Commercial Refrigeration Subcommittee Meeting #5

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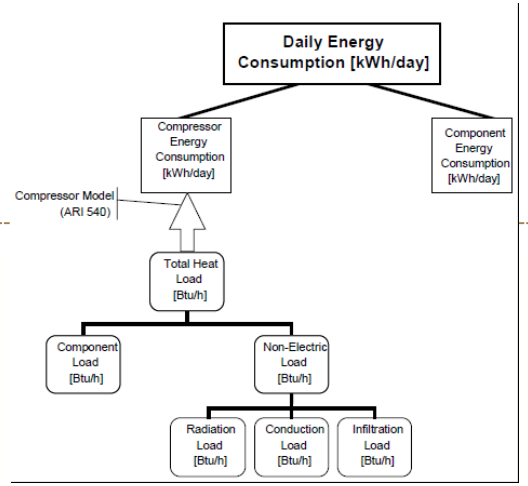
Agenda

- Materials:
  - Com Refrig, Sub Comm Mtg 5 – r2.xls
  - Technology Summary - 1.0 Comm Refrig r4.1.xls
- 1.17 Display Cases
  - Follow-up on SCE workpaper SCE17RN028
- Cost
  - 1.01, Anti-Sweat Heater (ASH) Controls
  - 1.04, Refrigerated Storage Auto Door
  - 1.05, Walk-in Cooler Evaporative Fan Cycling and VFD Control
  - 1.06a & 1.06b Refrigeration Controls Measures
- 1.22, Comm Reach-In Refrig and Freezer - CDF
- Building Type Discussion
- NTGR Question (Hard-to-Reach option)

1.17 Display Cases
Like for Like Replacement



- Daily Energy Consumption formulas developed through models (5.6.7), for primary equipment
  - Component energy consumption
  - Compressor energy consumption (CEC)
    - Component load model (ending up as heat)
      - All energy from evap fan, lighting inside, and defrost energy (not part of phase change)
      - 50% of lighting adjacent to air curtain
      - 70% of ASH adjacent to refrigerated space
  - Model verified against some third-party testing
    - Models and performance data “showed sound agreement”
  - Scale factors used to extend primary results
  - Baseline definitions (Table 5A.2.1)
  - Ex: VOP.RC.M (kWh/day) = 0.64 x (Total Display Area, ft^2) + 4.07
    - TDA – derived from large database of units
- Conclusion: Not all indirect effects are accounted for
  - But is it close enough?

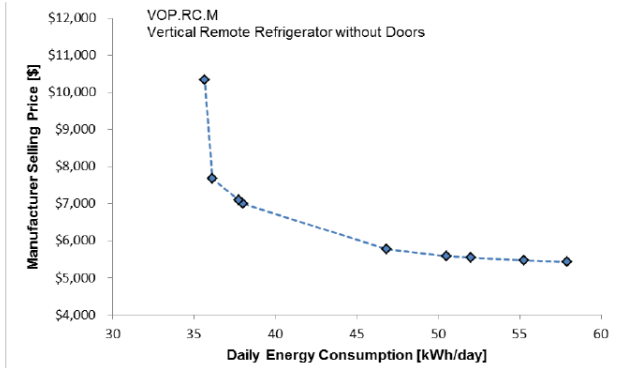


Figure 5.7.1 Cost-Efficiency Curve for the VOP.RC.M Equipment Class

Table 5.7.2 Cost-Efficiency Data for the VOP.RC.M Equipment Class

Design Option Level	Calculated Daily Energy Consumption *kWh/day*	Manufacturer Production Cost *$*	Manufacturer Selling Price *$*	Design Option Added Above the Baseline
AD1	57.90	3,650.17	5,435.54	Baseline
AD2	55.28	3,674.99	5,470.79	AD1 + Permanent Split Cap. Evap. Fan Motor
AD3	51.99	3,727.73	5,545.67	AD2 + Brushless DC Evap. Fan Motor
AD4	50.52	3,756.68	5,586.79	AD3 + Super T8 Lighting
AD5	46.84	3,880.77	5,762.99	AD4 + Night Curtains
AD6	38.02	4,754.26	7,003.35	AD5 + LED Lighting with Occupancy Sensors
AD7	37.76	4,808.98	7,081.05	AD6 + Additional 1/2" Insulation
AD8	36.10	5,231.22	7,680.63	AD7 + Enhanced-UA Evaporator Coil
AD9	35.65	7,092.80	10,324.07	AD8 + Vacuum Insulated Panels

Cost Analysis

- 1.01, Anti-Sweat Heater (ASH) Controls
  - Same cost for Freezer / Cooler
    - 16 amps/controller
    - 1.6 amp/door
    - 2.6 ft/door
    - So, there are 26 Len-ft / controller
  - Different cost for Freezer / Cooler – Consensus Approach
    - Average Cooler (MT) has 10 doors (same as 1.6 amps/door)
    - Average Freezer (LT) has 4.5 doors (equiv to ~3.5 amps/door)
    - 2.6 ft/door
    - So there are:
      - 26 len-ft / controller (MT) (=10*2.6)
      - 11.7 len-ft / controller (LT) (=4.5*2.6)
    - Therefore, cost/controller is about 2x higher for LT Offering
  - Savings are about 1.75x higher for LT Offering

Cost Analysis

- 1.04, Refrigerated Storage Auto Door
  - Average WO017 cost is about 3x the DEER cost

Measure Description	Cost Unit	N	Cost Estimate	DEER 2008	DEER 2005	DEER 2001
Auto-closers on main cooler/freezer doors, <42" wide	Per cooler door	1	$155.67	$120.00	$322.59	N/A
Auto-closers on main cooler/freezer doors, >42" wide	Per cooler door	1	$917.19	$120.00	$322.59	N/A

  - Weighted Average approach considered – approximately the same

Store Type	Area Type	Room Type	Door type (width, inches)	Number of Doors	Locking hinge		Auto-Closer Average Cost
	Back-Room Walk-ins	Freezer	60"	1	expensive	1277	$917.19
		Meat Cooler	60"	1	expensive	1277	$917.19
		Dairy Cooler	60"	1	expensive	1277	$917.19
		Produce Cooler	60"	1	expensive	1277	$917.19
		Beer Cooler	60"	1	expensive	1277	$917.19
	Deli & Bakery Areas	Deli Cooler	42-48"	1	inexpensive	1097	$155.67
		Bakery Cooler	42-48"	1	inexpensive	1097	$155.67
		Bakery Freezer	42-48"	1	inexpensive	1097	$155.67
	Prep Areas	Prep Area	60-84"	2	?	?	$155.67

Total Rooms 10
Average Cost $ 536.43

Source: Source Refrigeration & HVAC Inc. based upon conversationn with a Walk-In supplier.

Cost Analysis

- 1.05, Walk-in Cooler/Freezer and Refrigerated Storage Evaporative Fan Cycling and VFD Control
  - PG&E methodology
    - Uses WO017 values
    - Removes EC motor cost to match Measure's savings
    - Uses "<1 hp cost" for Fan Cycling measure
    - Uses ">1 hp cost" for VFD Control measure

Measure	Installation Type	Incremental Measure Cost	Full Measure Cost	
			1st Baseline	2nd Baseline
Measure #1: RF-37766 Walk-in Cooler Evaporator Fan Cycling Control replacing No Control	REA	$328.5/motor	$328.5/motor	N/A
Measure #2: RF-NEW01 Walk-in Cooler Evaporator VFD Control replacing No Control	REA	$1,880.12/motor	$1,880.12/motor	N/A

~2x more than DEER/SCE

~5x more than DEER/SCE

Cost Analysis

- 1.06b Suction Control
  - WO017 – per suction group

Measure Cost Build-Up

- Supermarket multiplex system

Item	Description	Source	Units	Qty	Cost ea.	Contractor Margin	Price
	Equipment						
1	None Assumed						
2	**Materials**						
3	None Assumed						
4	**Labor and Subcontracts**						
5							
6	Engineering, Project Management	Estimate	Person-hrs	16	$95		$1,520
7	Calibration and fine-tuning labor	Estimate	Person-hrs	32	$115		$3,680
8	**Others**						
9	Taxes and Permits		%		0%		$0
10	Contingency Costs		%		5%		$260
				Total			$5,460
				Total Capacity or Size	Per Suction Group		1.0
				Costing Units	$/Suction Group		$5,460

WO017: Assumed no material cost and built-up cost of $5,460 for labor

  - Values used in SCE workpaper

Cost Reference - 2010-2012 Work Order 017 - Cost Study Report	Cost Per Discharge/Suction Group			Cost Per Ton		
Cost Case Description	**Material Cost**	**Installation Labor Cost -**	**Measure Cost**	**Material Cost**	**Installation Labor Cost -**	**Measure Cost**
Floating Suction Pressure Controls on Commercial Multiplex Refrigeration System						
Floating Suction Pressure	6,210	7,944	14,154	311	397	708

Cost Analysis

- 1.06a & 1.06b – Refrigeration Controls
  - WO017 – per suction/discharge group
  - Convert from $ / group to $ / ton
  - Currently, dividing by 20 tons
  - Example: Weighted approach

		MT	Tons[4]			LT	Tons[4]			
	Market[1]	Number of groups[2, 3]	min	max	avg	Number of groups[2, 3]	min	max	avg	wt avg
Supermarket	34%	3	30	60	45	1	8	20	14	37.3
Grocery Store	66%	3	30	60	45	1	8	20	14	37.3

Wt Avg: 37.3

Sources:

1. Market breakdown: Supermarket 33% / Grocery Store 67% comes from a PG&E-territory NAICS code study in Sept 2017.
   - Grocery Stores - Large Enterprise Accounts 2085 34%
   - Grocery Stores - Small and Medium Sized Business 4014 66%
   - Note that 879 Grocery Stores were unclassified and therefore not included in these numbers.
2. Number of groups per store documented by EnergySmart Grocer program in 2011.
   - Supermarket typically has 3 MT and 2 LT groups per store
   - Grocery Store typcially has 2 MT and 1 LT group per store
3. Commercial Saturation Study has data on the breakdown between MT and LT cases for both Glass Door and Open DC's.
   - Supermarket 0.75 MT 0.25 LT
   - Grocery Store 0.75 MT 0.25 LT
4. Documented in SCE workpaper.
   - EnergySmart Grocer program has audit information to improve the accuracy of these values.

1.22 Comm Reach-In Refrig and Freezer

- The 0.9 factor in the demand savings may not be CDF

  Measure Case Peak Demand Reduction = Measure Daily Energy Usage / 24 hrs
  Base Case Peak Demand Reduction = Base Daily Energy Usage / 24 hrs
  Demand Reduction Savings = (Base Reduction – Measure Reduction)

  Peak Demand Reduction Savings = Reduction Savings * **0.9**

- Should it be included?
  - Is an average value for demand savings already conservative?

    or
  - Is part-load performance more efficient than near-full load performance for these types of refrigeration cycles?
- Note that there is a similar question in:
  - "1.15, Low Temp Coffin to Reach-In" Measure. (CDF of 0.81)

Building Type

code	description
Asm	Assembly
Gro	Grocery
RFF	Restaurant - Fast-Food
RSD	Restaurant - Sit-Down
Rt3	Retail - Multistory Large
RtL	Retail - Single-Story Large
RtS	Retail - Small

- Claims existed also for:
  - 1.01 – ASH Controls (SDG&E)
    - 30 of 21,570
  - 1.03 – Evap Fan Motors (PG&E)
    - 594 of 2,632
    - Commercial, Lodging-Hotel, Storage-Unconditioned, Warehouse-Refrigerated
  - 1.04 – Auto Door Closer (PG&E, SCE)
    - 366 of 1,760 (300 are PG&E/COM)
    - SUN, AGOTH, COM, Nrs, WRf, OfL, OfS, s_FSt, s_Mic
  - 1.05 – Walk-in Cooler Evap Fan Control (PG&E)
    - 214 of 619
    - Commercial, Warehouse-Refrigerated
  - 1.08 – Bare Refrigeration Lines (SDG&E)
    - 197 of 1,028
    - ESE, HTL, MLI, Nrs, OfL, OfS
  - 1.22 – Commercial Refrigerators
- Question:
  - Use Commercial Refrigeration standard set of building types for most Measure (all except blue)
    - Use an expanded set for blue measures (list = tbd).
  - Use COM for all Commercial Refrigeration Measures that are not building type specific
    - COM intent is: “weighted average of all commercial building types” – *Verify statement is accurate.*
    - Not currently aware of any Com Refrig Measures that vary by Building Type.

Building Type

- Proposed default Building Type for Commercial Refrigeration measures of "Com" because:
  - COM describes savings as the weighted average across all buildings in this category.
  - No commercial refrigeration Measures use building type as a parameter to change savings.
    - Specifically, the weighted average would be more qualitative…based upon 2016 claims data, most savings comes from grocery stores/supermarkets so the grocery prototype model is used for modeled measures.
  - More importantly, this points out that we do not have building type specific savings (ie, not adjusted for HOU).
  - Note that this would not apply to all Comm Refrig Measures. For example, the "1.22, Reach-In Refrig and Freezer" would still be "Any".
  - *BUT, we do not want to cause claims issues because of this change.*

Net-to-Gross Ratio (NTGR)

- Many Commercial Refrigeration workpapers include two options for NTGR

NTGR ID	Description	Sector	BldgType	Measure Delivery	NTGR
Com-Default>2yrs	All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years	Com	Any	All	0.6
Com-Default-HTR-di	All other EEM with no evaluated NTGR; direct install to hard-to-reach only.	Com	Any	DirInstall	0.85

- Only one option is typically reflected in Ex Ante tables: “Com-Default>2 yrs”

No.	Measure Names
1.01	Anti-Sweat Heater (ASH) Controls
1.02	Anti-Sweat Heater Display Doors
1.03	Evaporator Fan Motors
1.04	Refrigerated Storage Auto Closer
1.05	Walk-in Cooler Evaporative Fan Cycling and VFD Control
1.06	Refrigeration Head Pressure Controls
1.07	Refrigeration Night Covers
1.08	Bare Refrigeration Line Insulation

Other Questions…

- Are there standard temperature ranges for a med temp cooler and a low temp freezers?
  - From an earlier discussion: “Analysis should be done with setpoint of
    - 38°F setpoint for products stored in coolers.
    - 0°F setpoint for products stored in freezers.
    - -15°F setpoint for ice cream freezers.
  - This is the way that it is in the prototype models now. Uses DOE energy standard/ASHRAE 72 (test method).”
- Night Covers
  - Assumption that infiltration is reduced by multiplier of 0.50
  - DEER assumption for night cover application for 6 hours per day.

Back-up