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Please see attached document

Additional submitted attachment is included below.

1. The following will help target specific research for industrial and commercial cold storage systems:

1. What are examples of advanced or noncommercially available energy efficiency control software packages applicable to refrigeration systems?
    - ATLAS by CrossnoKaye is by far the most advanced control system on the market today. It's built on a modern software architecture which allows for the development and deployment of new features within week instead of months with traditional control systems.
    - Lineage has realized a 30% reduction in energy costs with the ATLAS pilot at our Oxnard Building 4 site.

2. Are there examples of commercial-scale desiccant dryers for refrigeration systems in use? If so, where and what is the application?
    - High humidity can build up when warm fresh product gets put into a refrigerated room, or if the outside humidity leaks in while doors are open. When this happens the moisture in the air will hold onto the heat longer and the refrigeration system may struggle meeting temperature thresholds. In addition to this the moisture in the air will solidity as ice on evaporator coils causing the efficiency of the refrigeration system to go down as well as an increased need for defrost cycles to thaw the evaporator coils, which both adds heat into the room and is energy intensive.
    - The wet-scrubber dehumidifier technology being developed by Rebound offers substantial potential advantages over a traditional dessicant dryer

3. What are examples of retrofit waste heat recovery technologies for refrigeration systems that have been implemented in industrial and commercial cold-storage facilities?

    - Transcritical CO2 Refrigeration Systems present a unique opportunity to capture waste heat and/or but utilized as a heat pump. The heat recovery potential can be as high as 1:1 but the need for hot water in a Cold Storage application is low. Typical hot water requirements for a Cold Storage are domestic hot water, possibly dock heat, office and welfare area heat in cool/cold climates, and underfloor heat.
    - This would be an interesting research avenue for the CEC to explore.
        - Incentives to store hot water for central distribution in high density hot water use areas.

4. What emerging technology advancements have the potential to meet the return on investment requirements of industrial and cold-storage facilities?
    - ATLAS by CrossnoKaye
    - Modulating liquid valves by Danfoss
    - Wet Scrubber by Rebound Technologies
    - Predictive maintenance tool by SnoFox
    - Linear power generators by Mainspring
    - Low charge ammonia refrigeration systems
    - CO2 refrigeration systems
    - nSight by ndustrial.io
    - Thermal Storage Medium by Viking Cold
    - Microgrid design by Motive Technologies
    - Charging infrastructure for e-TRUs and 18-wheeler cabs
    - Liquid Control Defrost Method

5. What are examples of best practices that could increase the energy efficiency of refrigeration systems that are not widely adopted?
    - Extensive data monitoring from refrigeration systems to perform Coefficient of Performance (COP) calculations.
    - Advanced control systems to continuously optimize COP
    - Predictive maintenance to identify efficiency issues
    - CMMS tools (such as e-maint) to schedule maintenance work orders.
    - Beyond energy efficiency, smart refrigeration control systems can automate demand response and other load curtailment solutions.
    - Establishing an Energy Management Program.
    - Replace inefficient or obsolete equipment with new efficient ones.
    - Replace malfunctioning doors and doors that don't seal properly.
    - Repair walls and replace old insulation that allow for heat to penetrate building.
    - Optimize timing of defrost cycles.

6. Are there past or current cold-storage projects and related publications, proceedings, or reports you think the California Energy Commission should be aware of to target potential future solicitations?
    - Lineage Logistics – Mira Loma report (Alex Woolf, awoolf@lineagelogistics.com can provide)
    - Modulating liquid valve report from Portland utility

7. In which utility incentive or government programs (energy efficiency and demand response) do industrial and commercial cold-storage facilities generally participate?
    - Lineage participates in as many programs as possible, but many require a level of sophistication/load management that other cold-storage facilities may not be equipped to leverage. Below is a list of our involvements, many of which are shared others in our industry.
    - In CA all of our sites participate in the Base Interruptible Program (BIP) or the Demand Response Auction Mechanism (DRAM). We would welcome the further development of capacity-based market programs and increasing the value given to reliable participants in order to leverage the inherent energy storage and flexibility of cold storage buildings.
    - We participate in the Energy Star ratings program
    - Projects leveraging the Self Generation Incentive Program (SGIP)
    - We have initiated, vetted, and implemented many novel energy efficiency projects coordinated through SCE's Emerging Technologies group, several of which are now standardized EE rebates (this may be uncommon).
    - Most of our sites are enrolled in the Direct Access program, and though we do match our usage profile to CAISO prices (thereby maximizing energy generation efficiency and aligning our incentives with the grid), we are limited by the FERC all-time demand charge during peak solar hours.
    - Lastly, we leverage numerous incentives for existing EE projects, such as LED lighting, variable frequency drives, freezer door replacements, etc.

8. What electrical loads can be shifted in industrial and commercial cold-storage facilities? What incentives would encourage them to shift their electrical load? Do these facilities have the ability and possess the equipment to shift electrical load?
    - Compressors are the primary power consumer at cold storage facilities. Scheduling evaporators and vessel set-points allows for safe and effective energy scheduling of compressors.
    - Incentives to install and/or modify control systems to automatically shift could help in faster adoption of more efficient control technologies.

9. What research has been conducted on increasing thermal mass (e.g., adding thermal storage) within a cold-storage facility for greater demand response participation?
    - No rigorous research that I'm aware of. Lineage is currently planning to conduct one such study with Viking Cold.

10. Has the current shift to online grocers affected the cold-storage economy? If so, how:

    - **From CBRE, their research is indicating that the conversion of retail to industrial will accelerate, by how much, for how long, and differentiation between dry goods vs. cold storage was not given.**
    - **What is shown in this report is that Cold Storage Investment appears to be sustaining Pre-Covid investment levels including the expected downturn due to election year and that the occurrence of speculative development will continue to grow.**
    - **https://www.cbre.us/research-and-reports/2021-US-Real-Estate-Market-Outlook-Industrial-Logistics**
    - 2021 U.S. Real Estate Market Outlook Data Centers / Alternatives | CBRE
    - **https://www.refrigeratedfrozenfood.com/articles/99545-cold-storage-construction-and-covid-19**
    - **https://www.dropbox.com/sh/5chejcvlyetggxl/AACoGjULIjNrFcxuOSVUbiSba?dl=0**

11. What are some of the major advanced technologies or strategies used to retrofit industrial and commercial cold-storage facilities to keep energy costs low? What are some of the barriers to their use? How can research help overcome these barriers?

    - Rigorous research quantifying ROI of various energy efficiency technologies would promote adoption. Currently the industry is generally skeptical that promised ROIs will be realized.
    - Financing mechanisms where the grants help minimize risk to cold storage operators and drive technology adoption.
    - Control system advancements are the most tractable, impactful and cost efficient upgrade to keep energy costs low.
    - However the current boundary is that much of the existing hardware/firmware in place to control industrial equipment is not open platform. Upgrading such systems to a base hardware/firmware platform such as AllenBradley or Opto22 increases the scope, cost and timeline associated with refrigeration upgrades.
    - The problem does not lie with deficiencies in fundamental research but rather the adoption and deployment of existing solutions. Outlining best practices and standards would help inform and guide cold storage owners and operators on how to improve their facilities.

12. How often do industrial and commercial cold-storage facilities replace inefficient equipment with high-efficiency systems and improve system controls for energy efficiency or reducing cost?
    - It depends on the culture of the organization, however, the vast majority of cold storage facilities wait until equipment reaches its end of life before replacing/upgrading. The lack of a defendable ROI or inability to calculate an ROI leads to hesitation in large capital outlays for equipment such as condensers.

13. What is the best way to communicate with industrial and commercial cold-storage facilities regarding energy-efficient and demand response technologies (for example, utility representatives, trade organizations)?
    - Utility representatives

14. Are there any industrial and commercial cold-storage trade groups or committees that meet periodically to share information on energy-saving programs, technologies, and best practices? If so, what are their names and contact?
    - Education: RETA
        - Executive Director: James Barron
        - Ph: 541-497-2955
        - Email: jim@reta.com
        - www.reta.com
    - Government Affairs/Policy/Standards: IIAR
        - President: Gary Schrift
        - Email: gary_schrift@iiar.org
        - www.iiar.org
    - Government Affair/Policy: GCCA
        - CEO: Matt Ott
        - Ph: 703 373 4300 ext: 213
        - www.gcca.org

2. The following will help us establish the technology status in California:

1. Examples of technologies that could increase energy efficiency and load flexibility for industrial and commercial cold storage facilities include:
    - Advanced refrigeration systems (large interrelated systems bringing in variables such as product temperature, grid pricing, and thermal mass).
    - Artificial intelligence (AI)-based software and controls.
    - Advanced coatings on refrigeration/freezer coils to reduce defrost times.
    - Innovative moisture control methods to reduce cooling load (such as desiccant dryers, evaporators, or other energy-efficient means).
    - Thermal energy storage and controls to enable grid flexibility and participation in demand response programs.
    - Deployment of smart control systems and software to optimize system performance to increase energy efficiency, reduce operation and maintenance costs, reduce GHG emissions, and identify system refrigerant leaks and other equipment performance issues that affect equipment lifespan.

2. Are there any additional technologies that should be included and why?
    - Modulating liquid feed valves offer an important opportunity for energy saving. Binary heat loads lead to modulating energy consumption, which compromises efficiency.

3. The following will help us establish performance metrics for commercial and industrial refrigeration systems:

1. Metrics and performance indicators to evaluate new advanced technologies compared to current commercial equipment include:

- Electrical energy savings(%).
- Avoided/reduced maintenance costs ($).
- Increased system efficiency (COP).
- Load shift potential (kW/time).
- Increases in cooling capacity (BTU).
- Savings for the delivered end product ($).
- Increase in system operability.
- Greenhouse gas savings (MTCO2e).
- Decrease in defrost intervals (time).

1. Should any of these be excluded and why?
   - Load shift potential should be in units of kWh as it's the amount of load reduction (from a baseline) multiplied by the time period of the reduction (like an integral). Load shift potential (kW*time).

2. Are there other performance indicators and metrics to consider
   - Volume of hazardous refrigerant (e.g. lbs NH3)