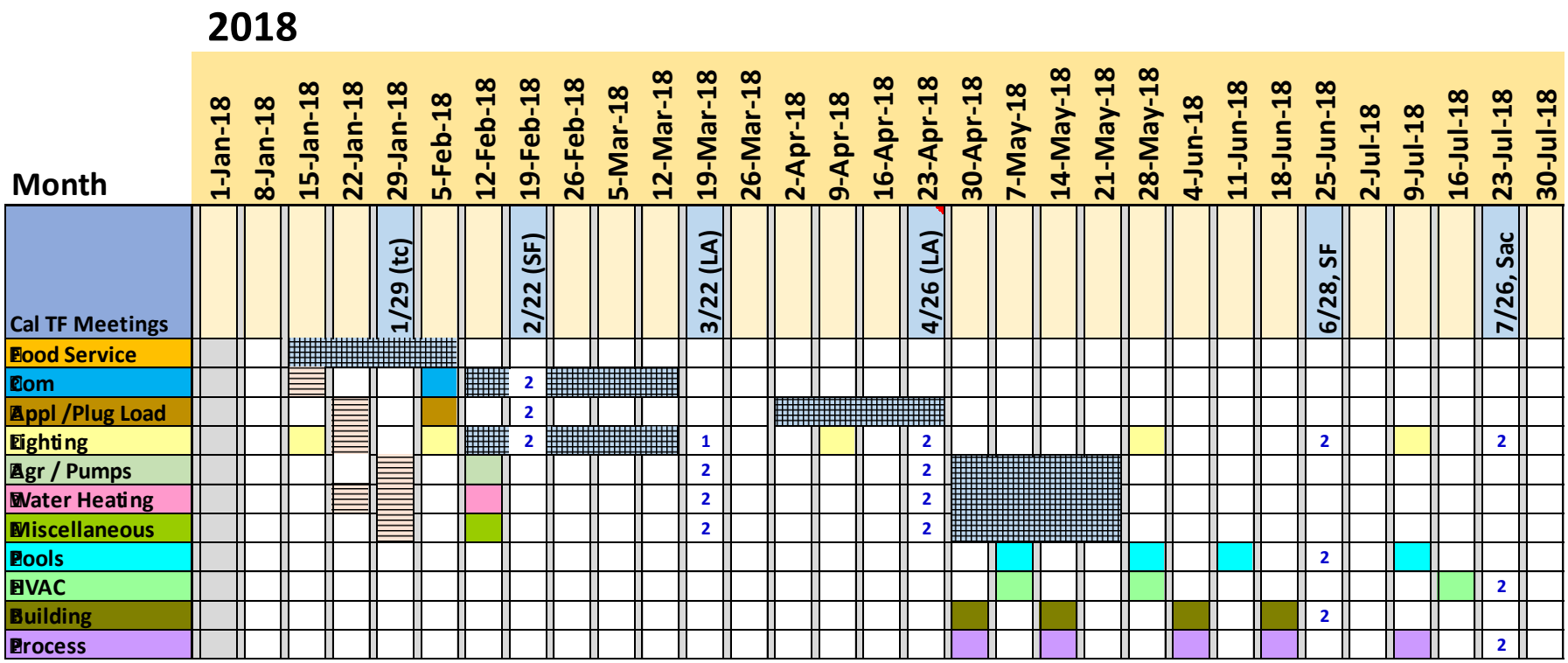
Process Subcommittee Meeting #1

CALIFORNIA
TECHNICAL FORUM

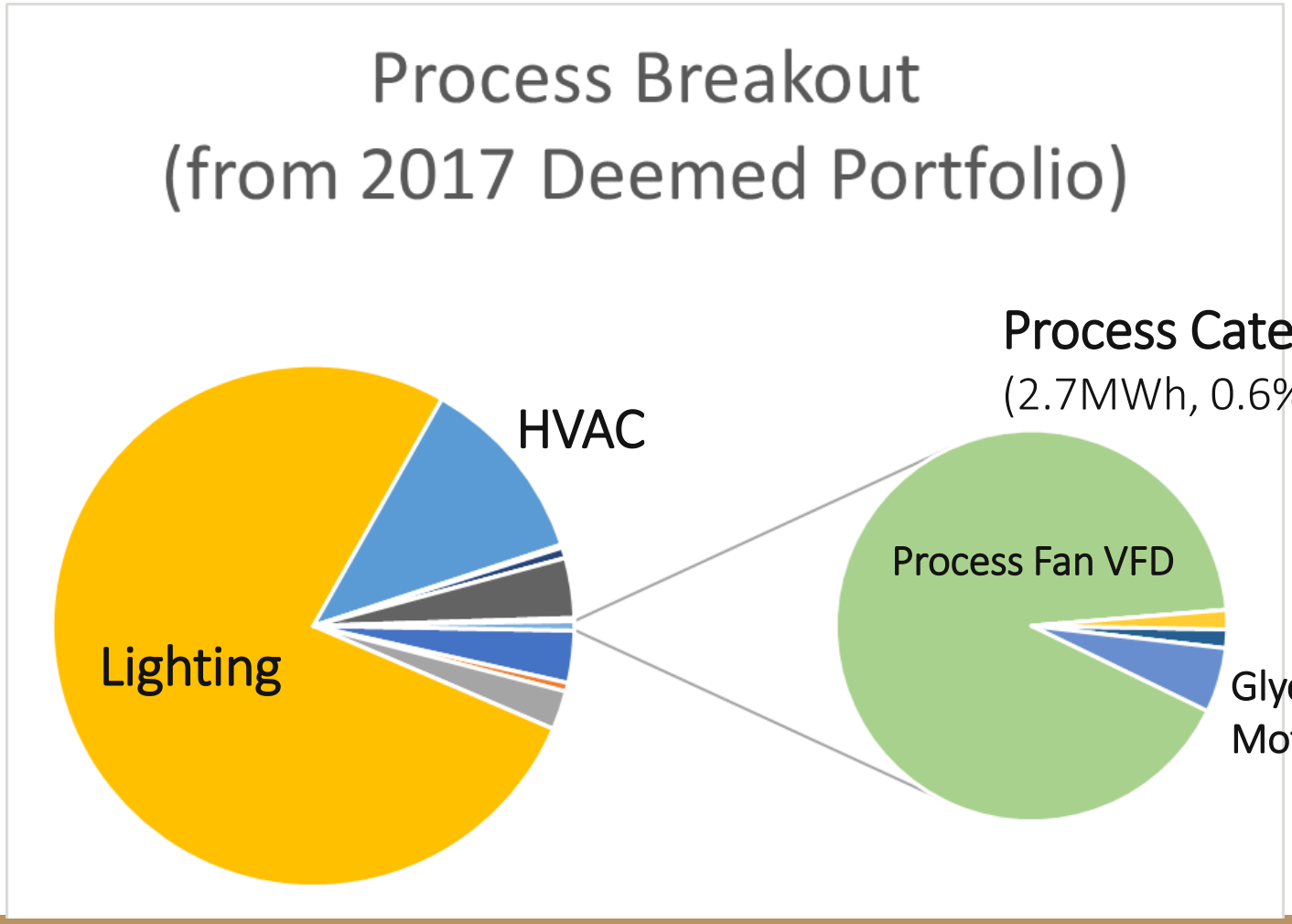
AYAD AL-SHAIKH

MAY 2018

2018 Schedule



Process Savings (Source – 2017 Q1-Q3, IOU Claims Data)



Process Savings (Source – 2017 Q1-Q3, IOU Claims Data)

CALIFORNIA TECHNICAL FORUM

		Gross kWh				Gross kW				Gross Therms			
Ref No	**Description**	**PG&E**	**SCE**	**SDG&E**	**SCG**	**PG&E**	**SCE**	**SDG&E**	**SCG**	**PG&E**	**SCE**	**SDG&E**	**SCG**
10.01	Industrial Blower Replacing Air Compressor		42,104				27.45				-		
10.02	Air Compressor VFD Retrofit		-				-				-		
10.03	Cycling Air Dryers for Compressed Air Systems												
10.04	Electronic Zero Air Loss Condensate Drains for												
10.05	Glycol Pump Motor VFD	145,917				-				-			
10.06	Process Fan VSD	2,332,736	158,425			1,345	91.37			-	-		
10.07	Motor Upgrade												
10.08	Commercial Steam Traps				-				-				8,806
10.09	Venturi/GEM Steam Trap												
10.10	Circulating Block Heater		43,753				5.46				-		
10.11	Boiler Cleaning												
10.12	Process, Head Pressure Controls												
10.13	Process, Suction Pressure Controls												

Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Offering
  - SCE workpaper (SCE13PR006.3) – minimal savings in 2017
  - Existing system
    - Rotary screw compressor, 25-500 HP
  - Proposed system
    - Low pressure air application
    - Blower must be less than 50 HP
  - Electric only
  - Build Types:
    - Health/Medical - Hospital
    - Manufacturing - Bio/Tech
    - Manufacturing - Light Industrial
    - Retail - Single-Story Large
    - Office – Small (alternate for Clinic, Misc. Commercial, Transportation Communication Utilities)
- Stage 1 Issues
  - Offering:
    - Should Industrial analysis also be included (not currently)?
  - Savings
    - BHP is used for normalizing savings. Assumes 100% load. Claims like per rated HP.
  - *Cost - TBD*
- Stage 2 Issues
  - *Any thoughts?*

Blue text = Changing and first time that item is mentioned
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Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Savings Methodology

Description	Light Ind	Industrial	Source
Base Case (kW/100acfm @100 psig)	18.1	18.1	AirMaster+ default for 100HP single-stage lubricant injected rotary screw at full load
Measure Case (kW/100acfm @100 psig)	2.94 (5 psig)	5.94 (10 psig)	Manufacturer data based upon operating pressure
Operating Hours (hrs/yr)	1,534 (a)	7,752 (b)	(a) 50% of Light Industrial DEER hours; (b) 8,760 hrs/yr – 6 wks maintenance

  - Savings normalized per blower HP. Typical value taken from the most commonly used sizes 7.5-15 HP (8.3 BHP, full load)
  - Demand savings assumes operation throughout the 2-5pm period
  - Savings not weather sensitive

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Measure Consensus - 10.02 Air Compressor VFD

- Offering
  - SCE workpaper (SCE17PR005.0 – Nov 2016) – no savings in 2017
    - SDG&E workpaper (WPSDGENRPR0001, Rev 0 – Aug 2014) – no savings in 2017
  - Existing system
    - Rotary screw compressor using load/unload controls with rated capacity between 5 and 25 HP
    - When multiple compressors are included in the base case, the base case operates as a trim compressor
  - Proposed system
    - Add a VFD to the existing compressor
  - Electric only
  - Compressor ranges: 5 to 15 HP, 15 to 25 HP
  - Build Type: (*include: Ag, Clinic, Industrial, Misc Commercial, Transportation – Communication – Utilities*)
    - Health/Medical - Hospital
    - Manufacturing - Bio/Tech
    - Manufacturing - Light Industrial
    - Retail - Single-Story Large
    - Office – small
- Stage 1 Issues
  - Offering:
    - Is this measure still offered due to Title 24 constraints?
    - Addition Building Types identified by SDG&E: *Ag, Clinic, Industrial, Misc Commercial, Transportation – Communication – Utilities*
  - Savings
    - Calculated using AIRMaster+ modeling
  - *Cost - TBD*
- Stage 2 Issues
  - *Any thoughts?*

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Measure Consensus - 10.02 Air Compressor VFD

- Savings – Key Assumptions in Models
  - Base Case
    - Compressors run at 70% of full load capacity.
    - Compressors are rated at 100 psig. 100 psig was chosen as a conservative assumption. System efficiency increases as operating pressure decreases.
    - System air storage volume is equivalent to 2 gallons per acfm of compressed air demand. This is based on the minimum storage capacity specified in the Title 24 (2016) compressed air standard.
    - Compressors typically run 24 hours per day, 7 days per week for 50 weeks per year (8400 annual operating hours). However, the kWh usage in this work paper was scaled to match the DEER defined operating hours for Manufacturing - Light Industrial buildings existing buildings in SCE Climate zones (Com-Indoor-LF lighting type, 2920 hours).
  - Measure Case
    - The measure case (VSD) compressor was assumed to have equivalent rated airflow at 100 psig to its respective base case (load/unload) compressor.
    - To account for the overhead power required to operate the added controls, the full load power of the VSD compressor was assumed to be 105% of the full load power of its respective load/unload compressor.
    - The no load power of the VSD compressor was assumed to be 5% of the full load power of the load/unload compressor.
    - The VSD compressor was assumed to unload at the same point (40% of full load capacity) as its respective load/unload compressor.
    - The power at the unload point (40% of rated capacity) of the VSD compressor was assumed to be 45% of the full load power of the load/unload compressor.

Measure Consensus - 10.05 Winery Glycol Pump VFD

- Offering
  - PG&E workpaper (PGE3PRO108, R2) – minimal savings in 2017
  - Existing system
    - Constant speed glycol pump for process cooling in a winery
  - Proposed system
    - VFD controls required
    - Not applicable for back-up pumps
  - Electric only
  - Pump sizes: 3, 5, 7.5, 10, 15, 20, and 25 HP
  - Build Type:
    - Wineries
- Stage 1 Issues
  - Offering:
    - Can this be extended to other building types based upon data (alternative hours of operation)?
  - Savings
    - Based upon typical winery project data
    - Should savings be normalized to “per HP” to be more consistent with other measures?
  - *Cost - TBD*
- Stage 2 Issues
  - *Any thoughts?*

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Measure Consensus - 10.05 Winery Glycol Pump VFD

- Savings Methodology

Description	Base	Measure	Source
Rated HP	3 – 25 HP	3 – 25 HP	Typical rated HP values for glycol pumps
Motor Efficiency (%)	Varies with rated HP	Varies with rated HP	EPAct 1992 values, Subtype II, Enclosed, 4-pole, 1800 rpm (Statewide manual, App C)
Motor Load (%)	80%	80%	Typical Load
Operating Hours (hrs/yr)	8,413 (a)	1,773 (100%) 6,639 (70%)	(a) Average value from 19 projects; (b) Total hours match base case; reduced speed operating hours from 19 projects.

- Typical proposed motor load taken from 18 typical winery sites
  - 70% speed represents average speed plus one standard deviation to be conservative since significant variation exists from site to site
- Proposed power uses affinity relationships
  - Uses exponent reduced to 2
  - Power (measure) = Power (base) * (70% / 100%)$^{2.0}$

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Measure Consensus - 10.06 Process Fan VFD

- Offering
  - SCE workpaper (SCE17PR008.1 – Oct 2016)
    - Short Forms (PGECOPRO110, R2 – June 2017 and WPSDGENRPR0004, Rev1 – Oct 2017)
  - Existing system
    - May be used for exhaust, ventilation, pressurization, or other process applications.
    - May not be used for air compressor systems, HVAC or refrigeration.
  - Proposed system
    - VFD controls required
    - Not applicable for back-up pumps
  - Electric only
  - Fan sizes:
    - 3 to 5HP (SCE and SDG&E)
    - >5 to 75HP Fan (all IOUs)
  - Build Types:
    - Manufacturing - Bio/Tech
    - Manufacturing - Light Industrial
- Stage 1 Issues
  - Offering:
    - Should the “3 to 5 HP” bin be offered? The text in the workpaper states that SCE and SDG&E were not offering this smaller HP bin.
  - Disposition from 3/2/17:
    - Document range of applications (including type of process, type of fan, operating hours with control type, and other parameters used in custom input tool
    - Split savings into at least two bins (to account for non-linear savings (between Rated-HP and kWh/yr)
  - *Cost - TBD*

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Measure Consensus - 10.06 Process Fan VFD

- Savings

Site Characteristics

Fan System Name	F10_70%	Location/City	Los Angeles CO (Los Angeles)
Fan System Type	Centrifugal	Exhaust Fan?	No
Number of Fans	1		

System Design Conditions @ Maximum Flow

Estimate Ambient Air Teperature?	No	Inlet Air Temperature	85.0 °F
System Design (Max) Flow	6410 CFM	Sys. Total Static Press. @ Max Flow	5.0 "Wg

Fan Operating Information

Number of Operating Modes	1	Operating Hour Input	Yearly
Annual Operating Hours	3372		

	Description	On-Peak?	Average Oper. Data	Hours/Year
1	D3	True	4487	3372

Operating Days Per Month

Operating Hours Per Day

Variable Speed Drive Installation

Full Load Efficiency	96%	Minimum Operating Speed	50%

Measure Consensus - 10.06 Process Fan VFD

- Fan Detail

Existing Equipment Specification

Fan #1 Nameplate Data

Fan ID	F3	Manufacturer	M3
Model	M3	Serial Num	S3
Fan Type	Centrifugal Airfoil DIDW	Control Type	Centrifugal On/Off
Drive Type	Std. V-Belt Drive		

Fan Performance (Design)

Fan Speed	1800 rpm	Flow	6410 cfm
Total Static Pressure	5 "Wg	Static Efficiency	64 %

Fan Drive Motor Information

Manufacturer		Model	
Size (HP)	10	Speed (RPM)	1800
Service Factor	1.15	FL Speed	1790
Enclosure	ODP	NEMA Nominal Efficiency	89.5 %

Proposed Equipment Specification

Fan #1 Nameplate Data

Fan ID	F3	Manufacturer	M3
Model	M3	Serial Num	S3
Fan Type	Centrifugal Airfoil DIDW	Control Type	Centrifugal Variable Speed Drive
Drive Type	Std. V-Belt Drive		

Measure Consensus - 10.08 Commercial Steam Traps

- Offering
  - SCG workpaper (SCGWP100310A, R9 – Aug 2011) – minimal savings in 2017
    - Short Forms (WPSDGENRWH0010, Rev2 – Oct 2016)
  - Existing system
    - Commercial steam trap, 12-24 hrs/day
    - Replacement of steam trap that has failed in either leaking or blow-through mode (ie, not blocked)
  - Proposed system
    - New steam trap or new steam trap “capsule”
  - Gas only
  - Build Types:
    - Large educational facilities, correctional facilities, general medical hospitals, surgical hospitals, agricultural facilities, industrial launderers, tele-production and other postproduction services, and transportation equipment suppliers
- Stage 1 Issues
  - Offering:
    - Changing Installation Type to ROB (consistent with SDG&E Short Form)
  - Energy Savings
    - Review 2011 Disposition values to ensure reasonable
  - *Cost – TBD*
- Stage 2 Issues
  - *TBD*

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Measure Consensus - 10.08 Commercial Steam Traps

- Savings

Parameter	Value
Average steam trap inlet pressure (psig)	35.5
Average heat of evaporation of steam produced (Btu/lb)	924
Average installed boiler efficiency	80%
Boiler energy required to replace lost steam (Btu/lb)	1,155
Annual operating hours	4,380
Average percentage of leaking & blow-thru steam traps	16%
Average leak rate (lb/hr per trap rebated)	13.6
Annual gas savings (therms/year per trap rebated)	687

Measure Description	Gross per Trap Savings (th/yr)
Steam Trap Replacement – Large Commercial 12-24 hr/day [A]	687
Combined Adjustment Factor (CAF)	21.4%
Failed Adjustment Factor (FAF)	81%
Steam Trap Replacement – Large Commercial 12-24 hr/day	**119**

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Measure Consensus - 10.08 Commercial Steam Traps

- Savings
  - Savings factors
    - Pressure factor - The inlet pressure of a steam trap is greatly reduced due to the effect of a control valve which is between the steam line pressure and the steam trap.
    - Load factor - The hours that the trap is leaking steam are often less than the steam system operating hours.

Service	Population (%) *	Load Factor (%) **	Pressure Factor (%) *	Combined Factor (%)
Line	25%	32%	100%	8.0%
Load	75%	32%	56%	13.4%
Combined Adjustment Factor (CAF) for Line and Load Traps				**21.4%**

* Disposition value

** Conservative value based on the range of operation from Process Boiler workpaper

    - Failed Adjustment Factor - Steam traps that were replaced within this program but were mistakenly identified as meeting the failure eligibility requirements, i.e., instead of being failing open (leaking or blowing through), the trap was failed closed (blocked).
      - From SoCal study: 27.7% failed open; 6.3% failed closed.
      - Therefore, Failed Adj Factor = 27.7 / (27.7+6.3) = **81%**

Measure Consensus - 10.10 Circulating Block Heater

- Offering
  - SCE workpaper (SCE13HC055, R0 – Sept 2014) – minimal savings in 2017
    - Short Forms (WPSDGENRWH0010, Rev2 – Oct 2016) – no savings for SDG&E or PG&E
  - Existing system
    - Thermo-siphon heater on a back-up diesel generator
  - Proposed system
    - Circulating block heater, which includes a circulating pump and electric heater assembly
  - Electric only
  - 4 Sizes of Generators; Under-Sized/Properly-Size Existing Heaters; ROB / NC
    - Does not vary by Building Type or ROB / NEW
- Stage 1 Issues
  - CalTF reviewed measure (from 2014)
  - Savings
    - Only SCE Climate Zones included
  - *Cost – TBD*
- Stage 2 Issues
  - *TBD*

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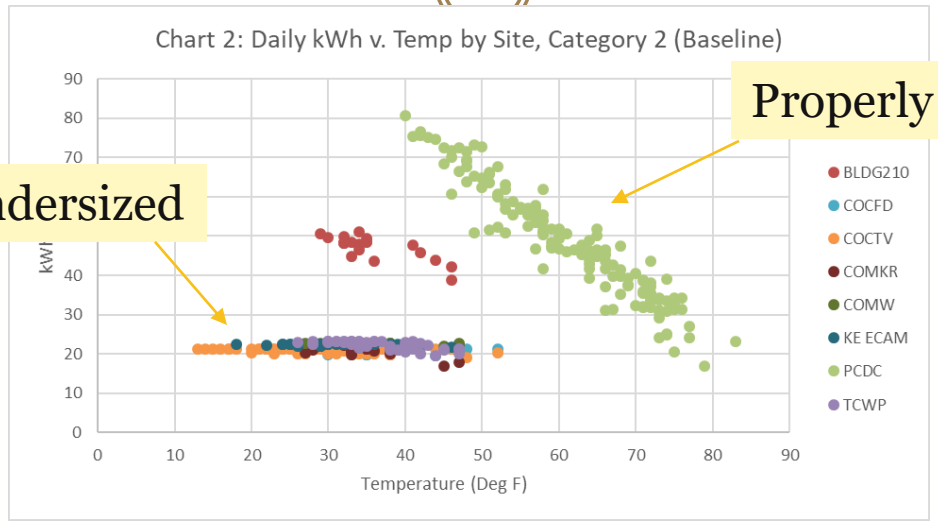
Measure Consensus - 10.10 Circulating Block Heater

- Savings



Site Size Category	Regression Coefficients	
	Intercept	Temp.
1	105.91	-1.178
2	88.92	-0.701
3	139.85	-0.932

Site Size Category	Regression Coefficients		
	Intercept	Heater Size	Heater Size * Temp.
1	3.70	13.135	-0.136
2	5.86	13.195	-0.133
3	10.26	16.688	-0.179
4	*229.52*	*0*	*-2.577*

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Measure Consensus - 10.10 Circulating Block Heater

- Savings

Savings Estimation Sample Calculation[5]:

Sample 1: Climate Zone 6, site size category 1, baseline heater size 1 kW, new heater size 1 kW, annual operation 334 days / year.

- Designation: Undersized
- Annual Average Temperature: 61.5°F
- Baseline Daily kWh: 20.2 * [Baseline Heater Size] = 20.2 kWh / day.
- Treatment Daily kWh: 3.70 + 13.135 * [New Heater Size] – 0.136 * [New Heater Size] * [61.5°F] = 8.4 kWh / day
- Annual Savings: (20.2 kWh/day – 8.4 kWh/day) * 334 days/year = **3,928 kWh/year.**

Sample 2: Climate Zone 8, site size category 3, baseline heater size 6 kW, new heater size 6 kW, annual operation 334 days / year.

- Designation: Proper-sized
- Annual Average Temperature: 63.4°F
- Baseline Daily kWh: 139.85 – 0.932 * [63.4°F] = 80.8 kWh / day.
- Treatment Daily kWh: 10.26 + 16.688 * [New Heater Size] – 0.179 * [New Heater Size] * [63.4°F] = 42.1 kWh / day
- Annual Savings: (80.8 kWh/day – 42.1 kWh/day) * 334 days/year = 12,908 kWh/year.

Questions…

- Plans for next meeting
- Other measures
  - Industrial Steam Traps
  - Industrial Floating Head / Suction Controls