Agriculture / Pumping
Cal TF Tier 2 Presentation

CALIFORNIA
TECHNICAL FORUM

AYAD AL-SHAIKH

APRIL 2018

Agricultural / Irrigation Measure Affirmation

"Cal TF affirms the subcommittee recommendations regarding 'Stage 1 Issues' for Agricultural / Irrigation Measures."

- 3.14, Greenhouse - Heat Curtain
- 3.15, Greenhouse - Infrared Film
- 3.16, New Water Pump Upgrade
- 3.17, Enhanced VFD on Ag Pump

Not Included:

- 3.01, Agricultural Pump System Overhaul (*On Hold*)

Measure Overview

No.	Measure Names	Plan	PG&E	SCE	SDG&E	SCG	POU
3.01	Agricultural Pump System Overhaul	2018-Q1					
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	Hold / Measure Sunset					
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-Q1					
3.15	Greenhouse - Infrared Film	2018-Q1					
3.16	New Water Pump Upgrade	2018-Q1					
3.17	Enhanced VFD on Ag Pump	2018-Q1					

Star'ed Measures - 2018 Measures

Measure Consensus - 3.14 – Greenhouse Heat Curtain

- Offering
  - Per square-foot-building-area
  - Assumes an overhead gas furnace or radiant heat
    - Programs need to distinguish the existing conditions
- Stage 1 Issues
  - Based upon Dec 2014 Disposition, PG&E sunset their workpaper
    - DEER measures are still available
    - *Grnhs-Shell-ThermCurt - Heat curtain installed in greenhouse with bare walls and bare double-poly roofs
    - Grnhs-Shell-LIR_to_LIR_Tcurt - Heat curtain installed in greenhouse that has roofs with IR film /bare walls
  - *Key issue is appropriate Standard Practices for greenhouses*
    - *Current study from 2015 Navigant report exists*
    - *Staff has rejected report as insufficient*
    - *PG&E is conducting additional research on Greenhouses to determine whether to include these measures*
- Stage 2 Issues
  - *Understanding if savings should vary with region (coastal / inland) or if baseline should vary with size of greenhouse.*
  - *Consider updating costs with WO017 or program data (SCG)*

Blue text = Changing and first time that item is mentioned
Italics text = Item that has not been completed

Input Consensus - 3.14 – Greenhouse Heat Curtain

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	GHs	No Value	No Value	GHs	GHs
BldgVintage	Ex	No Value	No Value	Any	Any
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05, CZ06,CZ07,CZ08,CZ09,CZ10, CZ11,CZ12,CZ13,CZ14,CZ15, CZ16, IOU	No Value	No Value	Any,CZ01,CZ02,CZ03,CZ04, CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16,IOU	Any,CZ01,CZ02,CZ03,CZ04, CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16,IOU
BldgHVAC	aGF	No Value	No Value	aRH	aGF

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA	No Value	No Value	RET	REA
NormUnit	Area - Ft2 - BA	No Value	No Value	Area - Ft2 - BA	Area - Ft2 - BA
EUL ID	Agr-GHC	No Value	No Value	Agr-GHC	Agr-GHC
RUL ID	Greenhouse (20 yrs)	No Value	No Value	No Value	No Value
NTGR	NonRes-sGHS-mHtCrtn-dn	No Value	No Value	NonRes-sGHS-mHtCrtn-dn	NonRes-sGHS-mHtCrtn-dn
DeliveryType	PreRebDown	No Value	No Value	PreRebDown	PreRebDown
GSIA	Def-GSIA	No Value	No Value	No Value	No Value

Measure Consensus - 3.15 – Greenhouse IR Film

- Offering
  - Per square-foot
  - Assumes an overhead gas furnace or radiant heat
    - Programs need to distinguish the existing conditions
- Stage 1 Issues
  - Based upon Dec 2014 Disposition, PG&E sunset their workpaper
    - DEER measures are still available
    - Grnhs-Shell-LowIRroof - Infrared film applied to bare double-poly greenhouse roofs
  - *Consider a change to ROB based upon way that the Measure is installed*
  - *Key issue is appropriate Standard Practices for greenhouses*
    - *Current study from 2015 Navigant report*
    - *Staff has rejected report as insufficient*
    - *PG&E is conducting additional research on Greenhouses to determine whether to include these measures*
- Stage 2 Issues
  - *Understanding if savings should vary with region (coastal / inland) or if baseline should vary with size of greenhouse.*
  - *Consider updating costs with WO017 or program data (SCG)*

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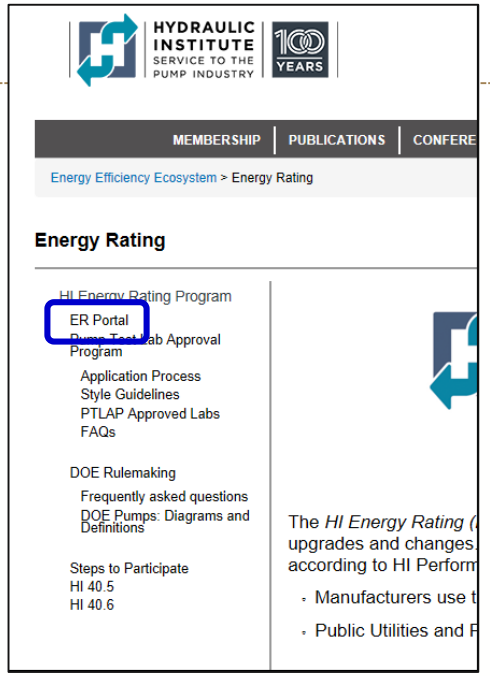
Input Consensus - 3.15 – Greenhouse, IR Film

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	GHs	No Value	No Value	GHs	GHs
BldgVintage	Ex	No Value	No Value	Any	Any
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05, CZ06,CZ07,CZ08,CZ09,CZ10, CZ11,CZ12,CZ13,CZ14,CZ15, CZ16, IOU	No Value	No Value	Any,CZ01,CZ02,CZ03,CZ04, CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16,IOU	Any,CZ01,CZ02,CZ03,CZ04, CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16,IOU
BldgHVAC	aGF	No Value	No Value	aRH	aGF

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	REA	No Value	No Value	RET	REA
NormUnit	Area - Ft2	No Value	No Value	Area - Ft2	Area - Ft2
EUL ID	Agr-Irfilm	No Value	No Value	Agr-Irfilm	Agr-Irfilm
RUL ID	Greenhouse (20 yrs)	No Value	No Value	No Value	No Value
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	Def-GSIA	No Value	No Value	No Value	No Value

Measure Consensus - 3.16 – New Water Pump Upgrade



- Offering (created by PG&E)
  - Allowable HP range: 1 hp <= Rated HP <= 200 hp
    - 3 ranges (1-3 hp, 3-50 hp, 50-200 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 (2,400 hrs/yr)
    - Commercial (4,000 hrs/yr)
    - Industrial (5,000 hrs/yr)
  - Savings based upon approved RTF analysis
    - 5 pump types
- Stage 1
  - *Calculation:* $kWh/hp = 0.746\ kW/hp * HOU\ (hrs/yr) * (PEI_{Base} * Adj_{Base} - PEI_{Proposed} * Adj_{Proposed})$
    - *Documentation for variable speed adjustment factor is needed*
    - *Documentation for proposed PEI values used in calculation is needed*
- Measure Extension
  - *Added measure for POUs*
  - *Added measure for SCE and SDG&E (electric measure)*

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Input Consensus
3.16 – New Water Pump Upgrade

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	AgOth IndOth Com	AgOth IndOth Com	No Value	No Value	No Value
BldgVintage	Ex	Ex	No Value	No Value	No Value
BldgLoc	IOU	IOU	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	ROBNC	RobNc	No Value	No Value	No Value
NormUnit	Rated-HP	Rated-HP	No Value	No Value	No Value
EUL ID	Motors-pump	Motors-pump	No Value	No Value	No Value
RUL ID	n/a	No Value	No Value	No Value	No Value
NTGR	All-Default<=2yrs	All-Default<=2yrs	No Value	No Value	No Value
DeliveryType	PreRebUp	PreRebUp	No Value	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	No Value	No Value	No Value

Measure Consensus
3.17 – Enhanced VFD on Ag Well Pumps

- Offering
  - Well Pumps (<=600hp-Enhanced Spec), Booster Pumps (<=150hp)
  - Enhanced Spec
- Stage 1 Issues
  - *Updated calculation approach after discussion with Kyle Feist / ITRC-CalPoly*
    - *Proposed using Motor Load and Motor Efficiency data from PG&E pump test database*
- Measure Extension
  - Added measure for POUs
  - Added measure for SDG&E (electric measures)
- Stage 2 Issues
  - *Include Enhanced Offering*
  - *Consider more sensitive variables to distinguish savings*
  - *Include opportunities to pump to open vessels*
  - *Documenting EUL for REA measure (next slide)*
    - *Received 30-yr data set*
    - *Working with Doug M. to start this analysis; running Monte Carlo analysis with Crystal Ball*

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Input Consensus
3.17 – Enhanced VFD on Ag Well Pumps

- Measure Permutations

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

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	ROBNC,REA	NC,REA	No Value	No Value	No Value
NormUnit	Rated-HP	Rated-HP	No Value	No Value	No Value
EUL ID	Agr-VSDWellPmp	Agr-VSDWellPmp	No Value	No Value	No Value
RUL ID	Agr-VSDWellPmp 10 yrs = 1/3 (3.33 years)	No Value	No Value	No Value	No Value
NTGR	Agric-Default>2yrs Com-Default>2yrs	Agric-Default>2yrs	No Value	No Value	No Value
DeliveryType	DirInstall PreRebDown	DirInstall PreRebDown	No Value	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	No Value	No Value	No Value

Agricultural / Irrigation Measure Affirmation

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- 3.14, Greenhouse - Heat Curtain
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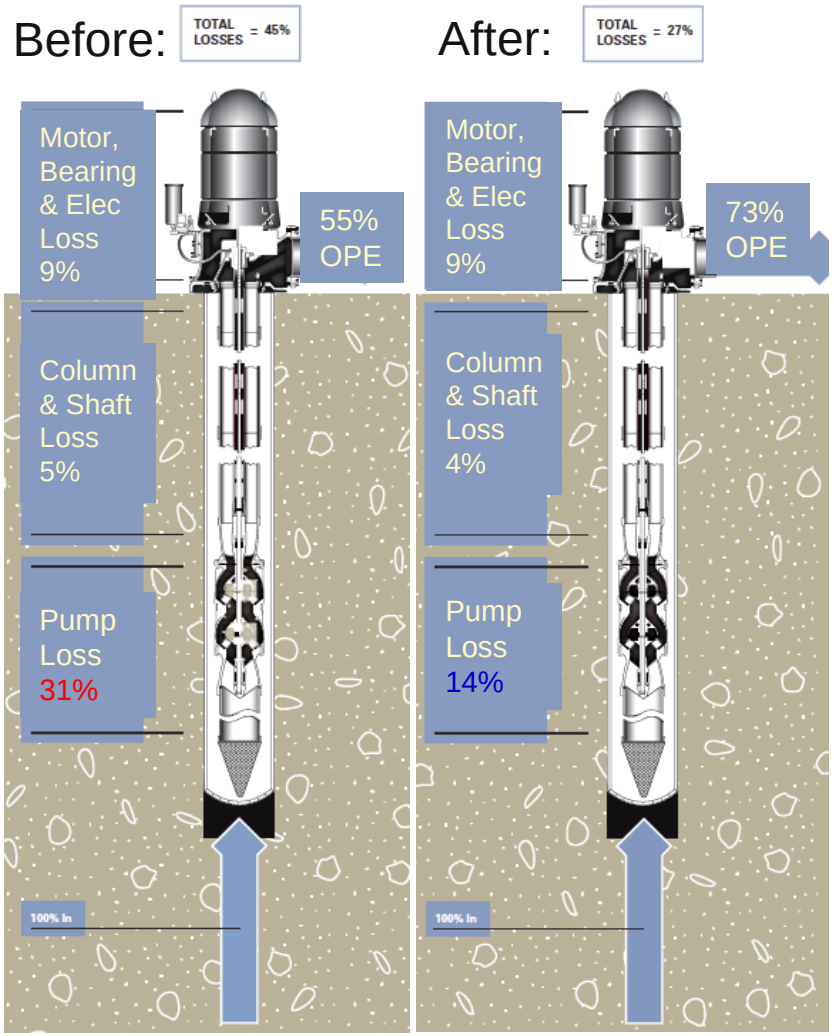
Measure Consensus - 3.01 Agricultural Pump System Overhaul

- Offering
  - 2 Pump Ranges
    - ≤25 hp
    - 25 < hp ≤ 50 hp
  - Varies by Pump Type (5 types)
    - Centrifugal Booster
    - Submersible Well
    - Submersible Booster
    - Turbine Booster
    - Turbine Well
  - Varies by Climate Zone (16 CZs)
- Statewide Measure Status
  - PG&E – Offering deemed measure for <25 hp pumps, but claiming no demand savings
  - SCE – Put the deemed program on hold while custom data is collected
  - SDG&E – Put the deemed program on hold



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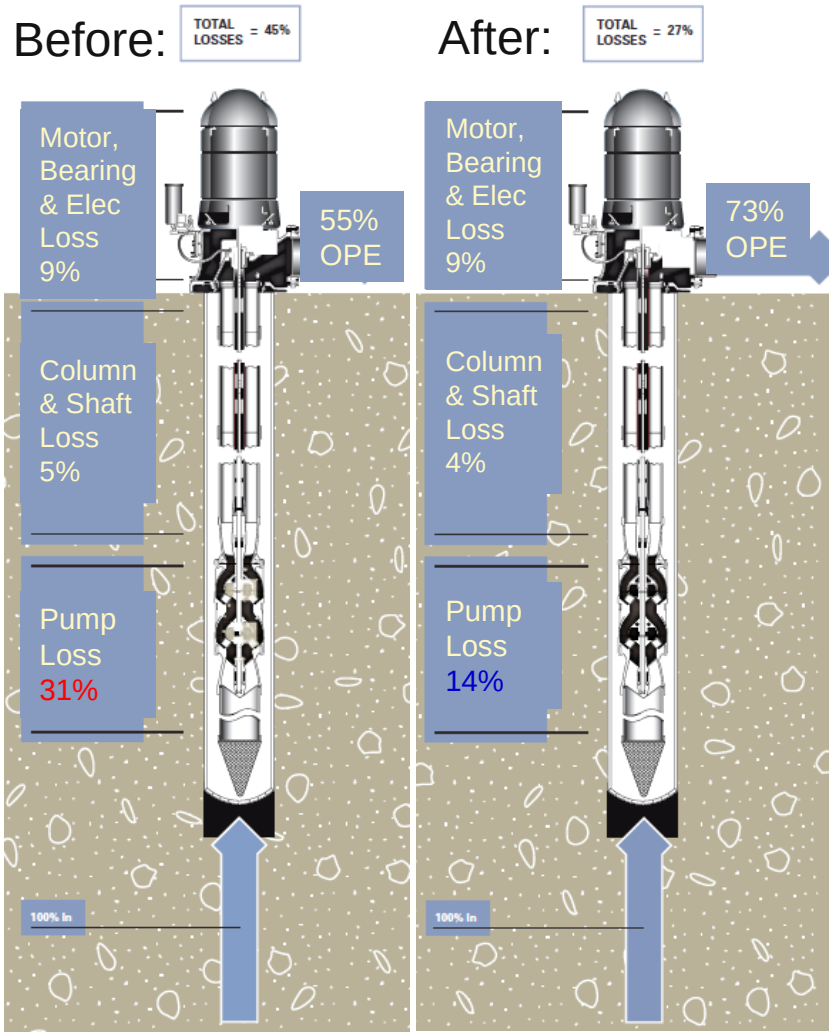
Measure Consensus - 3.01 Agricultural Pump System Overhaul

- Stage 1 Issues
  - Implementation related:
    - High pump range used by SCE and SDG&E
    - Pump Test and Overhaul required to claim savings
    - Motor replacements must exceed standard efficiency
  - Agreement to use BRO (Behavioral, Retro-commissioning, or Operational) installation type
  - *Savings related:*
    - *Peak Demand savings study is being completed*
    - *Data set that determines savings should:*
      - *Must have both pre- and post- pump tests*
      - *Include only pumps within correct rated hp range*
      - *Exclude Base / Post OPE records with >10% of total pump head difference*
      - *Higher post flow rates should not be eliminated*
    - Energy savings methodology in question
      - Add motor efficiency to SCE calculation
    - Some Climate Zones have limited data so assumptions are made to avoid gaps in Offerings
    - Agreement that savings do not need adjustment for pump wear
  - Cost methodology:
    - *Consider cost variation by pump type only*
      - PG&E uses a single value per hp
      - SCE averages cost for each pump type and CZ



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    - Centrifugal Booster
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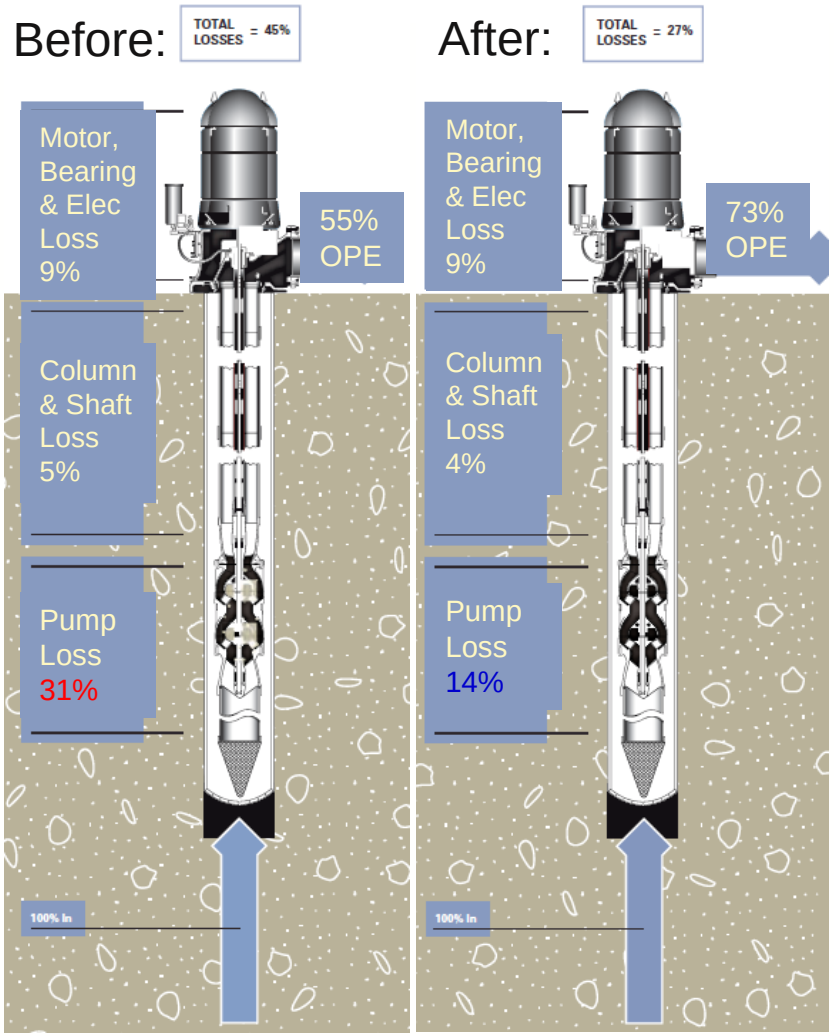
    - Submersible Booster
    - Turbine Booster
    - Turbine Well
  - Varies by Climate Zone (16 CZs)
- Measure Extension
  - Added measure for POUs
  - Added measure for SCE and SDG&E
- Stage 2 Issues
  - *Need to update EUL (Effective Useful Life) based upon SCE/Lincus study*
  - *Consider hours of operation within permutations*
  - *Consider using Hydrological or Geological Zones*



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Input Consensus - 3.01 Agricultural Pump System Overhaul

- Measure Permutations

	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
BldgType	AgOth, Com, IndOth	Any	MLI	Com	No Value
BldgVintage	Ex	Any	Any	Ex	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05, CZ06,CZ07,CZ08,CZ09,CZ10, CZ11,CZ12,CZ13,CZ14,CZ15, CZ16, IOU	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	CZ06,CZ07,CZ08,CZ10,CZ14,CZ15	No Value
BldgHVAC	cUnc	cUnc	Any	Any	No Value

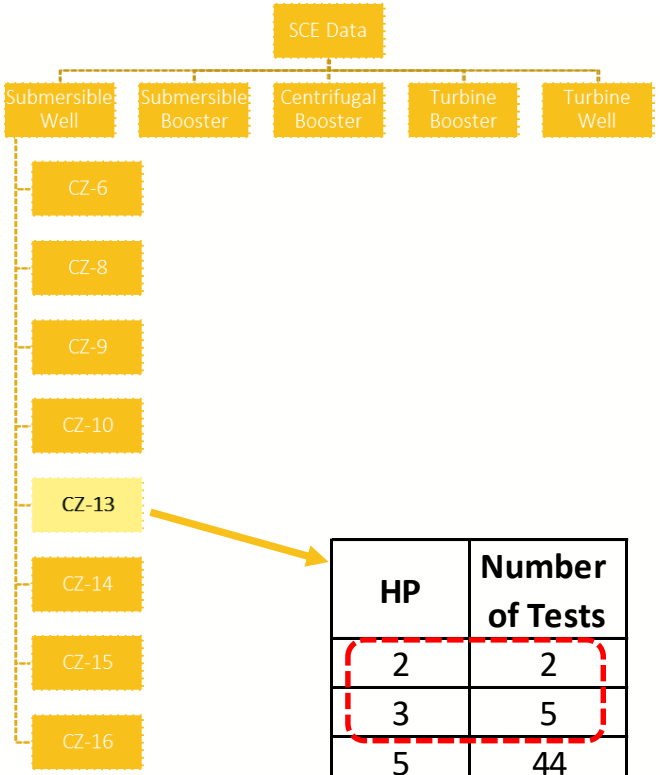
	eTRM Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	BRO	REA	REA	No Value	No Value
NormUnit	Rated-HP	Rated-HP	Rated-HP	Rated-HP	No Value
EUL ID	PumpCentBstr PumpSubBstr PumpSubWell PumpTurbBstr PumpTurbWell	PumpCentBstr PumpSubBstr PumpSubWell PumpTurbBstr PumpTurbWell	PumpCentBstr PumpSubBstr PumpSubWell PumpTurbBstr PumpTurbWell	ND-Pump-Rbld-Cen ND-Pump-Rbld-SubBst ND-Pump-Rbld-SubWell ND-Pump-Rbld-TbBst ND-Pump-Rbld-TbWell	No Value
RUL ID	PumpCentBstr PumpSubBstr PumpSubWell PumpTurbBstr PumpTurbWell	No Value	No Value	No Value	No Value
NTGR	Agric-Default>2yrs	Agric-Default>2yrs	Agric-Default>2yrs	No Value	No Value
DeliveryType	DirInstall PreRebDown	PreRebDown	DirInstall PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	Def-GSIA	No Value	No Value

Back-up / Histoy

- Details on Pump Overhaul Calculation Issues
  - From Cal TF Meeting – Oct 2017

3.01 Agricultural Pump System Overhaul

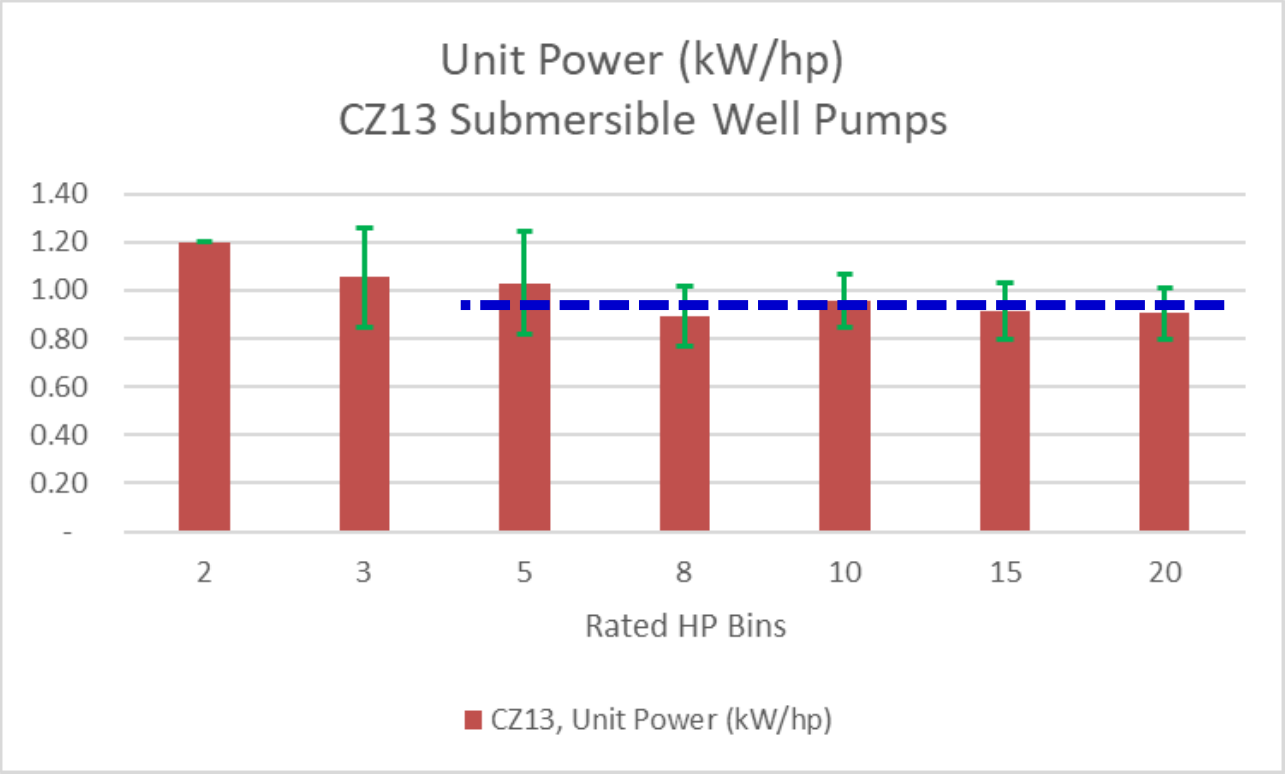
- Understanding variation
  - Existing data set (SCE, 3000+ records)
    - Savings = kW * OPE-Imp * HOU
  - Examine a subset of data to get a sense for what is occurring in the results:
    - Submersible Well pump
    - CZ13
    - Population of 729 tests
  - Because there are so few pump tests in the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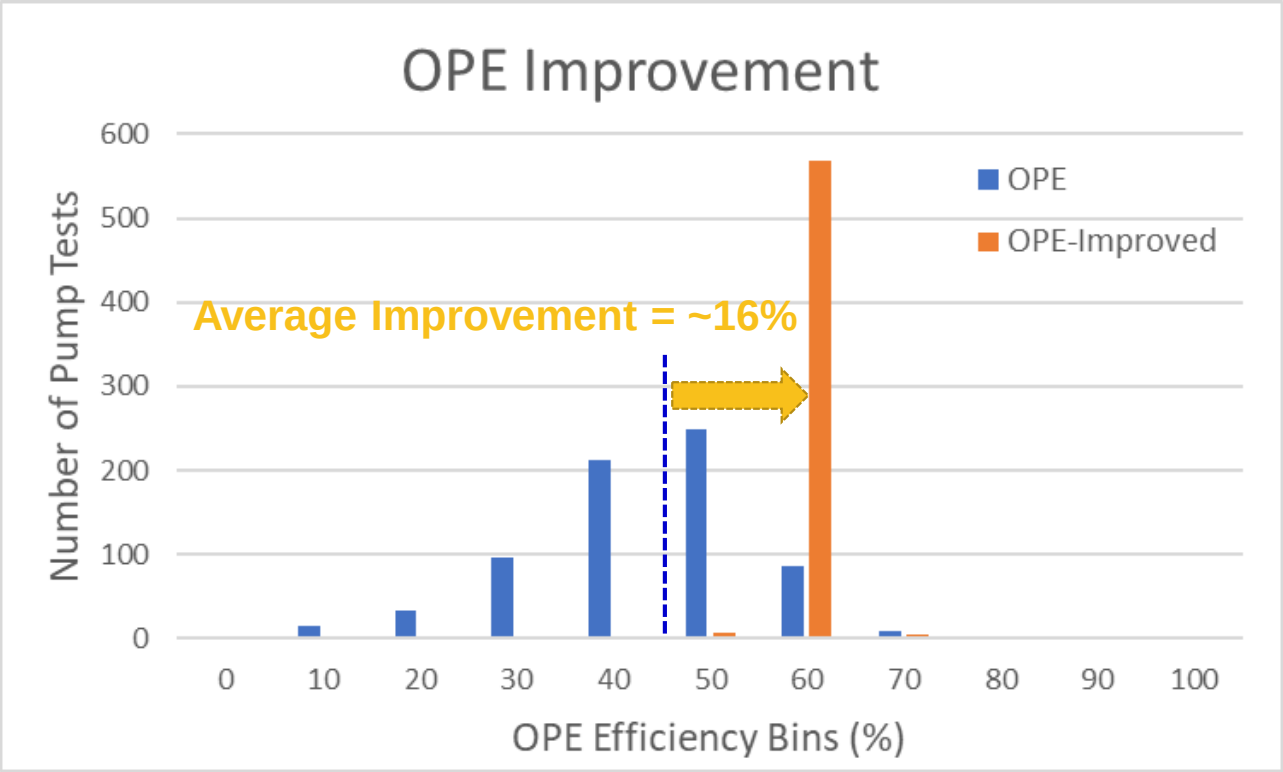

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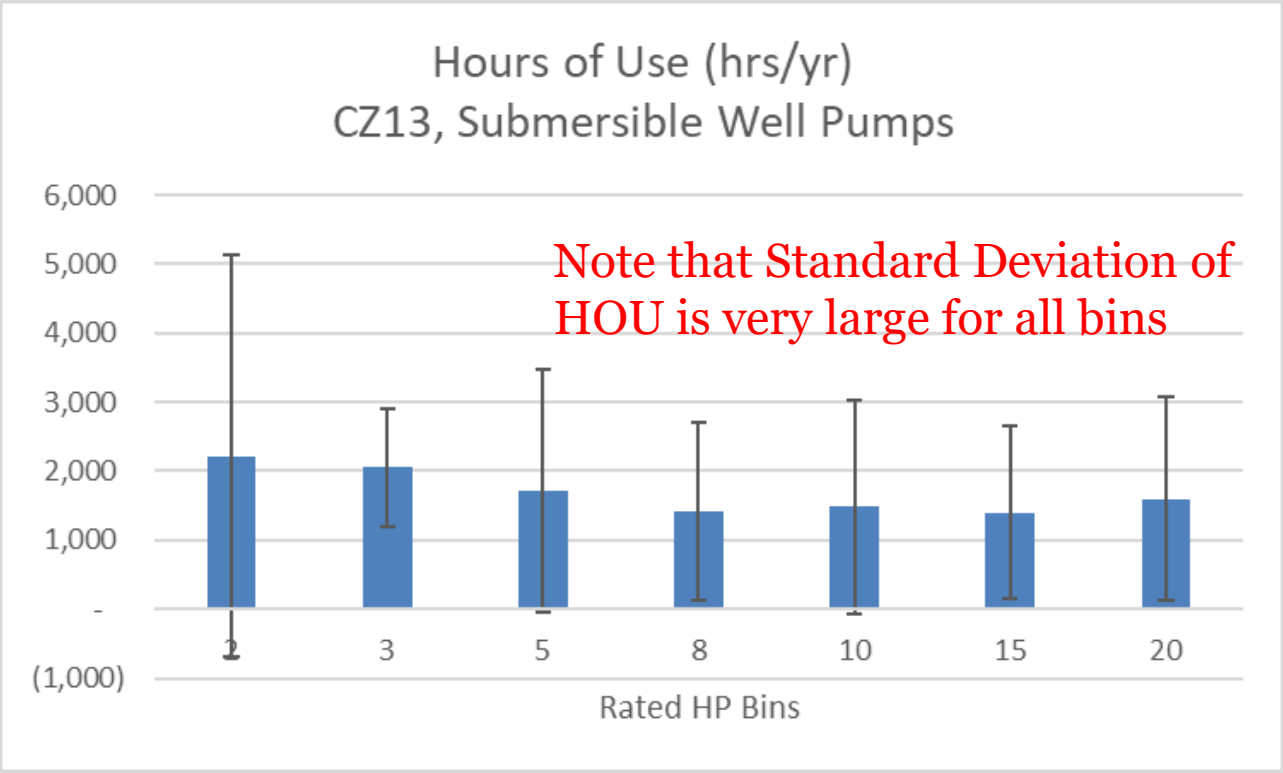

HP	Number
2	2
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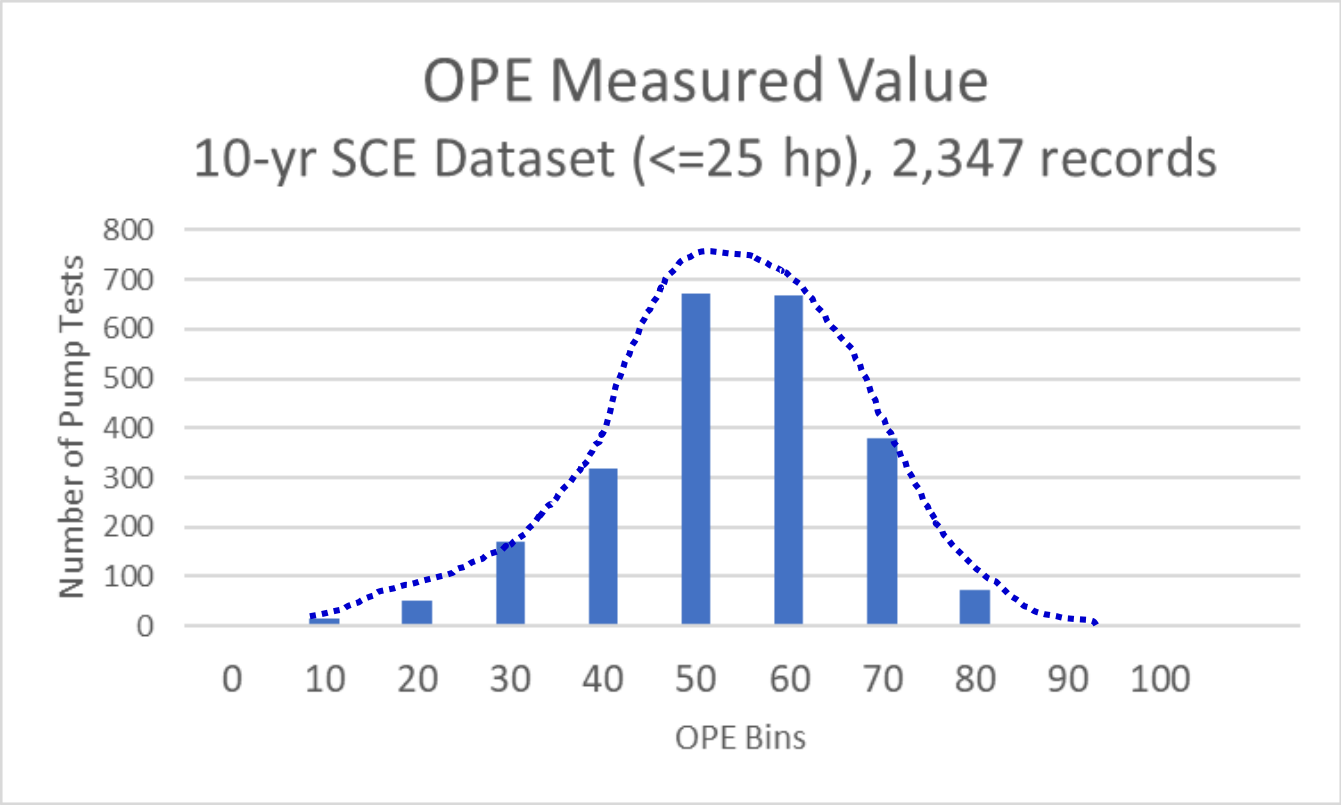
3.01 Agricultural Pump System Overhaul

- 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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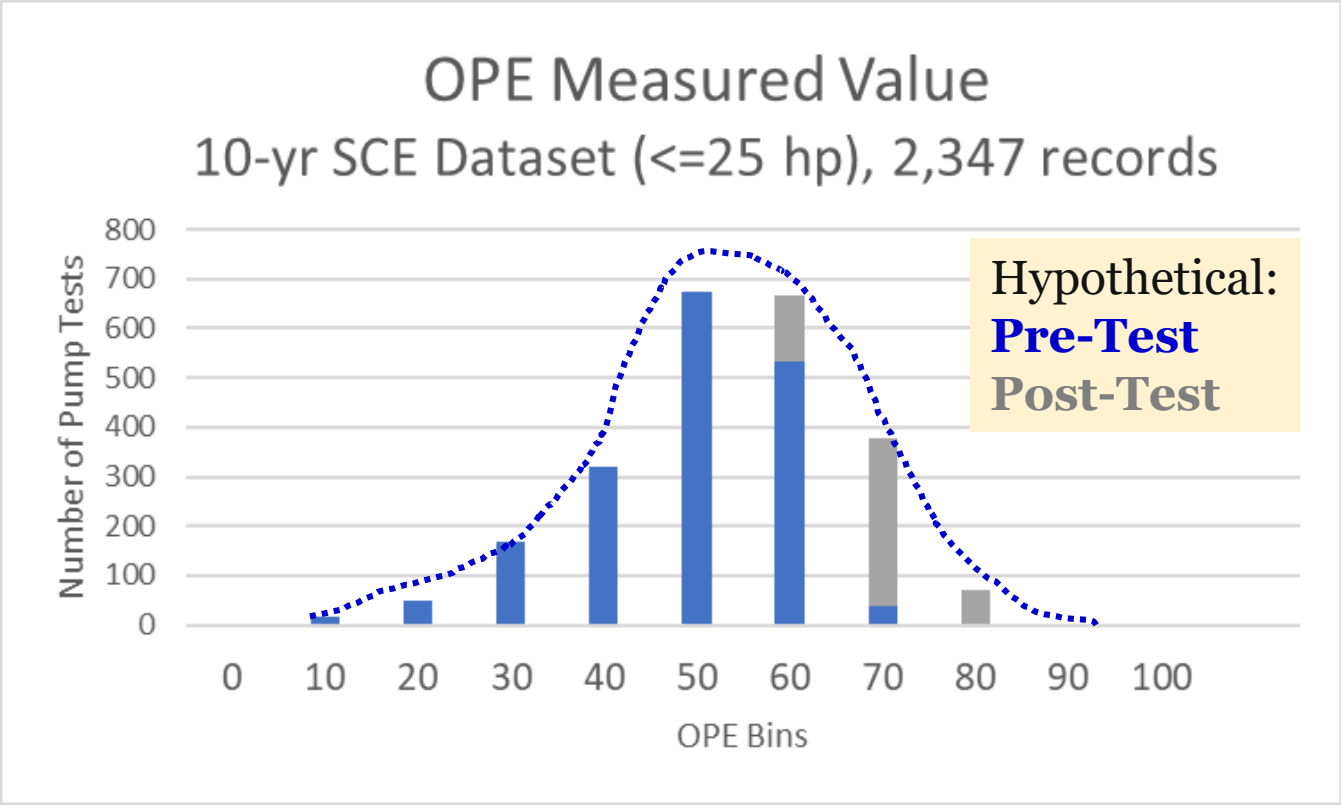

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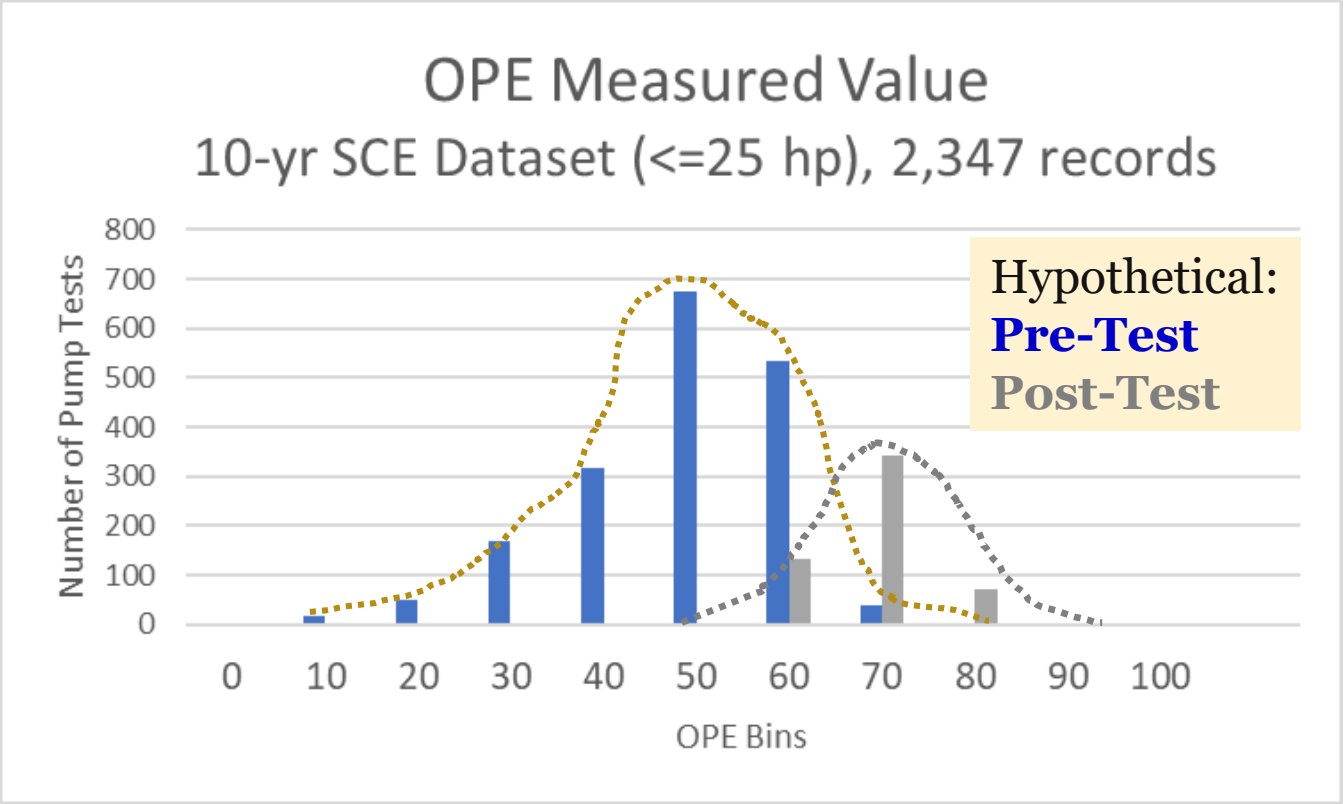
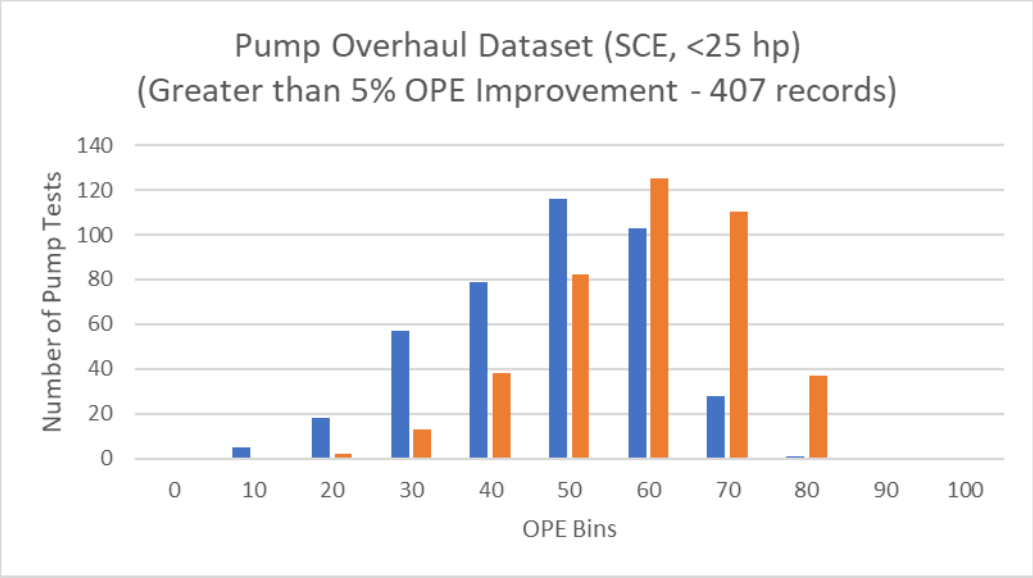


3.01 Agricultural Pump System Overhaul

- 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
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    - > 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?