Process Subcommittee Meeting #4

CALIFORNIA
TECHNICAL FORUM

AYAD AL-SHAIKH

JULY 2018

Agenda

- Measure Re-Review
  - 10.02 - Air Compressor VFD Retrofit
    - Building Type
    - Hours of Operation – SCE support
  - 10.08 - Commercial Steam Traps
    - Measure application type
    - Calculation methodology
  - 10.05 - Glycol Pump Motor VFD
    - Building type
    - Loop parameter
  - 10.01 - Industrial Blower Replacing Air Compressor
    - Decide about measure application type
    - Get next step on negative incremental cost issue
    - Decide on Early Retirement Cost approach
  - Hours of Operation
  - PG&E – Other Opportunities (Patrick Moore/PG&E)

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
    - Install a new air compressor with a VFD
  - Electric only
  - Compressor ranges: 5 to 15 HP, 15 to 25 HP
  - Build Type: 5 types (Hsp, MBT, MLI, OfS, RtL)
    - Health/Medical – Hospital (HSP); Manufacturing - Bio/Tech (MBT); Manufacturing - Light Industrial (MLI); Retail - Single-Story Large (RtL); Office – small (OfS)

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Measure Consensus - 10.02 Air Compressor VFD

- Stage 1 Issues
  - Offering
    - Reclassify this Measure as ROB, NC because a new air compressor would be required; load/unload components are fundamentally different. (This was an REA measure.)
  - Savings
    - Calculated using AIRMaster+ modeling (with 8,400 hrs/yr)
    - Savings scaled based upon DEER building type hours, two approaches:
      - "Any" vs Building Specific – Building specific values will be included
      - DEER hours need to be updated
    - Interactive effects will be removed since not installed in conditioned spaces
  - Cost
    - Material cost – web search (Load/Unload Screw Compressor vs VSD Screw)
    - Labor cost - RS Means 2016
- Stage 2 Issues / Measure Extension
  - *Consider "to code" measure for >25 hp*

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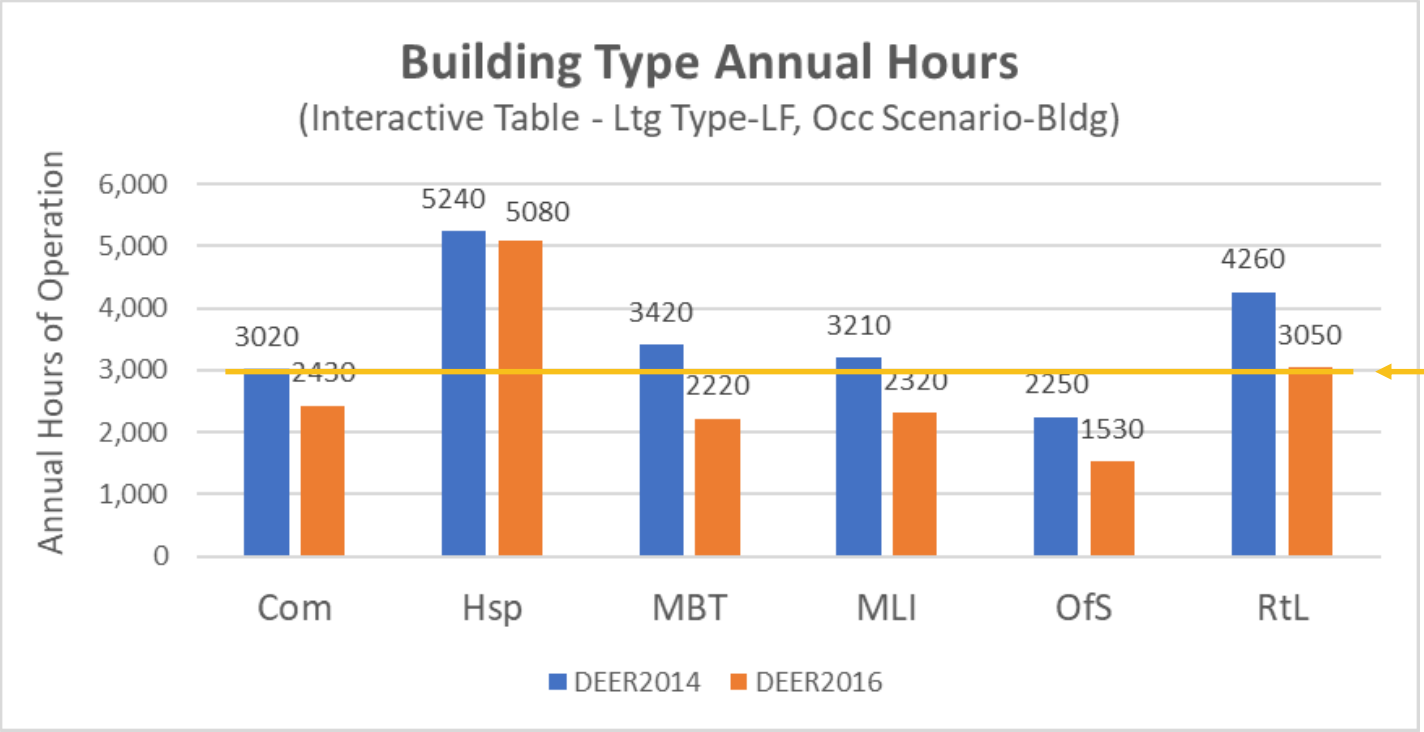
Measure Consensus - 10.02 Air Compressor VFD

- Savings
  - Savings scaled based upon DEER building type hours, two approaches:
    - "Any" vs Building Specific – Building specific values will be included
    - Using specific building type hours (Hsp, MBT, MLI, OfS, RtL)
    - DEER hours need to be confirmed (by IOUs)



Previous SCE workpaper used 2,920 hrs/yr

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Input Consensus - 10.02 Air Compressor VFD

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	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	Hsp,MBT,MLI,OfS,RtL	No Value	Any,Hsp,MBT,MLI,OfS,RtL	Com,Hsp,MBT,MLI,RtL	No Value
BldgVintage	Any	No Value	Any	Ex	No Value
BldgLoc	Any	No Value	Any,CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	CZ06,CZ07,CZ08,CZ10,CZ14,CZ15	No Value
BldgHVAC	Any	No Value	Any	Any	No Value

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	ROB, NC	No Value	REA,RobNc	No Value	No Value
NormUnit	Rated-HP	No Value	Rated-HP	Rated-HP	No Value
EUL ID	CompAir-Screw-VSD	No Value	CompAir-Screw-VSD	HVAC-VSDSupFan	No Value
RUL ID	CompAir-Screw-VSD	No Value	CompAir-Screw-VSD	No Value	No Value
NTGR	Com-Default>2yrs Ind-Default>2yrs Ag-Default>2yrs	No Value	Com-Default>2yrs Ind-Default>2yrs	No Value	No Value
DeliveryType	PreRebDown	No Value	PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	Def-GSIA	No Value	No Value

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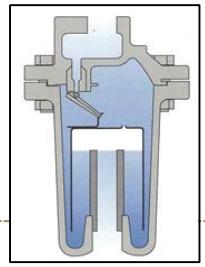
Measure Consensus - 10.08 Commercial Steam Traps



- 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
- Measure Extension
  - PG&E is planning to adopt this Measure.

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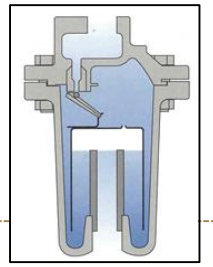
Measure Consensus - 10.08 Commercial Steam Traps



- Stage 1 Issues
  - Measure Application Type
    - *ROB (SDG&E approach)*
      - *Replaced at failure but bringing trap back to original functional level*
      - *Costs is given per trap now; What would IMC be?*
    - *ER (SCG approach)*
      - *Typically replace large group of traps through a survey; methodology accounts for portion that are not leaking/blow-thru (19%)*
      - *What would second baseline be? (Depends upon Code/Standard Practice)*
  - Energy Savings
    - Review 2011 Disposition values to ensure reasonable
      - Confirm that there is consensus / agreement with the “Adjustment Factors”
    - 2016 Disposition seems to refer specifically to Industrial Steam Traps – Get feedback from team
  - Cost – based upon survey data

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Measure Consensus - 10.08 Commercial Steam Traps

- Offering
  - Cost – Using SCG approach ($223 / trap)
    - SCG: Based upon a weighted average of cost for various categories (>15 psig):
      - Vendor conversations (Enbridge, 2005)
      - Enbridge Survey
    - SDG&E: $233.00 ($77.78 – materials + average DI contract labor)

Type of Steam Trap		Pressure (psig)						
	15	30	75	125	150	180	200	250
Float & Thermostatic								
3/4 inch	$127	$150	$203	$207	$454	$454	$454	---
1 1/2 inch	$258	$314	$352	$352	---	---	---	---
Average	***$193***	***$232***	***$278***	***$280***	***$454***	***$454***	***$454***	---
Other								
Inverted bucket	$82	$82	$82	$82	$105	$105	$105	$105
1/2 inch thermodynamic	$185	$185	$185	$185	$185	$185	$185	$185
3/4 inch thermodynamic	$235	$235	$235	$235	$235	$235	$235	$235
Average	***$167***	***$167***	***$167***	***$167***	***$175***	***$175***	***$175***	***$175***
Average	$180	$200	$222	$223	$315	$315	$315	$175

Parameters		Pressure (psig)						
	15	30	75	125	150	180	200	250
Number of Leaking Traps	1,539	171	235	264	54	0	2	26
Total Replacement Cost	$276,892	$34,143	$52,268	$58,982	$16,983	$0	$629	$4,550
Average Cost per Trap	**$180**	**$223**						

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Measure Consensus - 10.08 Commercial Steam Traps

- Savings
  - See Excel calculation
    - Consider calculated approach vs study average result

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Input Consensus - 10.08 Commercial Steam Traps

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	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	Com	No Value	No Value	Com	Com
BldgVintage	Any	No Value	No Value	Ex	Any
BldgLoc	Any	No Value	No Value	Any	IOU
BldgHVAC	Any	No Value	No Value	Any	Any

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	ROB	No Value	No Value	ROB	RET
NormUnit	Each	No Value	No Value	Each	Each
EUL ID	PrcHt-StmTrp	No Value	No Value	HVAC-StmTrp	PrcHt-StmTrp
RUL ID	n/a	No Value	No Value	No Value	No Value
NTGR	NonRes-sAll-mStmTrp-dn	No Value	No Value	Com-Default>2yrs	NonRes-sAll-mStmTrp-dn
DeliveryType	PreRebDown	No Value	No Value	PreRebDown	PreRebDown
GSIA	Def-GSIA	No Value	No Value	No Value	No Value

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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
    - Winery specific
    - Updated from Manufacturing Light (MLI) to Vineyards and Processing (VPr) – Ask PG&E to verify (intended to match winery building type

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Measure Consensus - 10.05 Winery Glycol Pump VFD

- Stage 1 Issues
  - Offering:
    - Decided not to consider for other building types
    - Updated existing building type to match Ag sector
  - Savings
    - Based upon typical winery project data
    - Considered changing normalized units to “per HP”
      - Decided not to change the Norm Units to “per HP” because cost variation too large
      - Both savings (5-10%) and cost (50-100%) vary at lower HP range
    - *Follow-up questions:*
      - *Is there a recommendation on how the typical winery system relates to the Closed Loop System Guidance Document*
  - Cost
    - RS Means 2016 (material, labor and mark-up)
- Stage 2 Issues
  - *Document that the speed of the pump is tied to the refrigeration load*

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Measure Consensus - 10.05 Winery Glycol Pump VFD

- Proposed power uses affinity relationships
  - Power (measure) = Power (base) * (70% / 100%)$^{2.0}$

For Systems of Fixed Geometry

	Air/Water Loop is:		
	Fully or Mostly Closed	Semi-Closed	Mostly or Fully Open
Fixed Geometry	2.4	2.2	2.0

For Systems of Variable Geometry

	The Pressure Setpoint is this percent of the Total Static Pressure at Maximum Flow			
	20% or Less	Greater than 20%, Less than 50%	Greater than 50%, Less than 80%	80% or More
Constant Pressure Setpoint	2.4	2.0	1.5	1.0
Variable Pressure Setpoint	2.4			

  - *Source: "Data Center Baseline" document (see page 59 of 61) – no deeper reference found*

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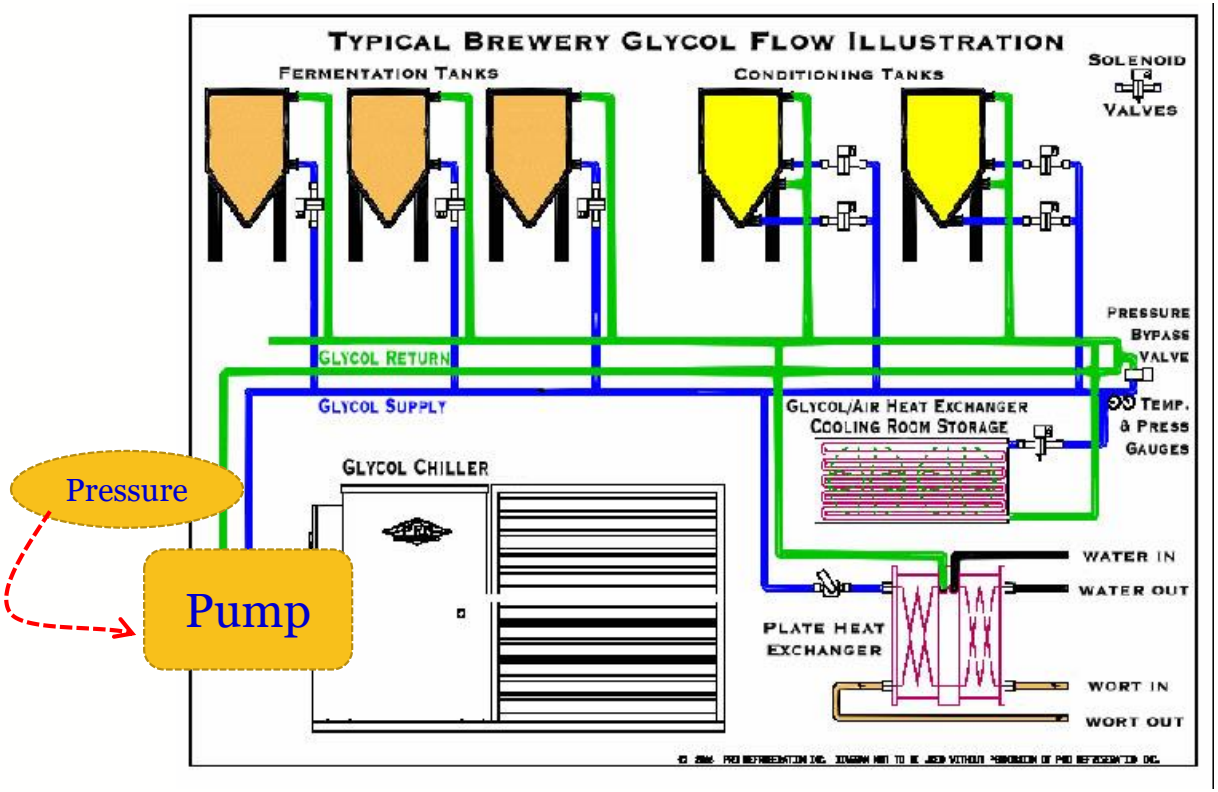
Measure Consensus - 10.05 Winery Glycol Pump VFD

- Proposed power uses affinity relationships
  - Power (measure) = Power (base) * (70% / 100%)$^{1.0}$



Sensor located close to pump

- Friction losses accounted for in controls are small
- Power vs Pressure is close to linear

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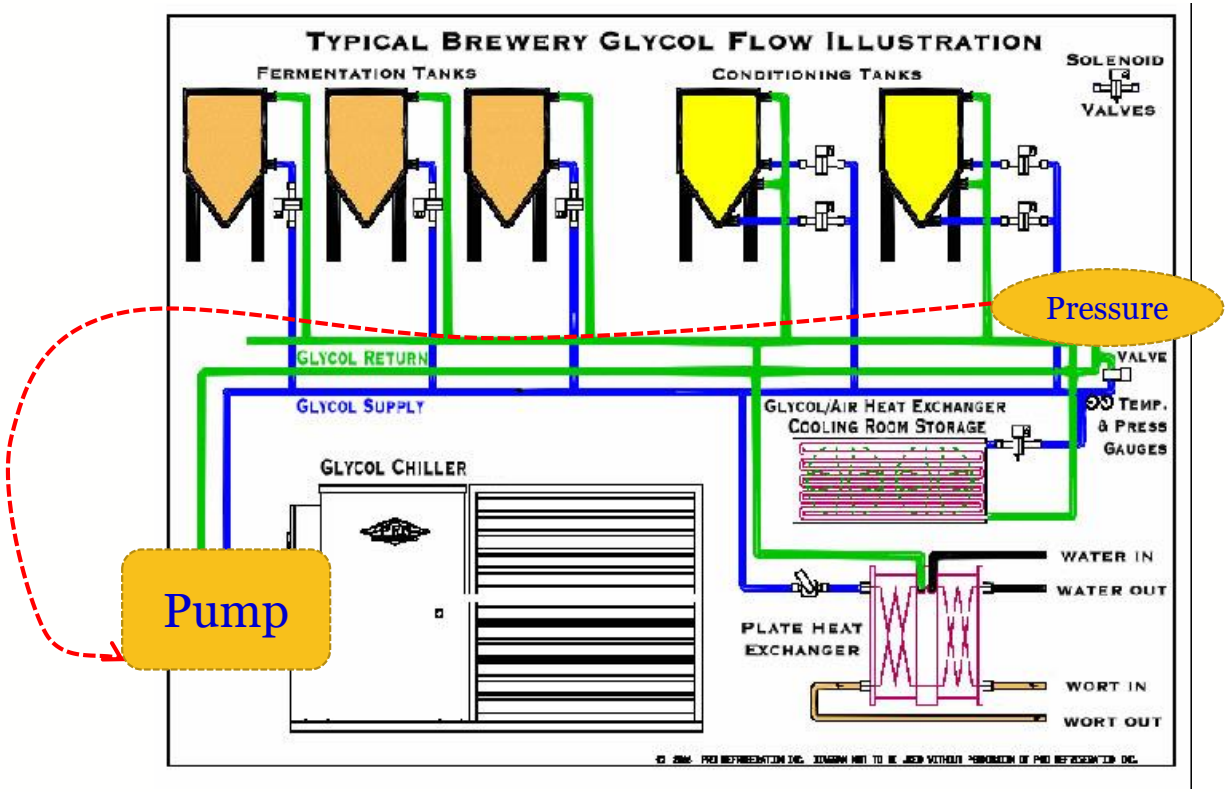
Measure Consensus - 10.05 Winery Glycol Pump VFD

- Proposed power uses affinity relationships
  - Power (measure) = Power (base) * (70% / 100%)$^{2.4}$



Sensor far from pump

- Friction losses accounted for in controls are high
- Power vs Pressure is closer to ideal

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Input Consensus - 10.05 Winery Glycol Pump VFD

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	VPr	MLI	No Value	No Value	No Value
BldgVintage	Ex	Ex	No Value	No Value	No Value
BldgLoc	Any	Any	No Value	No Value	No Value
BldgHVAC	cUnc	cUnc	No Value	No Value	No Value

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA	REA	No Value	No Value	No Value
NormUnit	Each	Each	No Value	No Value	No Value
EUL ID	HVAC-VSD-pump	HVAC-VSD-pump	No Value	No Value	No Value
RUL ID	Motors-Pump (1/3 of pump EUL)	HVAC-VSD-pump	No Value	No Value	No Value
NTGR	Ag-Default>2yrs	Ind-Default>2yrs	No Value	No Value	No Value
DeliveryType	PreRebDown	PreRebDown	No Value	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	No Value	No Value	No Value

VPr – Vineyards and Processing (Ag Sector)

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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
  - Negative incremental measure cost (IMC) – see next page.
  - 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*

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Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Stage 1 Issues
  - Negative incremental measure cost (IMC); From Resolution E-4818
    - What should the Measure Application Type be?
    - Do we agree to use the Early Retirement calculation?
      - Concern that using one Discount Rate (D) would lead to slight inconsistencies in cost effectiveness calculator. Is this a concern?

$$\mathbf{ERC = FMC - \frac{(FMC - IMC)}{(1+D)^{RUL}}}$$

      - What is passed to the calculator?
    - Next step?

Early Retirement Cost (ERC) is the total cost incurred to install the energy efficiency measure reduced by the net present value of the total cost that would have been incurred to install an ISP measure at the end of the remaining useful life period. This cost is considered for Early Retirement

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Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Stage 1 Issues
  - Negative incremental measure cost (IMC); From Resolution E-4818:

> "An Add-on Equipment (AOE) measure installs new equipment onto an existing host improving the nominal efficiency of the host system. The existing host system must be operational without the AOE, continue to operate as the primary service equipment for the existing load, and is able to fully meet the existing load at all times without the add-on component.
>
> *The AOE must not be able to operate on its own*[12]. The actual energy reduction occurs at the host equipment, not at the add-on component, although any add-on component energy usage must be subtracted from the host savings"

Our decision not to authorize pony measures as add-on equipment leaves certain types of optimization measures without a clear alteration type classification. Currently these are treated with either normal or accelerated replacement baselines, which does not fit well since no equipment is removed or replaced at the time of installation. In the future it may be worth exploring whether a new category would serve these measure types better.

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Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Stage 1 Issues
  - Negative incremental measure cost (IMC); From Resolution E-4818
    - Therefore, this is not an AOE (Add-On Equipment) measure because it can operate on its own.
    - If this is an ROB / NR (Normal Replacement)
      - Base case cost: New Air Compressor
      - Measure case cost: New Blower
      - Therefore, this creates a negative IMC
    - If this is an ER / AR (Accelerated Replacement)
      - Base case cost: n/a
      - Measure case cost: New Blower
      - POE would be required – Is this an option to proceed?

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Measure Consensus - 10.01 Industrial Blower Replacing Air Compressor

- Stage 1 Issues
  - Negative incremental measure cost (IMC); From Resolution E-4818
    - If this is an ER / AR (Accelerated Replacement)
      - Base case cost: n/a
      - Measure case cost: New Blower
      - POE would be required – Is this an option to proceed?

Early Retirement Cost (ERC) is the total cost incurred to install the energy efficiency measure reduced by the net present value of the total cost that would have been incurred to install an ISP measure at the end of the remaining useful life period. This cost is considered for Early Retirement Measures only. D = Discount Rate (fixed per PA); RUL = Remaining Useful Life, in years, of Existing Equipment.

$$\mathbf{ERC = FMC - \frac{(FMC - IMC)}{(1+D)^{RUL}}}$$

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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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Hour of Operation

- One shift
  - 9 hrs per day x 5 days per week x 51 weeks per year
- Two shifts
  - 17 hrs per day x 5 days per week x 51 weeks per year
- Three shifts
  - 24 hrs per day x 5 days per week x 51 weeks per year +
  - 51 hours (for start-up/shut-down)
- 24/7
  - 24 hrs per day x 7 days per week x 51 weeks per year

- Basis
  - 8 hours per shift plus 1 hour total for startup and shutdown
  - One week per year for maintenance and/or holidays

Others Measures

- Patrick Moore
  - Ag fan VFD
  - Others?
- Hours of Operation

Questions…