Agriculture / Pumping
Cal TF Tier 1 Presentation

CALIFORNIA
TECHNICAL FORUM

AYAD AL-SHAIKH

OCTOBER 2017

Measure Overview – From April

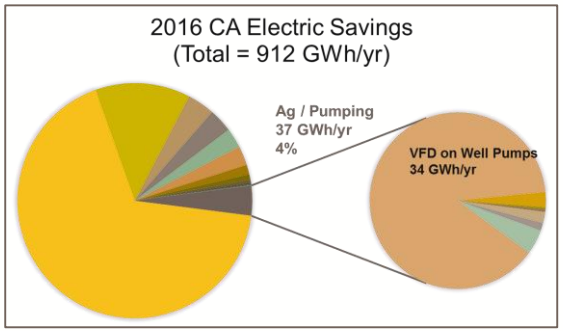
No.	Measure Names	Plan	PG&E	SCE	SDG&E	SCG	POU
3.01	Agricultural Pump System Overhaul	2017					
3.02	Agricultural Ventilation Fans	2017					
3.03	Farm Sprinkler to Micro Irrigation Conversion	2017					
3.04	Low Pressure Sprinkler Nozzles	2017					
3.05	Variable Frequency Drive on Agricultural Well Pumps	2017					
3.06	Milk Cooling Scroll Compressor	2018					
3.07	Vertical Hollow and Solid Shaft Pump Motors	2018					
3.08	CHR Unit - Electric and Gas	n/a					
3.09	Milk Vacuum Pump VSD	n/a					
3.10	Milk Transfer Pump VSD	n/a					
3.11	Chilled Glycol Pipe Insulation	n/a					
3.12	Glycol tank Insulation	n/a					
3.13	Milk Pre Cooler	n/a					

Measure Overview - Now

No.	Measure Names	Plan	PG&E	SCE	SDG&E	SCG	POU
3.01	Agricultural Pump System Overhaul	Disposition					
3.02	Agricultural Ventilation Fans	2017					
3.03	Farm Sprinkler to Micro Irrigation Conversion	Hold / Measure Revision					
3.04	Low Pressure Sprinkler Nozzles	Disposition					
3.05	Variable Frequency Drive on Agricultural Well Pumps	2017					
3.06	Milk Cooling Scroll Compressor	2018					
3.07	Vertical Hollow Shaft Pump Motors	Federal Code					
3.08	CHR Unit - Electric and Gas	n/a					
3.09	Milk Vacuum Pump VSD	n/a					
3.10	Milk Transfer Pump VSD	n/a					
3.11	Chilled Glycol Pipe Insulation	n/a					
3.12	Glycol tank Insulation	n/a					
3.13	Milk Pre Cooler	n/a					
3.14	Greenhouse - Heat Curtain	2018					
3.15	Greenhouse - Infrared Film	2018					
3.16	New Water Pump Upgrade	New Measure					

Measure Consensus
3.05 – VFD on Agricultural Well Pumps

- Offering
  - Well Pumps (<=300hp, <=600hp-Enhanced Spec), Booster Pumps (<=150hp)
  - Standard / Enhanced Spec
- Stage 1 Issues
  - Maintaining alignment with PG&E workpaper
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E (electric measures)
- Stage 2 Issues
  - *Including Enhanced Offering depends upon timing*
  - *Consider more sensitive variables to distinguish savings*
  - *Include opportunities to pump to open vessels*
  - *Documenting EUL for REA measure (next slide)*
    - *Waiting for 25-yr data set*
    - *We can use Cal TF Member help on improving the analysis*



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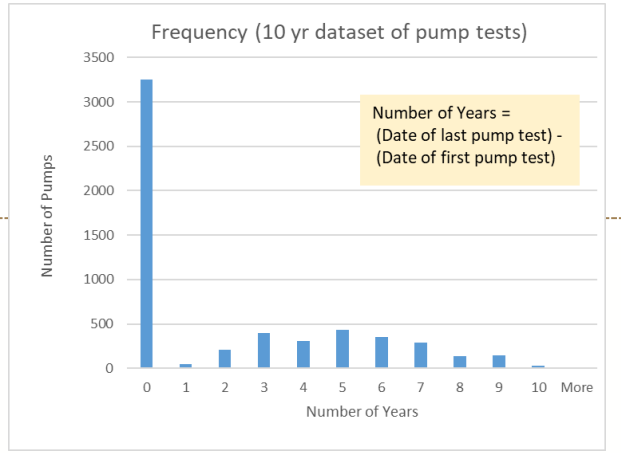
3.05 – VFD on Agricultural Well Pumps



- Current EUL
  - EUL (Agr-VSDWellPmp) = 10 years
  - EUL (Agr-VSDWellPmp) = 10 years (host)
    - 10 yrs comes from 1996-2002 study (old study)
    - 10 yrs represented time between overhauls not pump measure life
  - REA life = Minimum of (10 yrs, 10 yrs / 3) = 3.3 years
- Preliminary results from dataset
  - SCE Pump Test data set (10-yrs; 10,000 records, 5,500 pumps)
    - Life Analysis stated to determine if it is valuable to proceed
  - Note that this is a conservative result since the first pump test is not at the start of the pump life and the last pump test is not at the end of life
  - How can we improve the accuracy of this analysis?
    - Larger data set (SCE Pump Test data set (35+ yrs; 150,000 records/pumps)
- Potential TRC Impact
  - REA life = Minimum of (10 yrs, 30 yrs / 3) = 10 years
    - Change to EUL from 10 to 30 yrs due to SCE Ag Pump data; no policy change required
  - TRC would increase from ~1.0 to ~1.7

Input Consensus
3.05 – VFD on Agricultural Well Pumps

- Measure Permutations

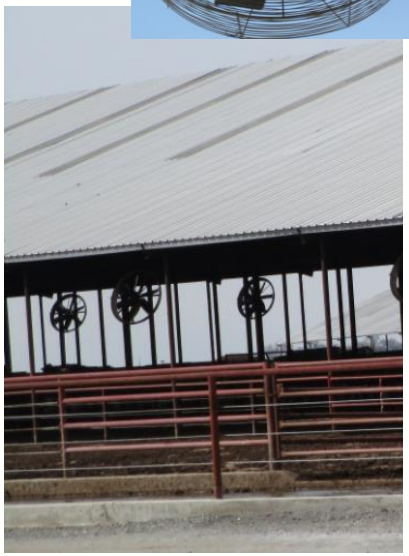
	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	Any	Any	Any	No Value	No Value
BldgVintage	Ex,New	Ex,New	Ex	No Value	No Value
BldgLoc	Any	Any	Any	No Value	No Value
BldgHVAC	Any	cUnc	Any	No Value	No Value

- Measure Implementation

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA,ROBNC	NC,REA	REA,ROBNC	No Value	No Value
NormUnit	Rated-HP	Rated-HP	HP	No Value	No Value
EUL ID	Agr-VSDWellPmp	Agr-VSDWellPmp	Agr-VSDWellPmp	No Value	No Value
NTGR	Agric-Default>2yrs	Agric-Default>2yrs	Agric-Default>2yrs	No Value	No Value
DeliveryType	DirInstall PreRebDown	DirInstall PreRebDown Any	DirInstall PreRebDown	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	Def-GSIA	No Value	No Value

Measure Consensus
3.02 – Agricultural Ventilation Fans

- Offering
  - Fan Size (24-26”, 36”, 48”) – like for like
  - Removing largest option (50-52”)
- Stage 1 Issues
  - Maintaining alignment with PG&E workpaper
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E (electric measure)
- Stage 2 Issues
  - *Consider adding larger fan options with VFDs*
  - *Consider adding new construction / added load*
  - *Consider other sensitive variables (Climate Zone, Setpoint Turn-On)*



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Input Consensus
3.02 – Agricultural Ventilation Fans

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	Any	Any	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	Any	cUnc	No Value	No Value	No Value

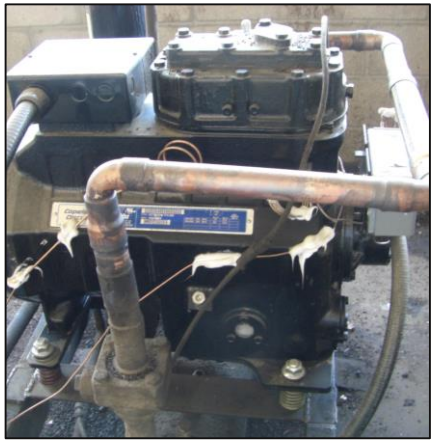
- Measure Implementation

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	ROB	ROB	No Value	No Value	No Value
NormUnit	Each	Each	No Value	No Value	No Value
EUL ID	Agr-VSDWellPmp	Agr-VSDWellPmp	No Value	No Value	No Value
NTGR	Agric-Default>2yrs	Agric-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

Measures for 2018

Measure Consensus - *2018*
3.06 – Milk Cooling Scroll Compressor

- Offering
  - Per Compressor
- Stage 1 Issues
  - *Clarifying savings calculation from evaluation study*
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E (electric measure)
- Stage 2 Issues
  - *Consider calculating savings per rated-hp*



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Input Consensus - *2018*
3.06 – Milk Cooling Scroll Compressor

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	Any	Any	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	Any	cWtd	No Value	No Value	No Value

- Measure Implementation

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	ROB	ROB	No Value	No Value	No Value
NormUnit	Each	Each	No Value	No Value	No Value
EUL ID	RefgWrhs-ScrollComp	RefgWrhs-ScrollComp	No Value	No Value	No Value
NTGR	Agric-Default>2yrs	Agric-Default>2yrs	No Value	No Value	No Value
DeliveryType	PreRebDown	PreRebDown	No Value	No Value	No Value
GSIA	No Value	No Value	No Value	No Value	No Value

Measure Consensus - *2018*

3.14 & 3.15 – Greenhouse Heat Curtain and IR Film

- Offering
  - Per square-foot
- Stage 1 Issues
  - *Based upon Dec 2014 Disposition, PG&E sunset their workpaper*
    - *DEER measures are still available*
  - *Key issue is appropriate Standard Practices for greenhouses*
    - *Current study from 2015 Navigant report*
    - *Staff has rejected report as insufficient*
  - *Work with Staff to create measure eligibility requirement to screen out free-riders*
- Stage 2 Issues
  - *Further discussions in subcommittee*

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Input Consensus - *2018*
3.14 – Greenhouse, Heat Curtain

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	AgOth, GHs, APF	No Value	No Value	AgOth, GHs	AgOth, GHs, APF
BldgVintage	Ex	No Value	No Value	Ex	Ex
BldgLoc	Any	No Value	No Value	No Value	No Value
BldgHVAC	aGF	No Value	No Value	aRH	aGF

- Measure Implementation

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA	No Value	No Value	RET	REA
NormUnit	Area-ft2	No Value	No Value	No Value	No Value
EUL ID	Agr-GHC	No Value	No Value	Agr-GHC	Agr-GHC
NTGR	NonRes-sGHS-mIRF-dn	No Value	No Value	NonRes-sGHS-mIRF-dn	NonRes-sGHS-mIRF-dn
DeliveryType	PreRebDown	No Value	No Value	PreRebDown	PreRebDown
GSIA	No Value	No Value	No Value	No Value	No Value

Input Consensus - *2018*
3.15 – Greenhouse, IR Film

- Measure Permutations

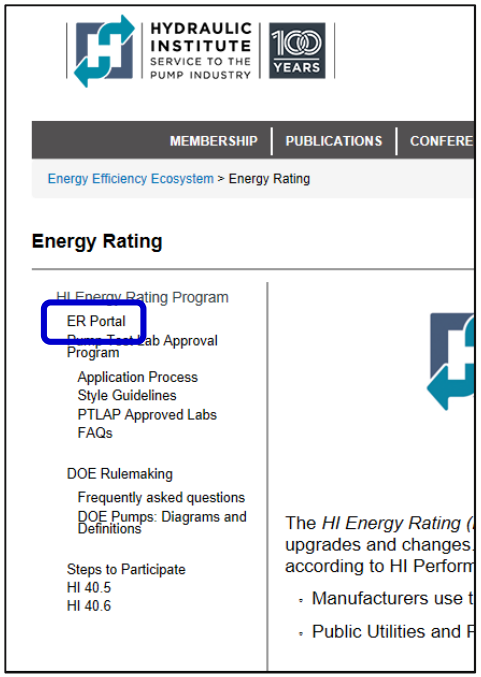
	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	AgOth, GHs, APF	No Value	No Value	AgOth, GHs	AgOth, GHs, APF
BldgVintage	Ex	No Value	No Value	Ex	Ex
BldgLoc	Any	No Value	No Value	No Value	No Value
BldgHVAC	aGF	No Value	No Value	aRH	aGF

- Measure Implementation

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA	No Value	No Value	RET	REA
NormUnit	Area-ft2	No Value	No Value	No Value	No Value
EUL ID	Agr-Irfilm	No Value	No Value	Agr-Irfilm	Agr-Irfilm
NTGR	NonRes-sGHS-mIRF-dn	No Value	No Value	NonRes-sGHS-mIRF-dn	NonRes-sGHS-mIRF-dn
DeliveryType	PreRebDown	No Value	No Value	PreRebDown	PreRebDown
GSIA	No Value	No Value	No Value	No Value	No Value

Measure Consensus - *2018*
3.16 – New Water Pump Upgrade

- Offering (created by PG&E)
  - Allowable HP range: 1 hp <= Rated HP <= 200 hp
    - Constant to constant (PEI, Pump Energy Index < 0.96)
    - Variable speed to variable speed (PEI < 0.49)
  - Intended for clean water pumps in:
    - Agricultural
    - Commercial
    - Industrial
  - Savings based upon approved RTF analysis
    - 5 pump types
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E (electric measure)



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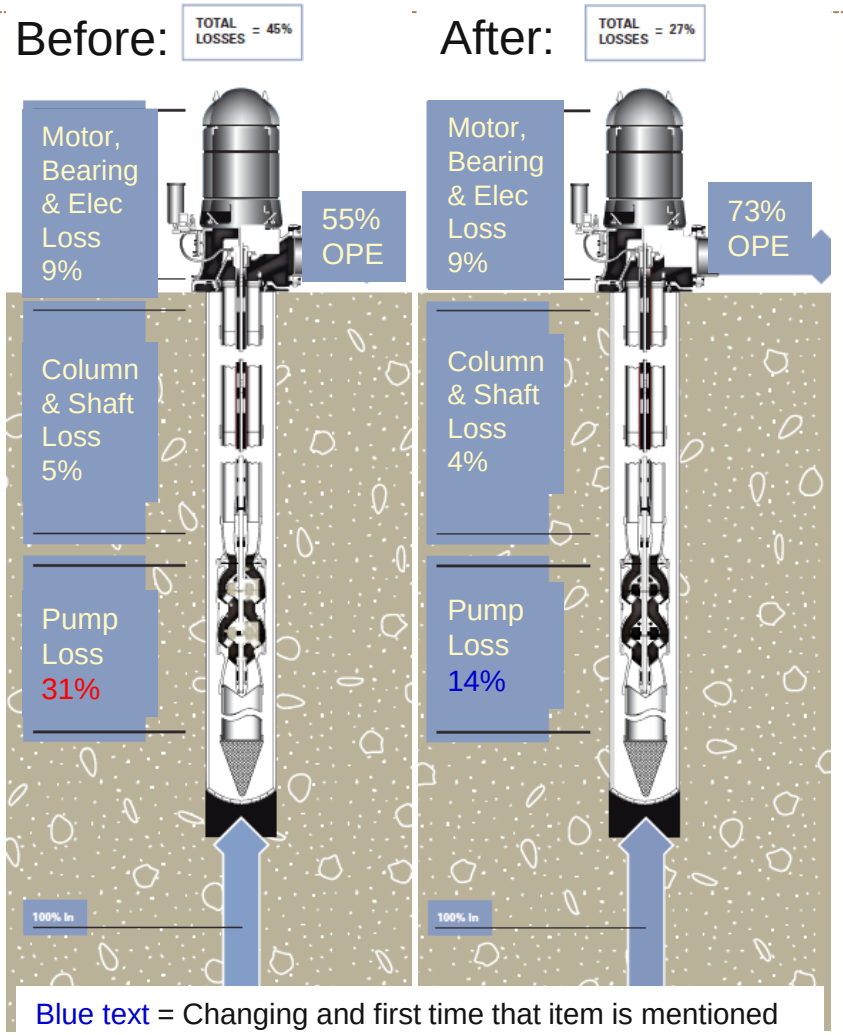
Measures on Hold

Measure Consensus - *Hold*
3.01 Agricultural Pump System Overhaul

17

- Offering
  - Pump size (<25 hp)
  - Varies by Pump Type (5 types)
  - Varies by Climate Zone (16 CZs)
- Stage 1 Issues
  - BRO measure agreed
  - *Peak Demand savings in question*
  - *Energy savings methodology in question*
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E
- Stage 2 Issues
  - *Improve accuracy of EUL*
  - *Consider hours of operation within permutations*
  - *Consider using Hydrological or Geological Zones*



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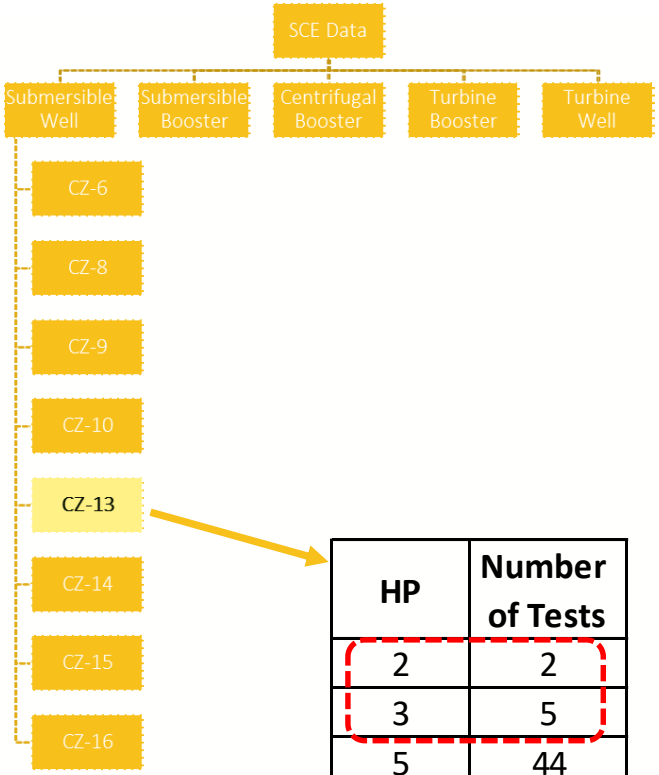
3.01 Agricultural Pump System Overhaul

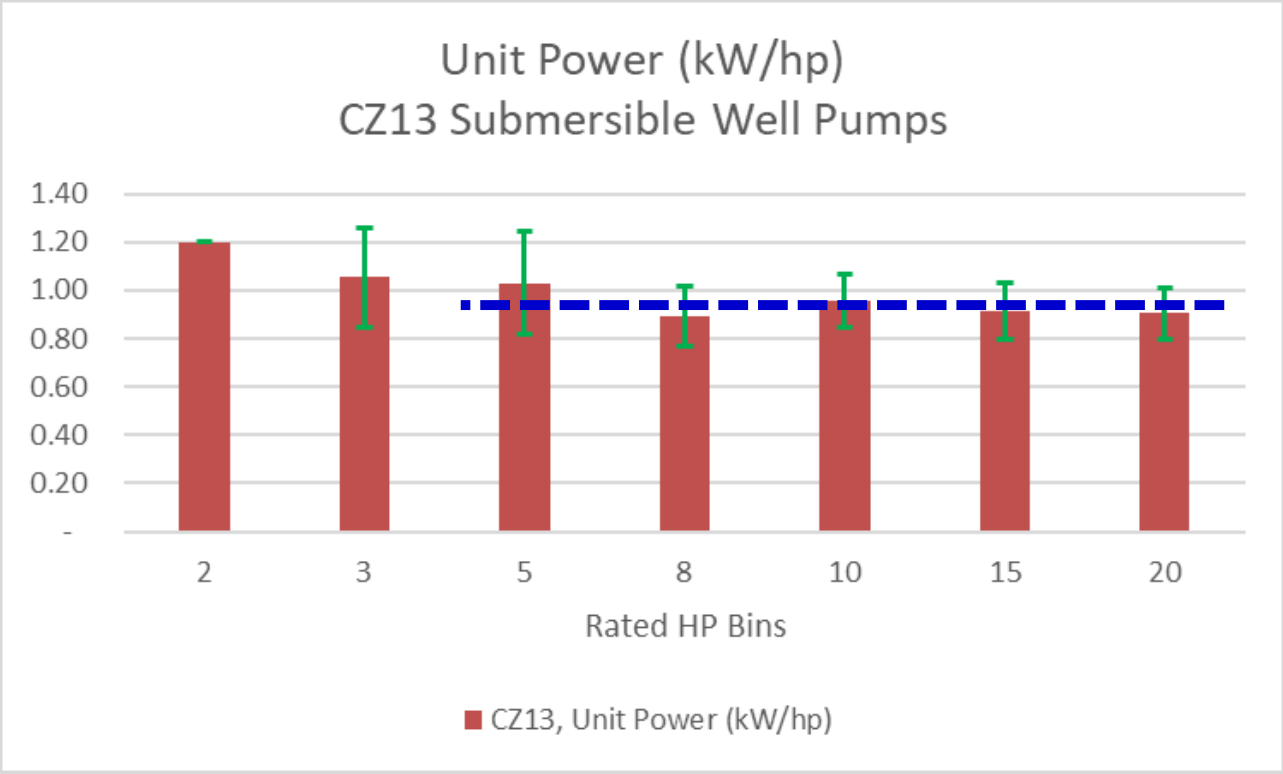
- Understanding variation
  - Existing data set (SCE, 3000+ records)
    - Savings = kW * OPE-Imp * HOU
  - Examine a subset of data to get a sense for what is occurring in the results:
    - Submersible Well pump
    - CZ13
    - Population of 729 tests
  - Because there are so few pump tests in the small pump sizes, I encourage you to ignore these bars on the following graphs



HP	Number of Tests
2	2
3	5
5	44
8	90
10	193
15	242
20	153
	729

3.01 Agricultural Pump System Overhaul

- Understanding variation
  - Existing data set (SCE)
    - Savings = kW * OPE-Imp * HOU



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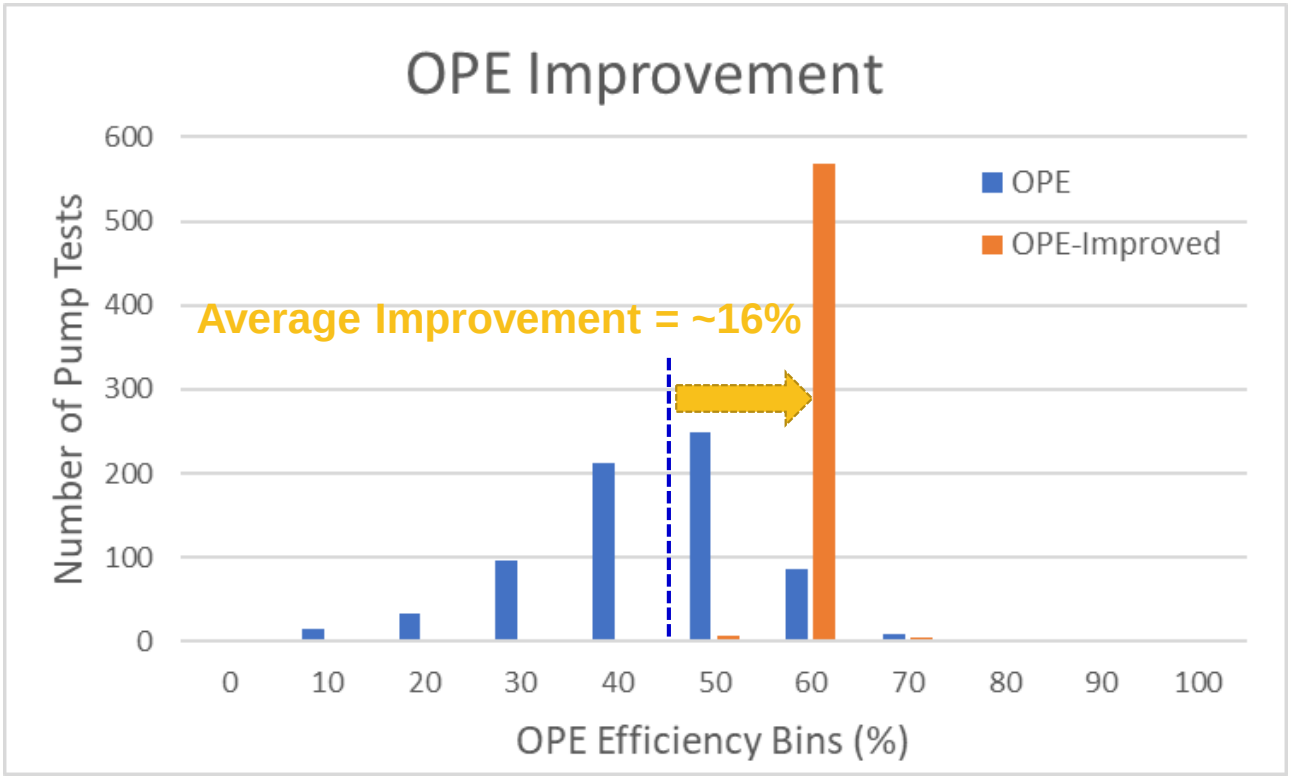

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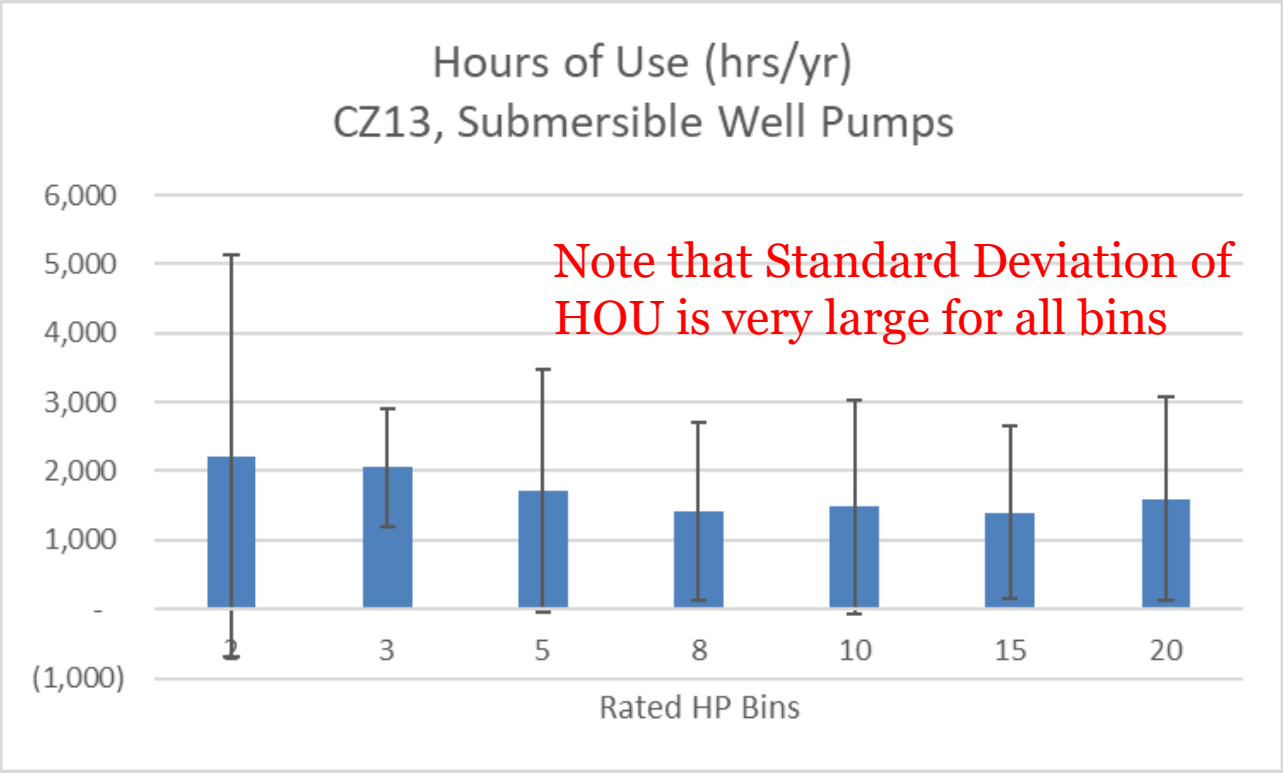


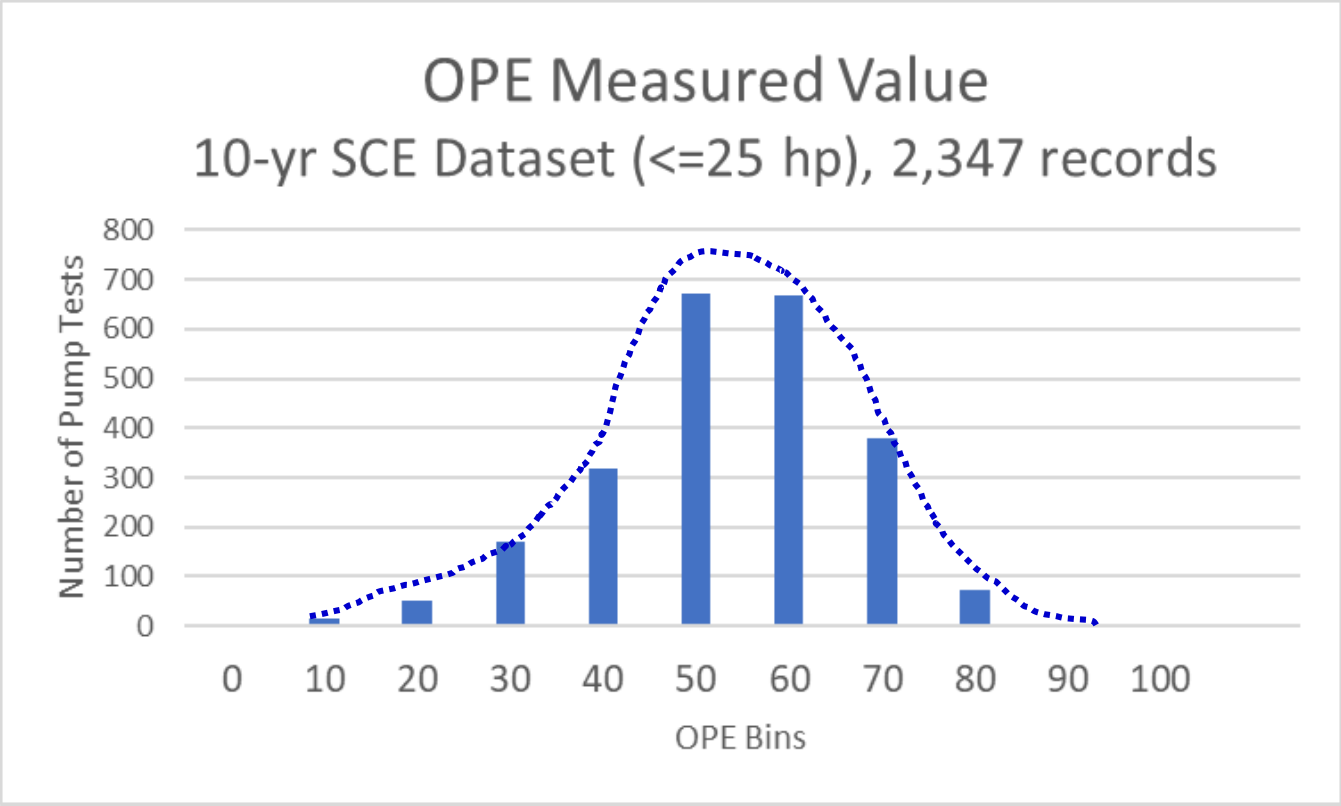
HP	Number
2	2
3	5
5	44
8	90
10	193
15	242
20	153

3.01 Agricultural Pump System Overhaul

- Working with SCE to understand if their dataset can:
  - Meet the Disposition request for (taken from II-B):
    A. Pumps with rated-hp that are covered by the workpaper
    B. Pumps with both pre- and post- test data
    C. Exclude Base and Post OPE within >10% of total pump head
       A. Higher post flow rates should not eliminate data
  - SCE - 10-year Pump Test dataset
    - Less than 25 hp: (9,944 pump test records; 5,575 pump IDs)
    - Pre- and Post-Data: (4,368 records; 2,323 pump IDs)
      - Qualifying record: Not just one test; Not first test of many
    - Total Pump Head within >10% (2,347 records)

3.01 Agricultural Pump System Overhaul

- SCE - 10-year Pump Test dataset
  - Records meeting all requirements: (2,347 records)



3.01 Agricultural Pump System Overhaul

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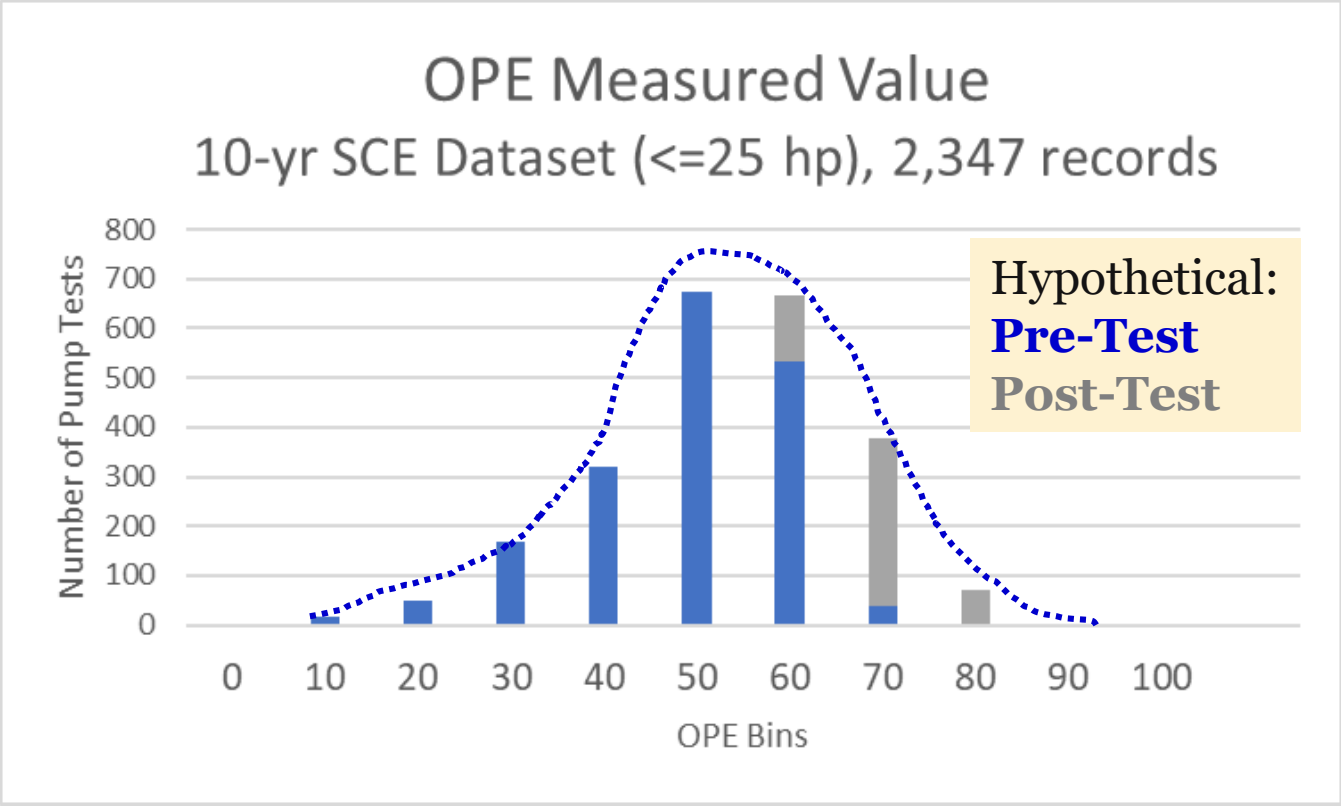
  - Records meeting all requirements: (2,347 records)



3.01 Agricultural Pump System Overhaul

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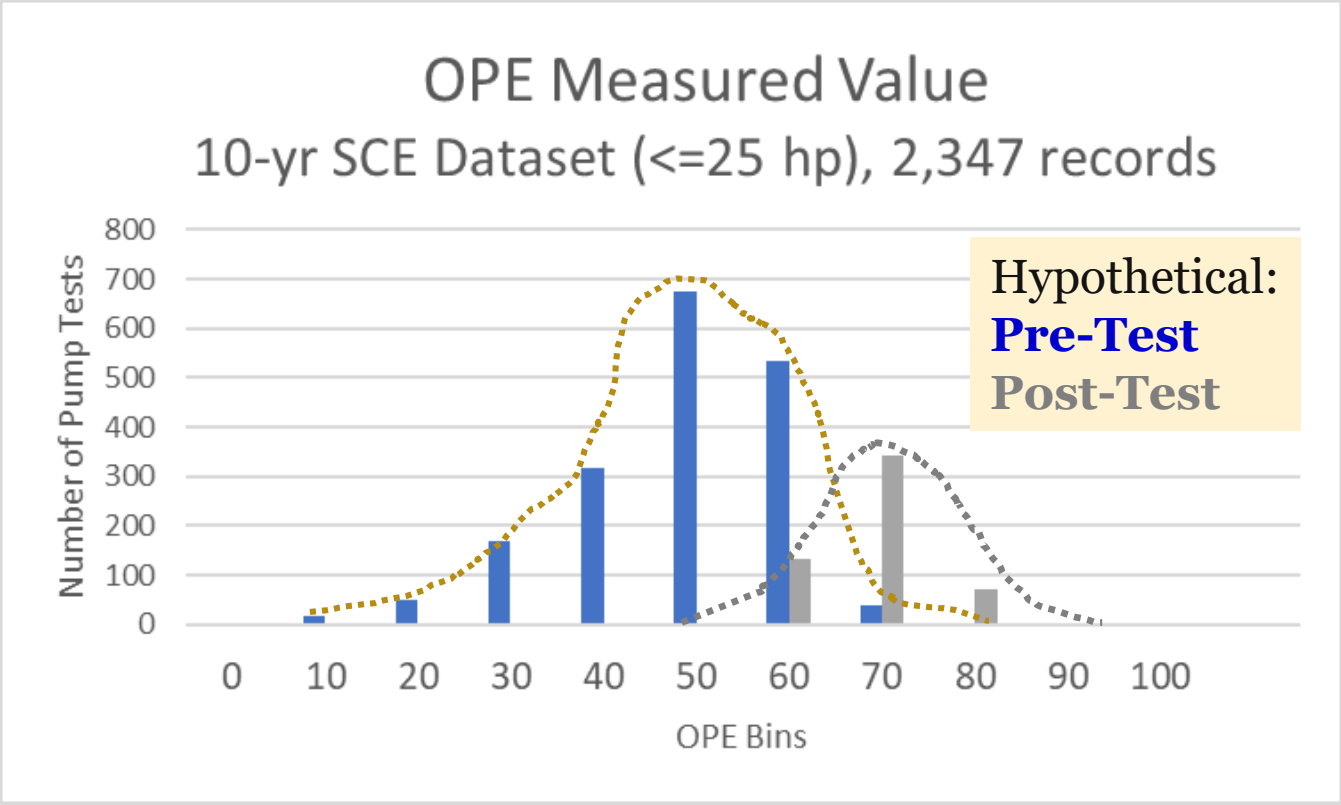
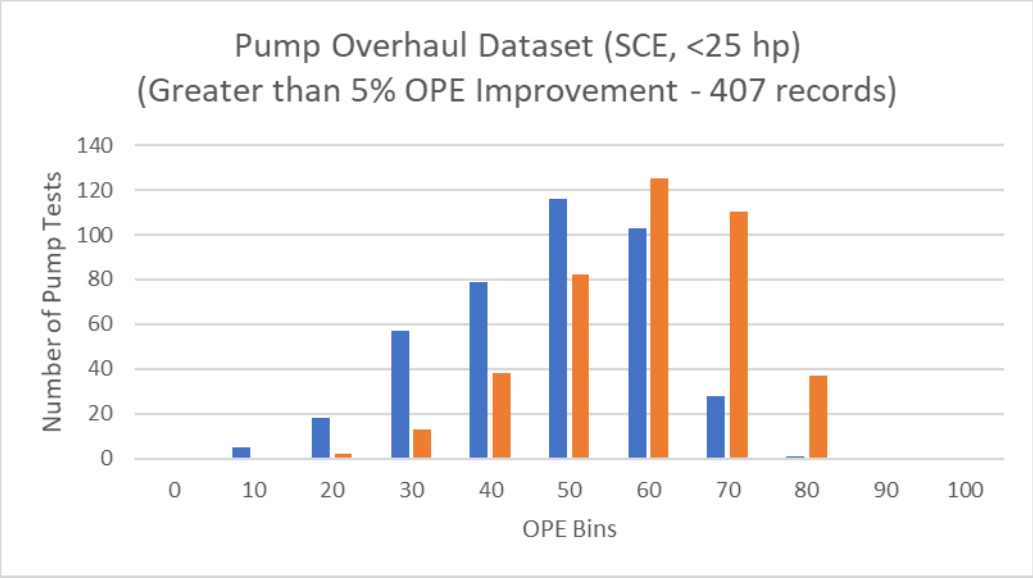


3.01 Agricultural Pump System Overhaul

- Preliminary results from dataset:
  - OPE difference between successive tests yielded a smaller number of tests than expected with savings.
    - >20% Improvement -> 55 records
    - >10% Improvement -> 185 records
    - > 5% Improvement -> 407 records
  - Why? Hypothesis include:
    - Fewer post tests are being completed for smaller pumps (<25hp)
    - OPE difference spans multiple years; not taken right before and after overhaul

3.01 Agricultural Pump System Overhaul

- SCE - 10-year Pump Test dataset
  - If we select for all the qualifying criteria (2,347 records)
  - Can we infer which tests are “post-overhaul” (407 records)
    - Select for tests that showed >5% OPE improvement since last test
    - Use the test prior to the improvement as the pre-test



Issues:

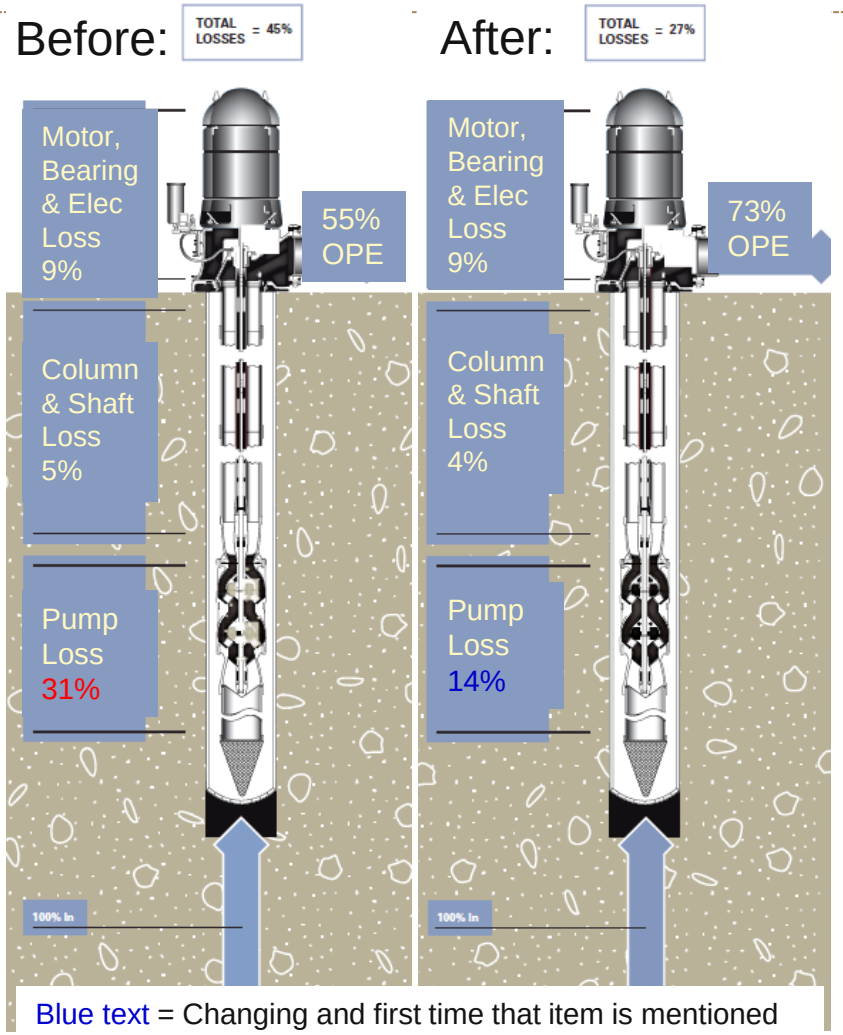
- Not sure that improvement due to “over-haul” activity
- Time between tests can be long; additional degradation would have occurred
  - Average of 2.1 yrs b/w tests
  - Average 1.8% degradation/yr

3.01 Agricultural Pump System Overhaul

- Preliminary results from dataset:
  - OPE difference between successive tests yielded a smaller number of tests than expected with savings.
    - >20% Improvement -> 55 records
    - >10% Improvement -> 185 records
    - > 5% Improvement -> 407 records
  - Why? Hypothesis include:
    - Fewer post tests are being completed for smaller pumps (<25hp)
    - OPE difference spans multiple years; not taken right before and after overhaul
- Other recommendations:
  - Starting to collect additional data:
    - Linking incentives paid -> minimal data in this set
      - 533 records = Pump Overhaul (PM-90890)
      - 434 records = also not the first pump test
      - 237 records = also with 10% total head
    - Linking post-test field -> minimal data in this set
      - 25 records
    - Look for trends from larger hp data sets (counter to disposition recommendation)
  - Other ideas on how to extract a more reliable pre/post-test set of data?

Measure Consensus - *Hold*
3.01 Agricultural Pump System Overhaul

- Offering
  - Pump size (<25 hp)
  - Varies by Pump Type (5 types)
  - Varies by Climate Zone (16 CZs)
- Stage 1 Issues
  - BRO measure agreed
  - *Peak Demand savings in question (Q1-18)*
  - *Energy savings methodology in question*
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E
- Stage 2 Issues
  - *Improve accuracy of EUL*
  - *Consider hours of operation within permutations (Q2-18)*
  - *Consider using Hydrological or Geological Zones*



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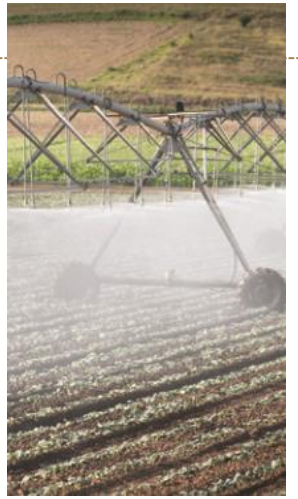
Measures that are Canceled

3.07 - Vertical Hollow Shaft Pump Motors

- Final DOE rulemaking with new standards effective June 1st, 2016
  - 2014-05-29 Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Electric Motors; Final Rule
- Is there an opportunity to use existing conditions baseline (Accelerated Replacement)?
  - Can installed measure exceed code?
  - (Policy issue) Can savings be exclusively to-code?

Irrigation Measures



- Consensus:
  - 3.04 - Low Pressure Sprinkler Measure
    - Recommend: Do not pursue
    - Considered to be a problematic measure
      - No inherent savings involved
      - Narrow focus of brass nozzle to low pressure
      - Considered ISP now (need documentation to support this claim)
  - 3.03 – Micro/Drip-Conversion Measure
    - Recommend: Do not pursue; current measure is Standard Practice
    - Revive this measure by redefining it (utility led)
      - Address impact evaluation issues
      - Include new requirements to make savings reliable (ie, VFD / design specs)