, and return temperatures all have large impacts on CHPWH performance and best design.

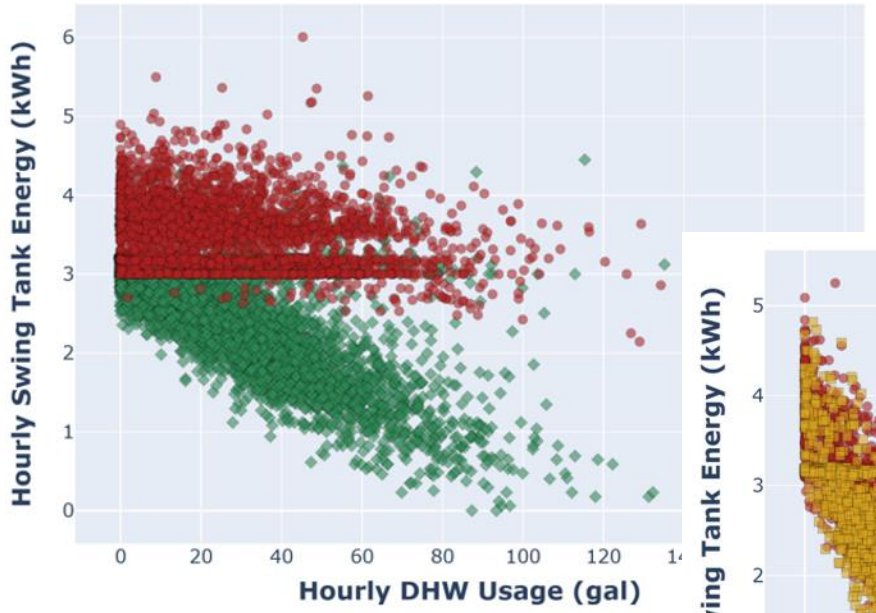


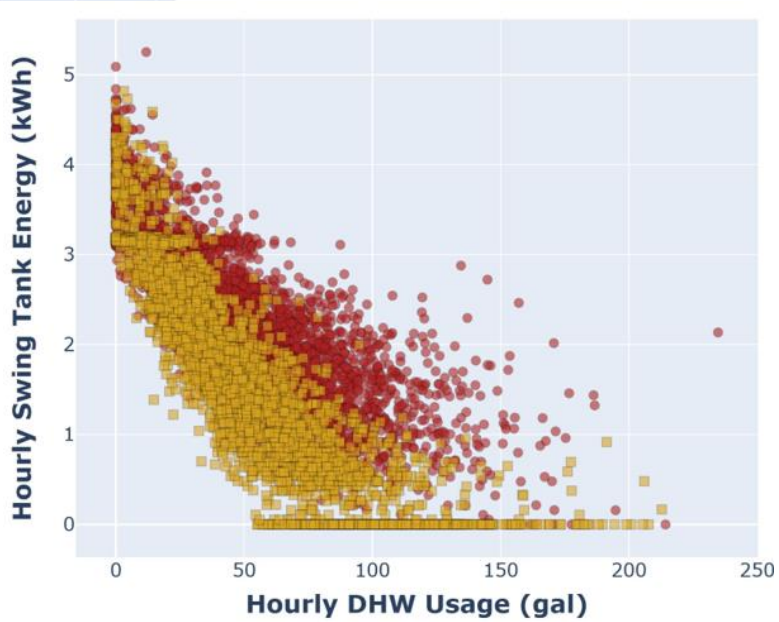


CHPWH Design and Program Implications

Recirculation loads, crossover, and return temperatures all have large impacts on CHPWH performance and best design.







Crossover

- High measured recirculation losses in existing buildings may actually be largely crossover instead of heat loss.
- Historically, correcting and reducing thermal losses has been the focus. We suggest focusing on crossover management and CHPWH implications moving forward.
- Crossover is not uniformly an energy problem – but it can be!
  - Cold to hot crossover displaces cold water make-up.
  - Energy impacts can occur with parallel temperature maintenance systems
  - Hot to cold crossover less common but has direct energy losses.
- Crossover implications can be an argument for return-to-primary configurations and parallel heat pump temperature maintenance.

Conclusions and Next Steps

Project Conclusion

- Investigate recirculation losses and crossover for any CHPWH retrofit with cascading rigor.
- Remediate and maintain crossover with any parallel temperature maintenance CHPWH.
- Return-to-primary may be more robust and resilient to crossover.
- Assumptions in existing CHPWH sizing tools were reinforced.
- Appendix M pipe sizing should include some insulation upsizing for certain pipe sizes.
- CHPWH designers, programs, and commissioning should look to the Advanced Water Heating Specification.

Next Steps

- Programs should incorporate support or requirements for investigation, remediation, design support, and ongoing maintenance.
- Controlled crossover quantification study and fixture-level crossover durability testing.
- Field validation of the recommended, optimized return-to-primary configuration.



Thanks to You, Ecotope, and Franklin Energy!

Project Final Report

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Double Duct Packaged Terminal Heat Pump Field Demonstration

Project Outcomes and Tech Transfer



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M M Valmiki, ASK Energy

Program paid for by ratepayers

Project Summary

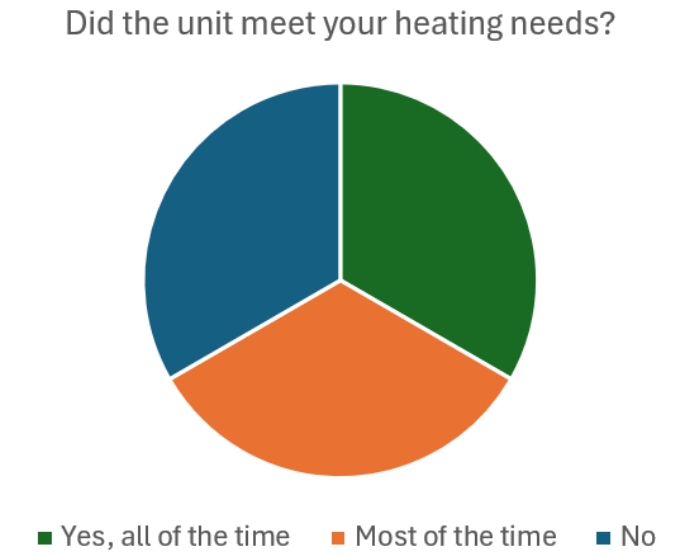
This study evaluated a new type of packaged terminal heat pump with a more compact form factor and two small duct penetrations for outside air exchange called double duct packaged terminal heat pump (DDPTHP).

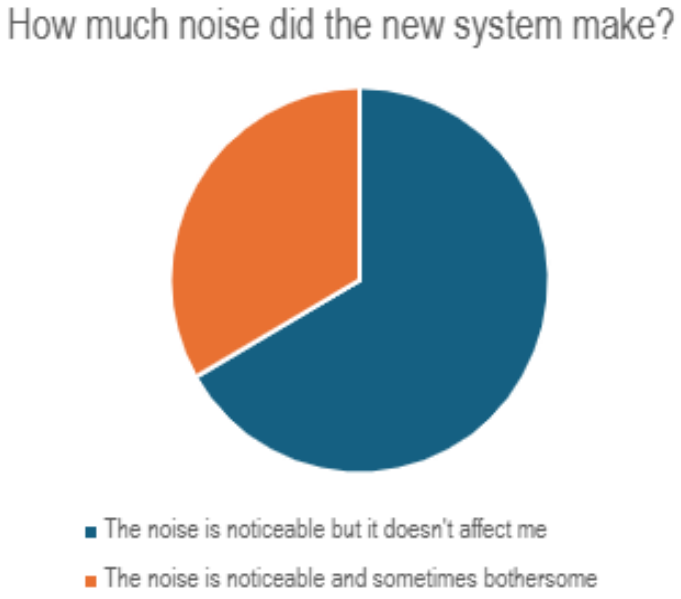
- Novel airflow design with all-inside installation and minimal penetrations.
- Variable-speed inverter-driven compressor and multi-speed supply fan, which allow the unit to improve efficiency at part-load conditions.
- No electric defrost and low-GWP refrigerant options.
- 120V hard-wired or plug-in options.

Project Summary

- Field demonstration in four homes within a new construction, affordable housing multifamily building.
- Six months of monitoring at each site for comparison to an equivalently sized, code-minimum baseline PTHP.
- Assessed energy efficiency, greenhouse gas reduction potential, cost-effectiveness, and user experience of the technology.







Stakeholders

- Manufacturers and distributors
- Engineering designers
- Building owners (Multifamily, Hotels, Education, Small business)
  - PTHP/AC make up 6.5% of commercial HVAC systems
- HVAC contractors

Mixed Resident Feedback:

- **Low Noise & Good Usability:** Users reported few usability concerns, and measured sound levels indicate noise is generally not an issue.
- **Comfort Concerns Noted:** Some occupants reported comfort issues, perhaps related to equipment sizing and building conditions rather than the technology itself.

Summary of Savings

Annualized Impact Results

Site	Energy Savings (kWh/yr)	Total System Benefit ($/yr)	Avoided Greenhouse Gases (tons CO_2e/yr)	Energy Cost Savings ($/yr)	Simple Payback (yrs)
Site 1	-81	-28	-0.006	-27	N/A
Site 2	82	8	0.005	27	9.2
Site 3	284	45	0.033	94	2.7
Site 4	186	23	0.023	61	4.1
Average Impacts	**118**	**12**	**0.014**	**39**	**5.3**

Conclusions

- **Energy Savings** - The field results generally indicate that the new type of PTHP has clear and dependable energy benefits over incumbent, code-efficiency PTHP options.
- **Part-Load Performance** - Variable-speed operation significantly improves efficiency and cost-effectiveness under typical part-load conditions. While highly efficient at part load, the technology may be slightly less efficient than incumbent equipment at full-load operation.
- **Economics** - Site-specific evaluations showed a simple payback of approximately 5 years relative to code-minimum PTHP installations.

Conclusions

- **Electrification-Friendly Solution** - Provides an affordable, practical heat pump alternative without the drawbacks of bulky through-the-wall units or inefficient window AC systems. Technology provides higher avoided GHG impacts over incumbent PTHP options.
- **Site-Specific Results** - Findings were based on four unique host sites and were not extrapolated to a broader market due to the limited sample size. Additional research and field deployments are recommended to validate performance across more applications and support emerging testing/rating methodologies.
- **Sizing** - Proper sizing to a site or zone's peak design load will help ensure that savings can be realized over the part-load conditions that will constitute most of the annual runtime.

Next Steps

- Lab testing to develop verified performance curves for variable-speed packaged terminal heat pumps to be used as the foundation for future energy modeling and program development efforts.
- Perform statewide modeling across California building types and climate zones using confirmed performance curves.
- Establish minimum workpaper eligibility requirements that define equipment and installation standards including proper sizing.
- Work with manufacturers to improve exterior weatherproofing solutions.
- Develop practical condensate management strategies and product enhancements for both new construction and retrofit applications.



Thank You, Franklin Energy, and participants!

Project Final Report

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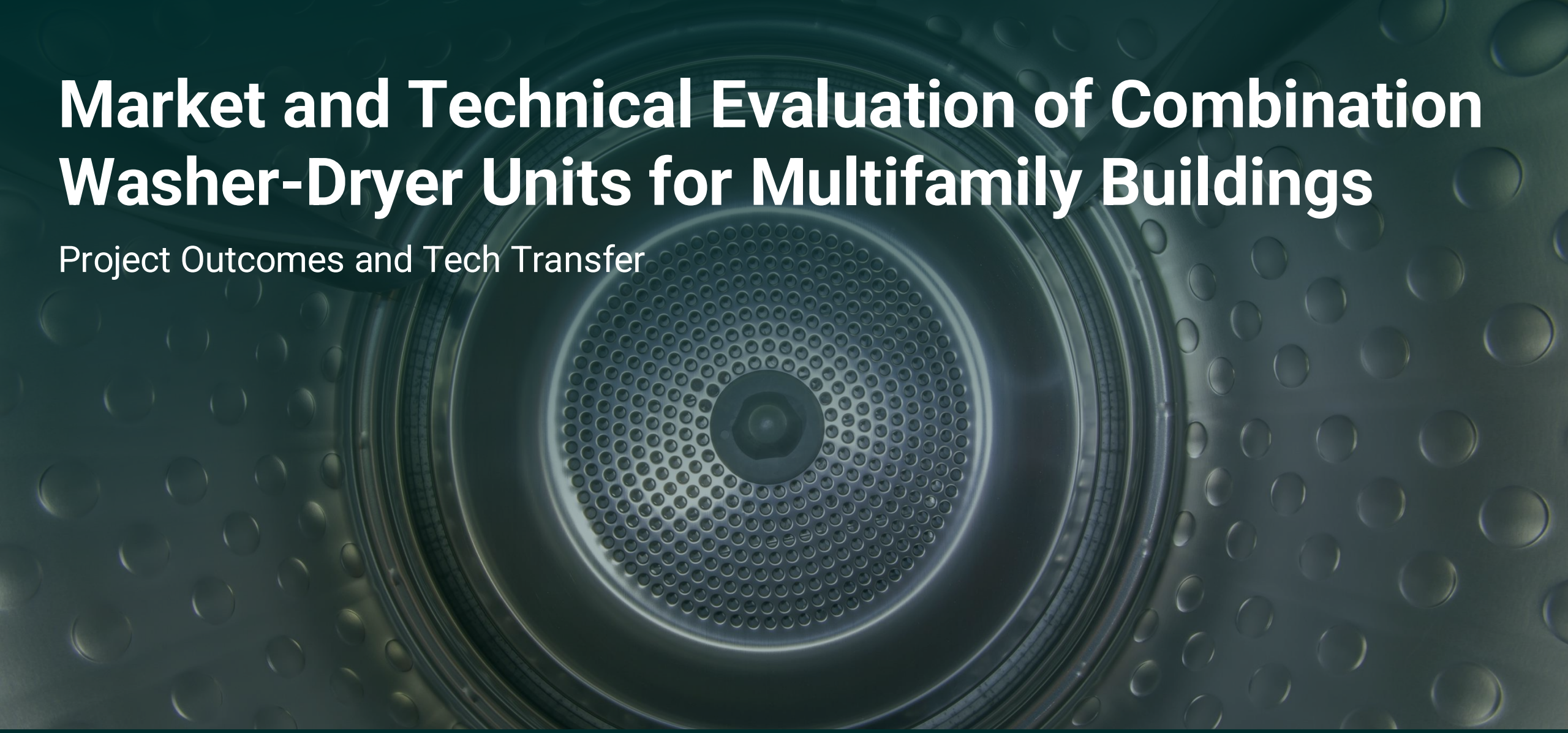

Market and Technical Evaluation of Combination Washer-Dryer Units for Multifamily Buildings

Project Outcomes and Tech Transfer

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Sarabeth Erdman, VEIC

Program paid for by ratepayers

Agenda

1	Project Summary
2	Baseline and Proposed Updates
3	Identified Stakeholders
4	Findings
5	Next Steps

Project Summary

The Objectives

- Evaluate 120V combination washer / heat pump dryers for **energy, cost, and applicability to** multifamily homes.
- Identify **adoption barriers** through secondary research and stakeholder engagement and provide actionable recommendations.

The Methods

- **Analyzed market conditions and product adoptability** through literature review and stakeholder interviews.
- **Evaluate technology performance through modeling energy and TSB impacts** using NREL ResStock.



Why focus on the multifamily market for combination unit adoption?

Market Need

- 76% of LMI households residing in MF housing in California do not have access to in-unit laundry
- The majority of buildings have shared laundry facilities that utilize natural gas as the fuel type for clothes dryers.

Emerging Decarbonization Solution with Features Suitable to the Multifamily Market

- 120V
- Ventless
- Smaller drum size
- User flexibility and DSM

Baseline Configurations

- In-unit singular washer and conventional electric dryer
- In-unit singular washer and gas dryer
- Common area laundry





Stakeholders

Combination Unit Manufacturers

- Interviewed for insights on appliance/brand approach, applicability for the multifamily market, and market codes and regulations

Affordable Housing Providers

- Interviewed to gain insights on the opportunities and barriers of in-unit laundry and combination units from an affordable housing provider, cost shifts and changes, and common laundry decarbonization methods
- Residents surveyed

Program Implementers

- Interviewed for insights on the technology from a program perspective, potential rebate design and eligibility, and considerations regarding scaling this technology through integration in statewide/regional rebate programs

Summary of Findings

Current Market Landscape

- Laundry configurations in multifamily buildings vary widely among vintage, size, and resident income levels.
- Generally, instances of in-unit laundry, or at least hook ups, in new construction have been increasing over time.
- Several types of affordable housing must have laundry on site to qualify for CA tax credits, leading to common area laundry being standard.

Barriers to Adoption

- Existing third-party appliance ownership model
- Limited warranties
- High price point of the technology
- Negative perceptions and lack of awareness regarding heat pump drying technology

Additional Market Considerations

- While modeling showed energy savings when transitioning to in-unit combo units from less efficient common area machines, additional demonstrations should consider behavioral changes and usage impacts of greater appliance accessibility when estimating overall reductions.
- In-unit laundry appliances are generally owned by residents while existing common area appliances are the responsibility of building owners. Consider ownership models as well as the shifting costs of fuel usage.
- Residents of multifamily affordable housing shared mixed preferences for in-unit versus shared facilities, highlighting the accessibility and convenience of in-unit appliances but emphasizing the cost savings of shared facilities.

Conclusions and Next Steps

Project Conclusion

120V combination washer heat pump dryer units are a market ready solution to assist in decarbonizing laundry in the California multifamily market. Prior to inclusion in incentive programs, additional research and potential demonstration projects should be done to explore both resident and building-owned models.

Next Steps

- Lab and field demonstrations to determine performance data, behavioral impacts on savings, and incentive program design
- Bulk order and service packages offered by manufacturers/distributors
- Modeling and calculations to support a measure package
- Integration into California incentive programs



Thank You!

Project Final Report

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Packaged Propane Refrigeration Market Study

Project Outcomes and Tech Transfer

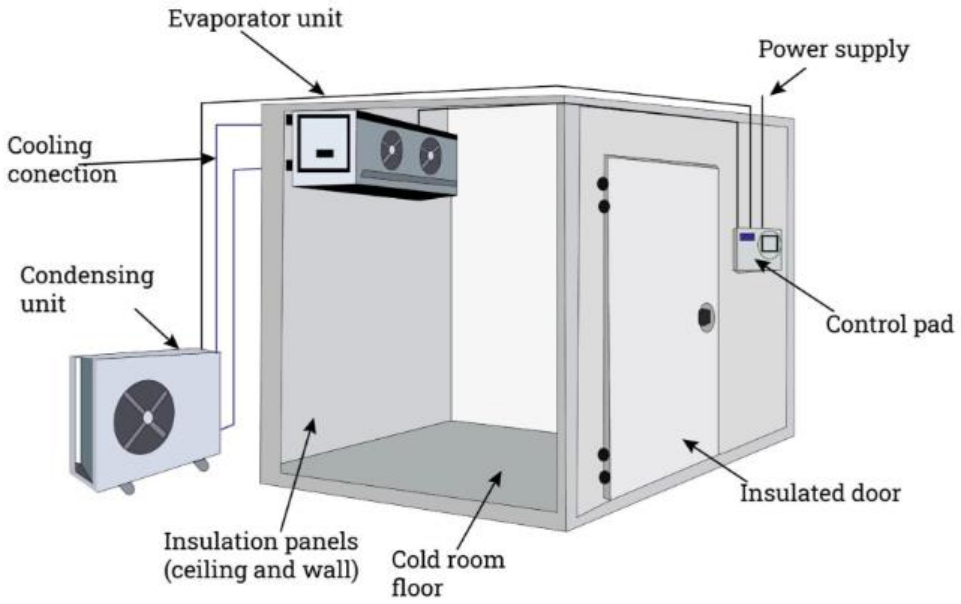


Nicole Duquette and Abby Wiseman, VEIC

Program paid for by ratepayers

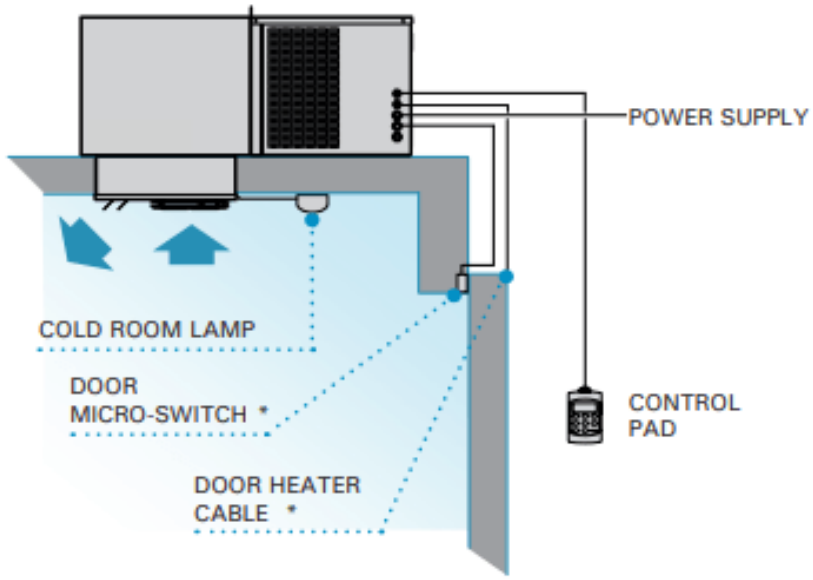
Packaged Propane Refrigeration Systems

Baseline: Remote Condensing Unit



- Condensing unit and evaporator unit are separate systems
- Connected by refrigerant piping
- Evaporator unit takes up space within WICF

New: Packaged Propane Unit



- Condensing unit and evaporator unit are contained within a single system
- No refrigerant piping
- Evaporator installed through ceiling of WICF

Why focus on Packaged Propane Refrigeration Systems?

Regulation Changes

HFC refrigerant phase-out as part of AIM Act, new reporting requirements for high-GWP refrigerants.

Market Needs

California has an estimated 200,000 condensing units in food service and food retail establishments.

Equitable Decarbonization Solution

Packaged propane refrigeration systems offer a natural refrigerant solution for SMB, HTR, and DAC businesses.



Packaged Propane Refrigeration Market Study

The Objectives

- Evaluate packaged propane refrigeration systems in walk-in coolers and freezers (WICF) for **energy, cost, and performance.**
- Identify **adoption barriers** through secondary research and stakeholder engagement and provide actionable recommendations.

The Methods

- **Analyzed market conditions and product readiness** via literature review, program peer review, stakeholder interviews.
- **Metered and modeled energy analysis** of installed systems.



Stakeholder Insights

Manufacturers

- Adoption limited by uncertain demand and safety concerns.
- Would invest with clear utility signals (incentives, pilots, QPLs).

Utilities & Program Admin

- Prefer easy-to-deliver, prescriptive programs.
- Require strong data, baselines, and eligibility clarity; use pilots to manage risk.

End Users

- Prioritize cost, reliability, and compliance.
- Struggle with upfront costs and confusing incentives; rely on trusted advisors.

Contractors

- Favor prescriptive/deemed incentives; low customer demand for complex projects.
- Concerned about propane safety, liability, and training costs.

Distributors

- Stock only predictable, low-risk products.
- Need upstream incentives and A2L/A3 training to reduce inventory risk.

Initial Metering Results

System Type	Baseline Energy (kWh/yr)	Packaged Propane Energy (kWh/yr)	Savings (kWh/yr)	% Savings
Medium Temp	11,130 kWh	1,806 kWh	9,324 kWh	84%
Medium Temp (vs HECU)	2,389 kWh	1,806 kWh	583 kWh	24%
Low Temp	7,625 kWh	3,431 kWh	4,191 kWh	55%
Low Temp (vs HECU)	4,289 kWh	3,431 kWh	855 kWh	20%

HECU = high-efficiency condensing unit

Weighted average savings:

- 54% Med Temp (MT)
- 38% Low Temp (LT)

Notes

- Baseline systems used HFCs
- MT baselines are mix of indoor & outdoor condensing units
- MT systems are 0.7 hp
- LT systems are 1.5 hp

Project Outcome: Path to Improvement

Established technical and market clarity

Demonstrated technology has significant energy savings, GHG reductions, and operational benefits

Identified barriers and solutions

Identified regulatory, market, training, and program design needs that enable adoption and scale

Enabled program and market advancement

Developed proposed measure framework optimized for small commercial refrigeration applications



Thank You!

Project Final Report

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Modeling CO_2 System Refrigeration Loads

Project Outcomes and Tech Transfer



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Modeling CO_2 System Refrigeration Loads

- This project collected data at two grocery store sites with transcritical CO_2 refrigeration systems in the greater San Francisco area to validate an energy modeling tool.
  - Collecting data on case loads, temperature, humidity, HVAC operation, compressor demand, and case door openings
- The energy modeling tool utilizes OpenStudio and EnergyPlus as the modeling framework
  - Update an existing refrigeration analysis tool (CalNEXT ET22SWE0025 “Next Generation Refrigeration Analysis Tool Proof of Concept”)

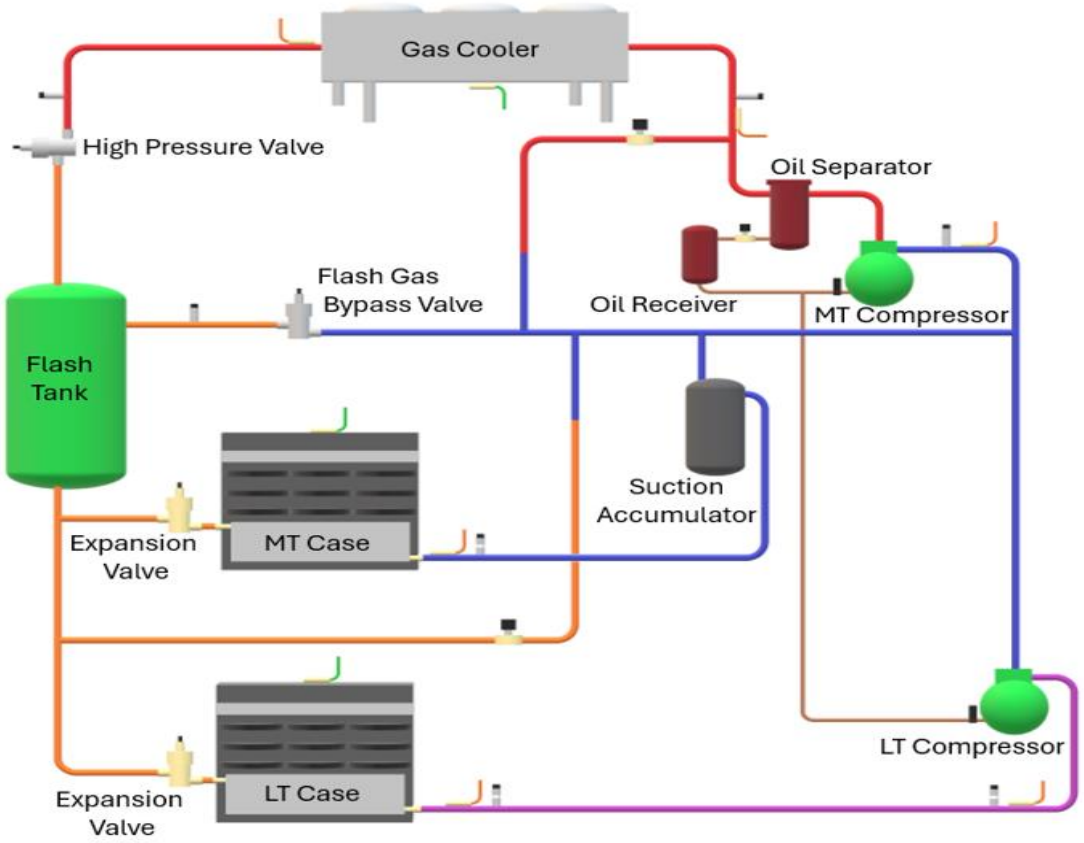
Questions

- Current energy models lack the ability to simulate the operating parameters of a natural refrigerant system vs a traditional HFC system
- How can refrigeration system design be improved upon for CO_2 Refrigeration Systems?
- What interactive effects exist in a grocery store?



Project Parameters

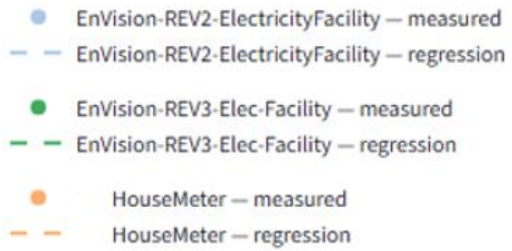
- Data collected over an eight-month period.
- Building management system monitors refrigeration and HVAC system.
- Each site uses standard transcritical CO_2 booster rack system with a dry gas cooler
  - Frozen doored cases, medium temp open cases, and a doored dairy cooler with rear-loading walk-in.

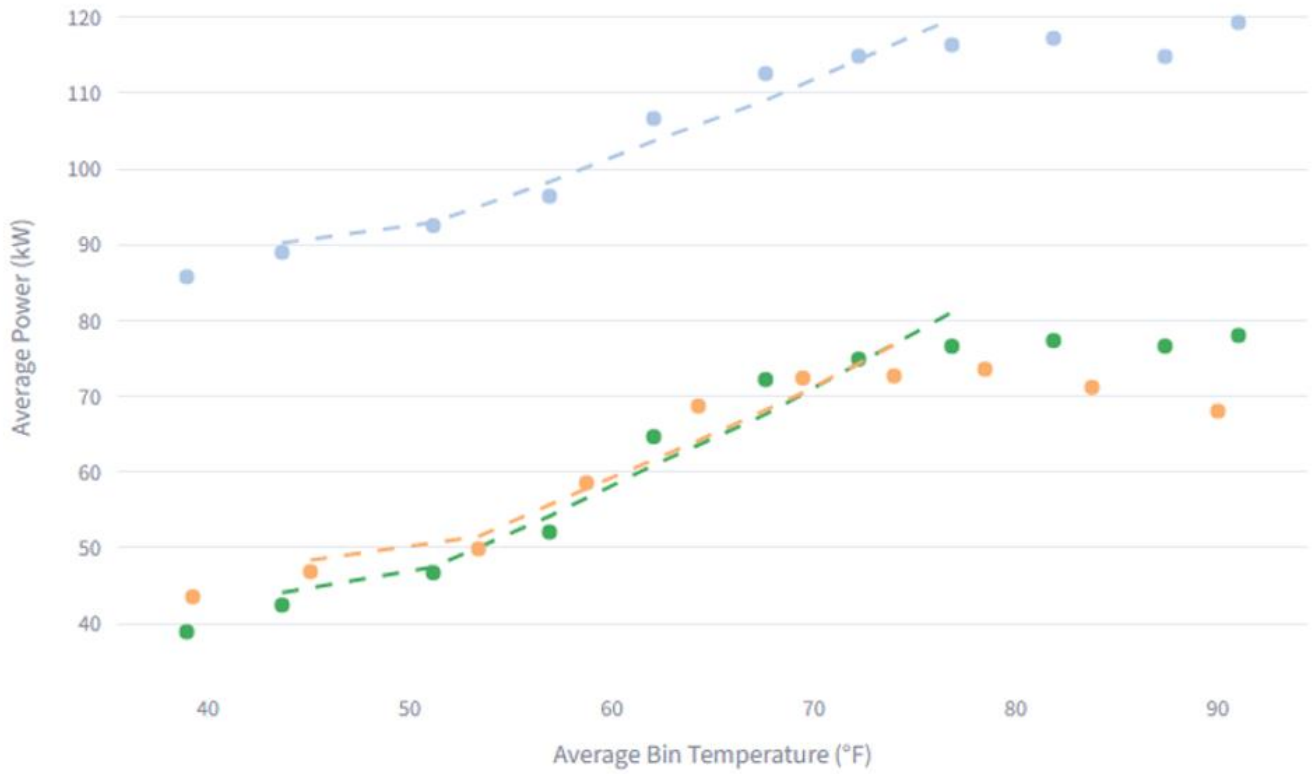


Results

- Primary driver for case loads
  - Outside air temperature
  - Amount of time doored cases are open
  - Time of day for open cases

- Model calibrated to include data for CO_2 Systems







Stakeholders

- Over 30 individuals representing manufacturing, engineering, vendors, and grocery store chains.
- Project work was presented and demo of the tool given.
- Stakeholders preliminary input in the project confirmed datapoints to consider for the model.
- Feedback provided from surveys sent to stakeholders.
    - Stakeholders saw a benefit in being able to predict load profiles, virtually comparing systems, and open-source availability
    - Additional metering at other locations to validate loads cross country would improve confidence in the tool and encourage usage

Summary of Findings

- The primary driver of energy consumption
  - External factors
    - OA temp influences compressor load the most
  - Internal Factors
    - Opened case doors
    - Time of day for open cases
- Oversized system
  - Low load of MT compressors resulted in suction pressure lower than recommended 420 PSI.
- Model was properly calibrated to metered data
  - Future projects should continue to validate and expand modeling tool.

	Defrost	OA Temp	Refrigeration Load	Time of Day
Avg Compressor Load	1%	**79%**	18%	2%

	Defrost	Door Open Time	OA Temp	Time of Day
Avg Non-Doored Cases	13%	0%	15%	**72%**
Avg Doored Cases	14%	**45%**	31%	11%

Conclusions and Next Steps

Project Conclusion

- This project aligns with Process Loads – Commercial Refrigeration in supporting the transition to low GWP and natural refrigerants.
- The modeling tool helps designers and contractors design CO_2 refrigeration systems for optimal system operation.

Next Steps

- Support refrigeration experts in CO_2 system design by providing access to developed modeling tool.
- Continue to invest in opportunities to further develop the modeling tool.



Thank You!

Project Final Report

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Q&A



Thank You!

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