Commercial Refrigeration Subcommittee Meeting #2

AYAD AL-SHAIKH

AUGUST 2017

Subcommittee Meeting #2

- Materials:
  - Com Refrig - Sub Com Mtg 2 - r2.xls
  - Technology Summary - 1.0 Comm Refrig r3.1.xls
- ECM Retrofit Structure
  - Remove overlap from existing workpapers now
- Refrigeration Controls
  - Consolidate on approach
- Display Cases

Consolidation Structure

- EC Motor Retrofits
  - Approach 1: Uses existing approaches only
    - Display Cases – follow 1.11 (PGE3PREF124) approach specifically for grocery stores – ER workpaper/ AFar changes
    - Walk-in Cooler / Freezers – follow 1.03 (PGECOREF109 / 1.03_SCE13RN011.2) approach
      - But do not use the part of the workpaper focused on Display Cases
  - Approach 2: Requires extending the approach from ECM controller
    - Display Cases – follow 1.11 (PGE3PREF124) approach specifically for grocery stores
    - Walk-in Evaporators (by motor rated hp) – follow approach similar to PGE3PREF126 (which is for ECM plus a controller)
  - Approach 3:
    - Evap motors (by motor rated hp) only
      - Walkin / Display Case
    - Baseline of 75% ECMs

Consolidation Structure

- Refrigeration Controls
  - Single Compressor
    - 1.14 - Floating Head Pressure - Single Compressors (1.14_PGE3PREF129) = seems like a separate measure
  - Multiplex Compressors
    - 1.06_SCE17RN023.0
      - DEER averaged
    - 1.06_PGE3PREF120 R4 and 1.06_PGE3PREF121 R3
      - DEER prototype-based
      - Modeled to include permutations for Climate Zone

Refrigeration Controls SCE17RN023.0

- **Floating Head Pressure:**
  - RF-31355: **Floating head pressure** control for comm. air-cooled, multiplex refrigeration systems.
    - DEER ID: D03-221: Fixed SCT = 70ºF
    - DEER ID: D03-223: Control SCT to ambient + 12ºF TD, 70ºF min, backflood setpoint of 68ºF
    - DEER ID: D03-225: Control SCT to ambient + 12ºF TD, 70ºF min, backflood setpoint of 68ºF, variable-speed fan control
  - RF-41488: **Floating head pressure** control for comm. evap-cooled, multiplex refrigeration systems.
    - DEER ID: D03-222: Fixed SCT = 70ºF
    - DEER ID: D03-224: Control SCT to wetbulb + 17ºF TD, 70ºF min, backflood setpoint of 68ºF
    - DEER ID: D03-226: Control SCT to wetbulb + 17ºF TD, 70ºF min, backflood setpoint of 68ºF, variable-speed fan control
  - RF-40395: **Floating head pressure** control for process, evap-cooled refrigeration systems.
    - DEER ID: D03-307: Fixed SCT = 70ºF, backflood setpoint of 68ºF
    - DEER ID: D03-308: Control SCT to wetbulb + 9ºF TD, 70ºF min, backflood setpoint of 68ºF
    - DEER ID: D03-309: Control SCT to wetbulb + 9ºF TD, 70ºF min, backflood setpoint of 68ºF, var-speed fan control
- **Suction Control**
  - RF-51222: DEER ID: D03-220: Multiplex system, air-cooled condenser, reset **SST** based on worst-case demand
  - RF-20965: DEER ID: D03-306: Process, Reset **SST** based on worst-case zone demand

Refrigeration Controls - Multiplex

- Floating head controls (PGE3PREF120)
  - Varying by Vintage and Climate Zone

Measure Code	DEER Measure / Impact ID	Description
R115	D03-223	The base case is an air-cooled multiplex, vintage dependent, and having a fixed condensing setpoint per vintage. The EEM is the addition of an drybulb-following condensing setpoint, with a 12°F temperature difference (TD) between ambient and setpoint. (Itron, 7-88)
R122	D03-224	The base case is an evaporative-cooled multiplex, vintage dependent, and having a fixed condensing setpoint per vintage. The EEM is the addition of a wetbulb following condensing setpoint, with a 17°F TD between wetbulb and setpoint. (Itron, 7-89)
R116	D03-225	The base case is an air-cooled multiplex, vintage dependent, and having a fixed condensing setpoint per vintage. The EEM is the addition of an drybulb-following condensing setpoint, with a 12°F TD between ambient and setpoint. In addition, the fans are controlled using a variable-speed drive. (Itron, 7-89)
R123	D03-226	The base case is an evaporative-cooled multiplex system, vintage dependent, and having a fixed condensing setpoint per vintage. The EEM is the addition of a wetbulb following condensing setpoint, with a 17°F TD between wetbulb and setpoint. In addition, the base-case two-speed fan is replaced with variable-speed. (Itron, 7-90)

Refrigeration Controls - Decisions

- (see Pivot table results to compare)
- Should we include process FHP and Suction Controls?
  - These are only included in the SCE workpaper
  - Currently part of SCE17RN023
- Do we want to include Vintage?
  - Always significant variation
  - Currently part of PGE3PREF120 and PGE3PREF121
  - Can IOU's handle implementation
- Do we want to separate installations with VFDs on condensers?
  - Variations changes with Climate Zone
  - Currently part of PGE3PREF120 and PGE3PREF121

Display Cases

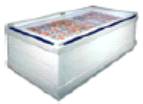
- Same Display Case (DC) to Same DC:
  - 1.17_SCE17RN028.0 High Efficiency Display Case_Final
  - Introduces DOE methodology to match with new Federal Standards
- Open to Closed:
  - REA, Add Door
    - 1.01
    - 1.09_PGE3PREF127 R4
    - 1.18_PGE3PREF116 R2
  - ROB, Replace Door
    - 1.02a
  - ROB, Replace Display Case
    - 1.15
    - 1.17b

Additional Consolidation

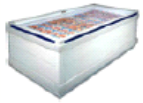
- Display Cases (DC):
  - Any DC
    - Replace DC with same-MT/LT, ROB (1.17) – new, ER
  - Any Closed-Transparent DC
    - Upgrade door-LT/MT, REA (1.01)
    - Replace door-LT, ROB (1.02a)
    - Replace Display Case-LT, ROB (1.02b) -> overlap with 1.17 –


  - Any Open DC
    - Add door-MT, REA (1.09)





  - Horizontal Open DC
    - Replace DC Closed, HE-LT, ROB (1.15)



  - Vertical Open DC
    - Replace DC with High Efficiency Vertical Open-MT, ROB (1.16) -> overlap with 1.17
    - Replace DC with High Efficiency Vertical Closed-LT/MT, ROB (1.17b) - existing

  - Vertical Open DC
    - Add door-MT, REA (1.18)

1.17 Display Cases w/ Doors (SCE approach)

Equipment Family	Equipment Family Designation	Sample Equipment Family Image	Operating Mode Designation	Temperature Designation	Operating Temp.	Equipment Class Designation
Vertical Open	VOP		Remote Condensing (RC)	M (38 °F)	≥32 °F	VOP.RC.M
Semi vertical Open	SVO			M (38 °F)	≥32 °F	SVO.RC.M
Horizontal Open	HZO			L (0 °F)	<32 °F	HZO.RC.L
Vertical Closed Transparent	VCT			M (38 °F)	≥32 °F	VCT.RC.M
				L (0 °F)	<32 °F	VCT.RC.L
Horizontal Closed Transparent	HCT		Self-Contained (SC)	L (0 °F)	<32 °F	HCT.SC.L
				I (-15 °F)	≤-5 °F	HCT.SC.I
Horizontal Closed Solid	HCS			M (38 °F)	≥32 °F	HCS.SC.M
Pull-Down	PD			M (38 °F)	≥32 °F	PD.SC.M

Source: DOE rule making [A], Table 3.2.5 Commercial Refrigeration Equipment Classes

Grocery Store Prototype Model

- FYI and Thoughts…
- Consider results from Commercial Saturation Study (CSS) to support the prototype model development
  - 649 commercial buildings with commercial refrigeration on-site

Table ES-6: Distribution of Businesses with Different Types of Refrigeration

Business Type	Businesses with Refrigeration Equipment	Remote Refrigeration	Self-Contained Refrigeration	Ice Makers
Food/Liquor	100%	13%	100%	46%
Health/Medical - Clinic	4%	0%	4%	3%
Miscellaneous	13%	0%	13%	3%
Office	3%	0%	3%	1%
Restaurant	97%	0%	96%	84%
Retail	13%	0%	13%	1%
School	84%	0%	84%	12%
Warehouse	3%	1%	2%	<1%
n	**649**	**65**	**637**	**350**

* **The results presented above have been weighted by site weight.**

Grocery Store Prototype Model

Self-Contained Display Case Systems by Detailed Business Type

Table 8-17

	Food / Liquor	Health / Medical - Clinic	Miscellaneous	Office	Restaurant	Retail	School	Warehouse
Convenience Store	16.90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Large Grocery	4.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Small Grocery	10.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Medical / Dental	0.00%	0.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rehabilitative Services	0.00%	0.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Assembly	0.00%	0.00%	5.50%	0.00%	0.00%	0.00%	0.00%	0.00%
Laboratory	0.00%	0.00%	1.20%	0.00%	0.00%	0.00%	0.00%	0.00%
Multi-Family	0.00%	0.00%	0.40%	0.00%	0.00%	0.00%	0.00%	0.00%
General Miscellaneous	0.00%	0.00%	0.80%	0.00%	0.00%	0.00%	0.00%	0.00%
Services	0.00%	0.00%	0.30%	0.00%	0.00%	0.00%	0.00%	0.00%
Office	0.00%	0.00%	0.00%	1.30%	0.00%	0.00%	0.00%	0.00%
Fast Food Restaurant	0.00%	0.00%	0.00%	0.00%	12.10%	0.00%	0.00%	0.00%
Table Restaurant	0.00%	0.00%	0.00%	0.00%	16.90%	0.00%	0.00%	0.00%
Other Food	0.00%	0.00%	0.00%	0.00%	14.60%	0.00%	0.00%	0.00%
Auto Sales	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%	0.00%	0.00%
Retail	0.00%	0.00%	0.00%	0.00%	0.00%	4.00%	0.00%	0.00%
Variety / Warehouse	0.00%	0.00%	0.00%	0.00%	0.00%	3.60%	0.00%	0.00%
School	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.40%	0.00%
Conditioned Warehouse	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%
Unconditioned Warehouse	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.30%
Storage	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Refrigerated Warehouse	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%

Grocery Store Prototype Model

- From Commercial Saturation Study (CSS)

Distribution of Display Case Types by Business Type

Table 8-15

	Food / Liquor	Health / Medical - Clinic	Miscellaneous	Office	Restaurant	Retail	School	Warehouse
Glass Door Case	41.60%	12.00%	12.80%	26.10%	13.60%	68.00%	6.30%	30.40%
Solid Door Storage Case	1.80%	80.60%	69.90%	36.90%	69.80%	4.40%	82.80%	60.70%
Open Display Case	28.60%	0.00%	0.90%	0.00%	0.30%	14.60%	1.60%	0.00%
Island / Coffin Case	13.00%	4.40%	3.10%	9.40%	4.90%	6.90%	4.20%	1.00%
Service Case	11.30%	0.00%	0.60%	0.50%	5.90%	0.40%	0.30%	2.50%
Beverage Merchandiser	2.60%	2.90%	7.90%	27.10%	3.70%	5.10%	0.40%	1.00%
Other / Unlisted Case	1.20%	0.00%	4.90%	0.00%	1.90%	0.50%	4.50%	4.50%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Grocery Store Prototype Model

- From Commercial Saturation Study (CSS)

Distribution of Display Case Types by System Type

Table 8-14

	Self-contained Refrigeration	Remote Refrigeration
Glass Door Case	31.70%	34.60%
Solid Door Storage Case	44.20%	0.00%
Open Display Case	2.50%	43.20%
Island / Coffin Case	7.10%	13.00%
Service Case	6.70%	9.20%
Beverage Merchandiser	5.30%	0.00%
Other / Unlisted Case	2.50%	0.00%
Total	100.00%	100.00%

- Thoughts…

Additional Measures
Not covered in Mtg #1

- 1.04 Auto-Door Closers
- 1.07 Night Covers
- 1.08 Bare Refrig Line Insulation
- 1.10 Compressor Retrofit: Multiplex
- 1.12 Efficient Condenser, Air to Evap-Cooled
- 1.13 Efficient Condenser: Multiplex
- 1.19 Adaptive Refrigerator and Freezer Controls
- 1.21 Ultra Low Temperature Freezer (On Hold)
- 1.22 Commercial Reach-In Refrigerators & Freezers

1.04 Auto-Door Closer

- Overview:
  - PG&E and SCE savings match
    - SDG&E savings (Len-Ft), but seem significantly lower (check)
    - SDG&E methodology is identical, so savings should be the same; confirm that this is correct.
  - POU savings vary by climate zone and offering, but savings smaller (2x) – references downrev PG&E workpaper
  - Savings vary by offering and CZ
  - Savings to not vary by Building Type, Vintage, or HVAC Type
  - Offerings: (same for all IOUs)
    - Cooler
    - Freezer

1.04 Auto Door Closer – SCE vs TRM

SCE Values

Measure			Combination						
SolutionCode	MeasIndex	Unit	InstallType	BldgLoc	EUL	Life_1BL	kWh_1BL	kW_1BL	Therm_1BL
RF-16925	Main Cooler Door Auto Closer	Unit	REA	05	6.67	6.67	1725.22	0.31144	-0.104
RF-16925	Main Cooler Door Auto Closer	Unit	REA	12	6.67	6.67	2074.98	0.46256	-0.597
RF-32156	Main Freezer Door Auto Closer	Unit	REA	05	6.67	6.67	3524.46	0.20	-0.04
RF-32156	Main Freezer Door Auto Closer	Unit	REA	12	6.67	6.67	3912.41	0.81	-0.60

TRM Values
About 50%

7.8.1 Energy Savings Table

This table provides the energy savings and peak demand reduction for each climate zone.

Climate Zone	Cooler Door		Freezer Door	
	Demand Reduction	Energy Savings	Demand Reduction	Energy Savings
2	0.162	980	0.452	2,450
3	0.127	958	0.296	2,394
4	0.143	981	0.363	2,365
5	0.165	961	0.192	2,378
8	0.108	998	0.280	2,394
9	0.181	1,005	0.422	2,432
10	0.190	1,022	0.326	2,442
11	0.159	1,014	0.363	2,457
12	0.149	998	0.400	2,453
14	0.225	1,000	0.141	2,495
15	0.060	892	0.141	2,409
16	0.149	943	0.326	2,386
Average	**0.152**	**979**	**0.309**	**2,421**

1.04 Auto-Door Closer

- The measures in this work paper are not in DEER 2017, so the energy savings were determined through building simulation in eQUEST 3.65 Refrigeration. Only the Grocery building type was simulated, and its savings were used for other building types because walk-in coolers and freezers generally have the same characteristics regardless of building type.

- Prototype generation
  - MASControl v3.00.20 was used to generate the DEER 2014 Grocery prototype files using the following parameters:
  - •Building Type: Grocery
  - •Climate Zones: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16
  - •Vintage: “14” (years 2014-2015)
  - •HVAC Type: Blank (Default)
  - •Thermostat Options: Blank (Default)
  - •Case Options: CAv (Customer Average), C13 (Code 2013)
  - •Tech ID: “D08-NE-HVAC-airAC-SpltPkg-135to239kBtuh-10p8eer”

- Models are available in workpaper.

1.07 Night Covers

- Overview:
  - PG&E and SCE savings do match
    - Methodology seems identical
    - Ex Ante data for LT Open Vertical matches
    - Any understanding of why claims savings does not match? - CZ
  - Savings vary by offering and CZ
  - Savings to not vary by Building Type, Vintage or HVAC Type
    - Measure has only been implemented in Grocery stores (all IOUs)
  - POUs do not offer this deemed measure.
  - Offerings:
    - Low Temperature Open Horizontal Night Cover (34.1 kWh)
    - Low Temperature Open Vertical Night Cover (141.9 kWh) – SCE only
    - Medium Temperature Open Vertical Night Cover (17.4 kWh)

1.07 Night Covers

- Measure ID D03-205 in the 2014 Database for Energy Efficient Resources (DEER) READi tool, which addresses installing night covers on medium-temperature open display cases. It does not address installing night covers on low-temperature open display cases (vertical or horizontal). The DEER 2014 savings are based on applying covers for a period of four hours and the database does not distinguish between vertical and horizontal cases. Also, the measure characteristics presents the savings due to installing infiltration barrier as 50%, this compares favorably with other studies on horizontal display cases and thus it is assumed that the database is referring to horizontal cases only. For medium-temperature display cases, existing DEER 2014 values are used.
- The building simulation models were generated for a Grocery Store with multiplex-compressor systems for the refrigeration display cases. Single-compressor systems are less efficient than multiplex-compressor systems. According to the DEER Report [26], single-compressor systems were typically designed prior to 1980. To be conservative, it is assumed that the generated energy savings of this work paper will also be applied to display cases with single-compressor systems.

- Models are available in workpaper.

1.08 Bare Refrig Line Insulation

- Overview:
  - SCE and SDG&E savings vary dramatically.
    - SCE savings vary by Climate Zone and Offering (Freezer / Cooler)
      - Savings do not vary by Building Type
    - SDG&E savings are averaged over all BT (Com) and all CZ (IOU)
      - Savings are also much smaller (1/10 to 1/100 of electric savings)
    - Assume this is baseline related (degraded vs no insulation)
  - PG&E does not currently offer this measure.
  - POUs do not offer this deemed measure.
  - Ensure that engineering assumptions in calculation are documented well and represent best available data.
  - Offerings: (for SCE)
    - Freezer
    - Cooler
  - Offering: (for SDG&E)
    - For Walk-in Refrigeration Units; Baseline not required to be bare.

1.08 Bare Refrig Line Insulation

- Methodology
  - SDG&E references an ASHRAE study, but adjusts the approach to meet SDG&E program implementation.
  - SCE uses an analytical calculation: (more detail on page 11)
    - Heat transfer analysis: Conduct a heat transfer analysis for both bare (baseline) and insulated (post-retrofit) suction lines of walk-ins to determine.
    - Refrigeration cycle analysis: Conduct refrigeration cycle analysis for both bare (baseline) and insulated (post-retrofit) suction lines.
    - Compressor power savings per unit of measure (ΔkW/linear-ft):
      - Determine demand savings by using bare and insulated suction line compressor power usage
      - Determine demand savings per linear-ft of exposed suction lines for both walk-in coolers and freezers
    - Equivalent-full-load-hours (EFLH) of operation:
      - EFLH is determined by using annual available operation hours (8,760) and overall duty cycle factor
      - Overall duty cycle factor is determined by taking into account compressor over-sizing factor, defrost periods and weather factor
    - Compressor energy savings per unit of measure (ΔkWh/sq-ft):
      - Determine energy savings by using demand savings and EFLH
      - Repeat energy savings calculation for all CTZs for both coolers and freezers and compile results
  - Discuss the best approach to take.

1.10 Compressor Retrofit: Multiplex

- Overview:
  - Savings vary by Measure Application Type (ER/ROB), Offering, Building Vintage, Climate Zone
  - Savings do not vary by Building Type or LT/MT
    - Only currently offered at Grocery Stores
  - PG&E only offers this measure.
  - POUs do not offer this deemed measure.
  - Ensure that engineering assumptions in calculation are documented well and represent best available data.
  - Offerings:
    - Air-Cooled to Air-Cooled / Air-Cooled to Water-Cooled
      - Includes controls on new Multiplex system
    - ER / ROB

1.10 Compressor Retrofit: Multiplex

- Methodology
  - The saving for this measure is from 2008 DEER data generated from MAS Control V3.00.19. The information can be identified in the database as measures D03-214 and D03-215.
  - ER - For early retirement claims: The existing compressor system must be in working order with no signs of replacement in the 12 months following the project application date. Pre-inspection of the existing equipment will be required. Preponderance of evidence must be supplied. Please see the template of information to be completed. Most projects will claim ROB. (ER savings 4-6x of ROB)
  - An additional rebate cannot be claimed for floating head pressure control
  - Models not available in workpaper; DEER savings.

1.12 Efficient Condenser Air to Evap-Cooled

- Note:
  - Measure being sunset due to cost effectiveness.
- Overview:
  - Savings vary by Building Vintage and Climate Zone
  - Savings do not vary by Building Type or LT/MT
    - Only currently offered at Grocery Stores
  - PG&E only offers this measure.
  - POUs do not offer this deemed measure.
  - Ensure that engineering assumptions in calculation are documented well and represent best available data.
  - Offerings:
    - ER / ROB

1.12 Efficient Condenser Air to Evap-Cooled

- Methodology
  - The data modeled using MASControl v3.00.19 includes: demand, electric, and interactive gas energy savings. DEER 2008 cost data includes: equipment unit costs, equipment incremental costs, and equipment useful life.
  - ER savings can be 2 – 10x of ROB savings.
  - Not clear why there is no later vintage (2003).
  - Water penalty not included; hybrid condenser not yet considered.
  - Negative IMC –
    - POUs generally use total cost and existing conditons
  - No models available in workpapers; DEER values.

1.13 Efficient Condenser: Multiplex

- Overview:
  - Savings vary by Building Vintage and Climate Zone
  - Savings do not vary by Building Type, Air/Evap-Cooled or LT/MT
    - Only currently offered at Grocery Stores
  - PG&E only offers this measure.
  - POUs do not offer this deemed measure.
  - Ensure that engineering assumptions in calculation are documented well and represent best available data.
  - Offerings:
    - ER / ROB

1.13 Efficient Condenser: Multiplex

- Methodology:
  - The savings for these measures are from DEER 2008 and generated through MASControl V3.00.19. The nonresidential technology codes selected was D08-NE-GrocRefg-Cndsr-AirCool-HiEff and D08-NE-GrocRefg-Cndsr-EvapCool-HiEff. The grocery building type was selected for PG&E climate zones (1,2,3,4,5,11,12,13,16) and vintage codes 75, 85, 96, 03, and 07.
  - No models available in workpapers; DEER values.

1.19 Adaptive Refrigerator and Freezer Controls

- Overview:
  - Savings vary by Offering, Climate Zone, Building Type
  - Savings do not vary by IOU or Vintage
  - Unit of Measure is “cap-tons”; other evap system control are “each”
  - Offered by PG&E only
  - POUs do not offer this deemed measure.
  - 2016 Offerings:
    - Refrigerator/Cooler
    - Freezer (includes therm savings)

1.19 Adaptive Refrigerator and Freezer Controls

- Methodology
  - The building simulation models were generated for a Grocery Store with multiplex-compressor systems for the refrigeration walk-in coolers and freezers. Single-compressor systems are less efficient than multiplex-compressor systems. According to the DEER Report [3], single-compressor systems were typically designed prior to 1980. To be conservative, it is assumed that the generated energy savings for this work paper will also be applied to walk-in cooler and freezer with single-compressor systems.
  - A set of sensitivity analyses for two additional building types (Fast Food Restaurant and Small Retail) at two extreme weather conditions for one Building Vintage are performed. Refer to the end of this section for discussion.
    - As a result, the study shows that the savings estimated by the Fast Food Restaurant and Small Retail models are within 3% discrepancy compared to savings estimated by the Grocery models for the same building vintage. (Att C)
  - Models available in folder.

1.21 Ultra Low Temperature Freezer

- Overview:
  - Workpaper not yet available form PG&E.
  - POUs are currently offering this deemed Measure.

Measure On Hold

1.22 Commercial Reach-In Refrigerators and Freezers

- Overview:
  - Savings vary by Offering, IOU (SDG&E savings are different, but methodology identical; references SCE13CCC001, Rev 2 – down rev)
    - Confirm that SDG&E savings should match other IOUs.
  - Savings do not vary by Climate Zone, Building Type, Vintage
  - POUs have the same offerings
  - Some offerings only by some IOUs (see chart on next slide)
    - Confirm the correct set of offerings
  - Discuss the purpose of the CDF factor for this Measure.
  - 2016 Offerings:
    - Refrig / Freezer
    - Solid / Glass Door
    - Size: <15 (under-counter), 15-29 (single door), 30-49 (double door), >50 (triple door) cubic feet

1.22 Commercial Reach-In Refrigerators and Freezers

- Offerings (savings kWh/unit)

Offering	PGE	SCE	SDGE
50 cubic feet Solid-Door Reach-In Freezer	4,552	4,552	5,108
50 cubic feet Solid-Door Reach-In Refrigerator	1,279	1,279	1,415
< 15 cubic feet Glass-Door Reach-In Refrigerator	723	723	
< 15 cubic feet Solid-Door Reach-In Freezer	595	595	679
< 15 cubic feet Solid-Door Reach-In Refrigerator	270	270	305
>50 cubic feet Glass-Door Reach-In Refrigerator	934	934	1,044
15 - 29 cubic feet Glass-Door Reach-In Refrigerator	661	661	738
15 - 29 cubic feet Solid-Door Reach-In Freezer	869	869	987
15 - 29 cubic feet Solid-Door Reach-In Refrigerator	493	493	554
30 - 49 cubic feet Glass-Door Reach-In Freezer		4,599	
30 - 49 cubic feet Glass-Door Reach-In Refrigerator	775	775	
30 - 49 cubic feet Solid-Door Reach-In Freezer	2,074	2,074	2,328
30 - 49 cubic feet Solid-Door Reach-In Refrigerator	854	854	924

- POU savings match
  - IOUs do not incent many glass door freezer options.

1.22 Commercial Reach-In Refrigerators and Freezers

- POU/TRM Offerings (savings kWh/unit)

		Unit Volume (Cu ft)			
	Door Type	< 15	15–29	29–49	>49
Refrigerator savings (kWh/yr)	Solid door	270	493	854	1,279
	Glass door	723	661	773	934
Freezer savings (kWh/yr)	Solid door	595	869	2,074	4,552
	Glass door	1,693	2,010	4,599	8,103

		Unit Volume (Cu ft)			
	Door Type	< 15	15–29	29–49	>49
Refrigerator incremental cost ($)	Solid door	$961	$1,241	$1,732	$2,396
	Glass door	$91	$760	$947	$1,363
Freezer incremental cost ($)	Solid door	$227	$1,200	$1,370	$1,732
	Glass door	$22	$109	$189	$791

1.22 Commercial Reach-In Refrigerators and Freezers

- Methodology
  - Baseline of Federal Requirement

Equipment Description (cubic feet)	Daily Energy Usage (kWh/day)
Solid-Door Reach-In Refrigerator	≤ 0.100V+2.04*
Solid-Door Reach-In Freezer	≤ 0.400V+1.38
Glass-Door Reach-In Refrigerator	≤ 0.120V+3.34
Glass-Door Reach-In Freezer	≤ 0.750V+4.10

  - Measure case of EnergyStar 2.0 Requirement

Equipment Description (cubic feet)	Daily Energy Usage (kWh/day)
Solid-Door Reach-In Refrigerator	
0 < V < 15	≤ 0.089V + 1.411*
15 ≤ V < 30	≤ 0.037V + 2.200
30 ≤ V < 50	≤ 0.056V + 1.635
50 ≤ V	≤ 0.060V + 1.416
Solid-Door Reach-In Freezer	
0 < V < 15	≤ 0.250V + 1.250
15 ≤ V < 30	≤ 0.400V – 1.000
30 ≤ V < 50	≤ 0.163V + 6.125
50 ≤ V	≤ 0.158V + 6.333

Glass-Door Reach-In Refrigerator	
0 < V < 15	≤ 0.118V + 1.382
15 ≤ V < 30	≤ 0.140V + 1.050
30 ≤ V < 50	≤ 0.088V + 2.625
50 ≤ V	≤ 0.110V + 1.500
Glass-Door Reach-In Freezer	
0 < V < 15	≤ 0.607V + 0.893
15 ≤ V < 30	≤ 0.733V - 1.000
30 ≤ V < 50	≤ 0.250V + 13.500
50 ≤ V	≤ 0.450V + 3.500