Hybrid Subcommittee Meeting #5

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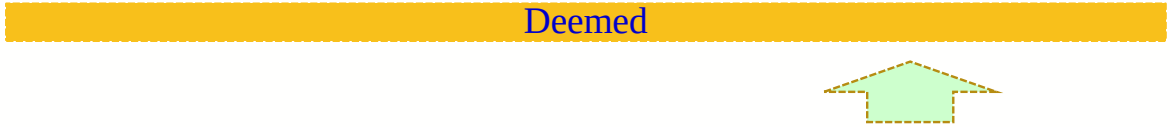
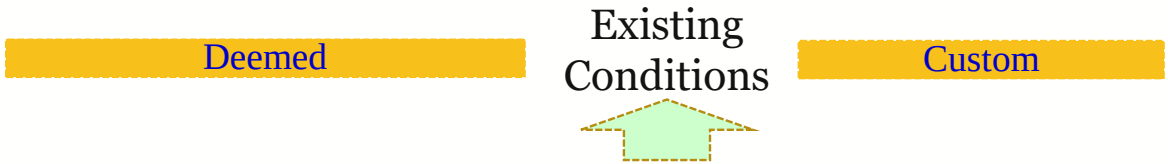
High Level Overview

- Three measures to review:
  - Process Boilers

  - Pipe Insulation, Nonresidential



  - Chillers, Non-Process



Hybrid Measure – Definition

- For a discrete (but growing) number of measures, document a framework for how to submit this *partially-deemed* measure
- Clarity that the submittal is expected to result in packets that:
  - Looks like a deemed measure to the customer
    - Known rebate based upon typical "normalizing unit" (ie, HP, kBTUH, etc)
    - No pre-approval required to install the measure
    - No requirement to document influence; uses a deemed Net-to-Gross value
    - Clarity on documentation that is required (up-front)
  - Provides deeper / more complete documentation than a deemed measure
- Improve customer participation in programs / customer perception
- Captures data in a structured format that could:
  - Improve inputs over time
  - Result in converting the hybrid measure to a deemed measure
- Balances:
  - Maximizing rate-payer funds by streamlining the process
  - Providing more site-level data than a typical deemed measure

Hybrid Measure – Target Measure

- Target Measure
  - Installed frequently, repeatably throughout the state
  - Enough clarity about the installation exists that there is acceptable trade-off between rigor and:
    - Reliability of the measure savings amount,
    - Persistence,
    - Double-dipping,
    - Gaming,
    - Etc.
  - Minimum and maximum project size or incentive amount could exist (per unit)
    - Ideally streamlined approach can reduce the minimum threshold of savings for accepting a project
    - Maximum project size may exist, but this is determined on a measure by measure basis

Hybrid Process Boiler Measure

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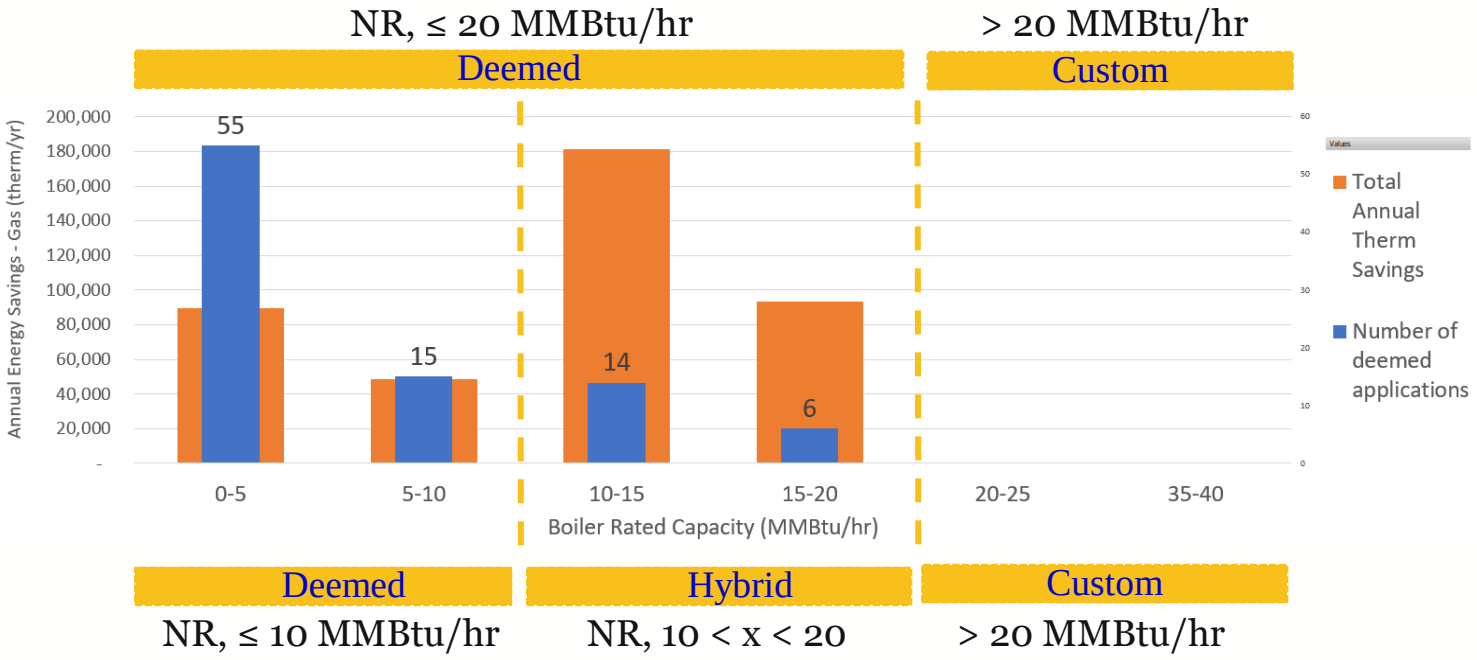
Process Boiler - Histogram

- Deemed Measure: SWWH008 Process Boiler
  - Normal replacement of ≤ 20 MMBtu/hr process boiler



- Deemed: ¾ of the applications are 1/3 of the savings
- Hybrid: ¼ of the applications are 2/3 of the savings

Process Boiler – Savings Calculation

- Basic Calculation: $Savings = Rated\ Load * LF\ * opHr * \left(1 - \frac{Eff_{base}}{Eff_{meas}}\right)$
- Deemed: ≤ 10 MMBtu/hr
  - 1 – Sensitive variable
    - *Norm Unit* = Rated Load
  - 1 – Categorization
    - Boiler Type – Efficiencies

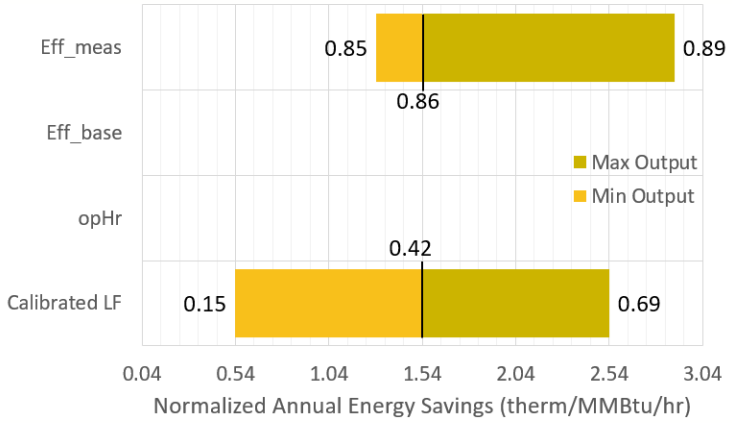
	HW I	HW II	Steam
Eff_{base}	.82	.82	.80
Eff_{meas}	.85	.90	.83

- Hybrid: 10 < x < 20 MMBtu/hr
  - 3 – Sensitive variables
    - *Norm Unit:* Rated Load
    - Load Factor (calibrated)
    - Measure Case Efficiency
  - 1 – Categorization
    - Boiler Type – Base case efficiency

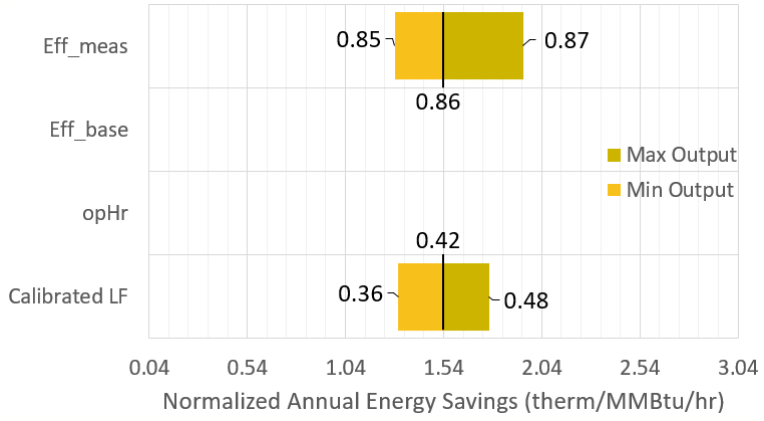
	HW I	Steam
Eff_{base}	.82	.80

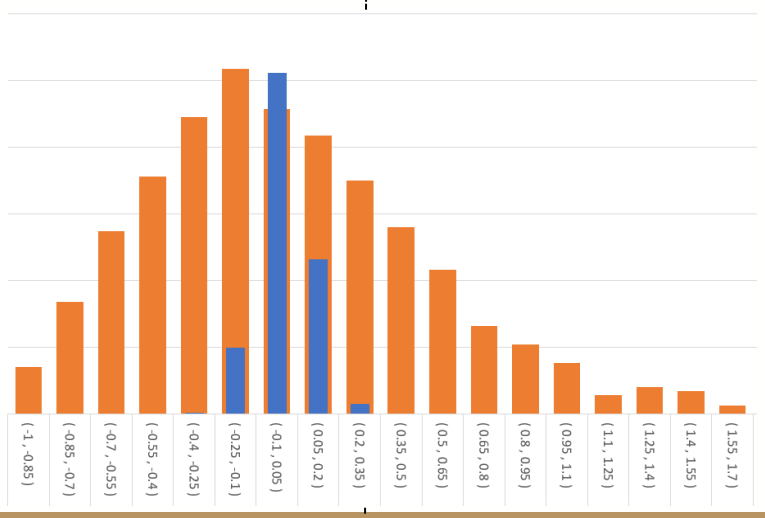
Process Boiler – Hot Water

Deemed



Hybrid





Process Boiler - Data Collection

Input Variable	Value	Source
Rated Load	10 – 20 MMBtu/hr	Report with measure application/form
Load Factor	0.15 – 0.69	Link to SCG Load Balance Tool
# of gas equipment	1 - ∞	
LF for each equip	0.15 – 0.69	
opHr for each equip	1,000 – 8,760	
Annual gas bill		
opHr	8,760 hrs	Calibrated in LF
Eff_{base}	0.80 – Steam 0.82 – Hot Water	Set by boiler type
Eff_{meas}	0.83 – 0.97	- Provide spec sheet - FGA Record - Study/engineering data for the boiler model

Hybrid Pipe Insulation Measure

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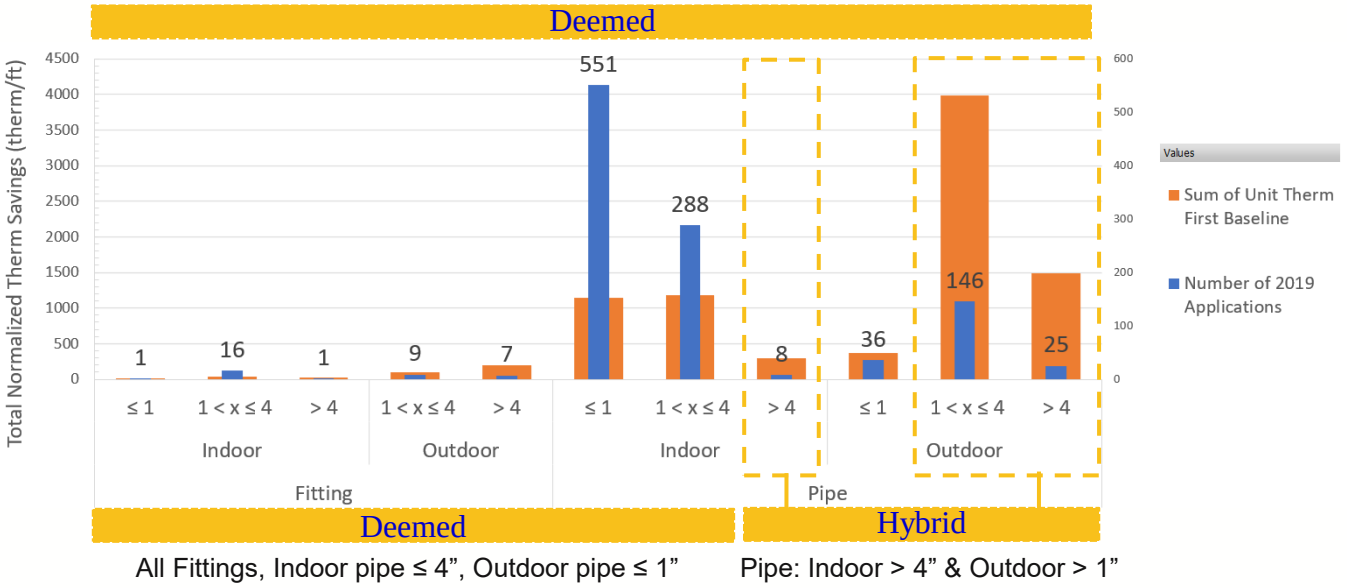
Pipe Insulation - Histogram

- Deemed Measure: SWWH017 Hot Water Pipe Insulation, NonRes
  - Installation of 1” insulation to bare hot water pipe



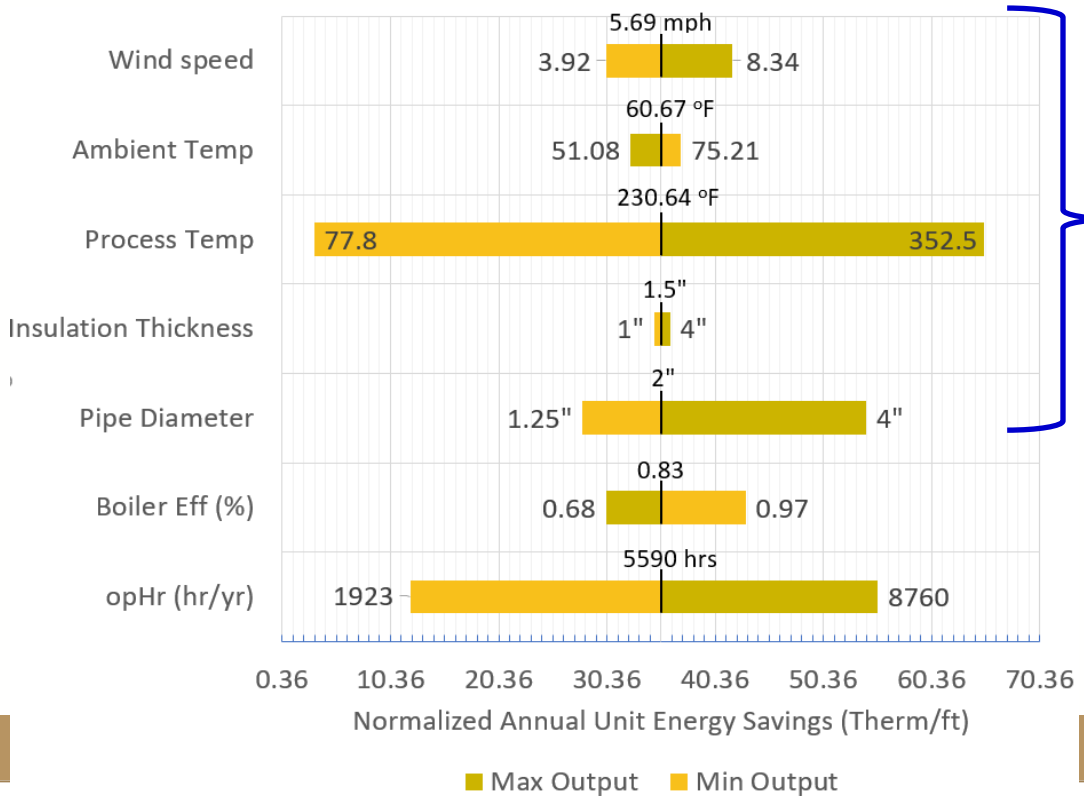
All Fittings, Indoor pipe ≤ 4”, Outdoor pipe ≤ 1”

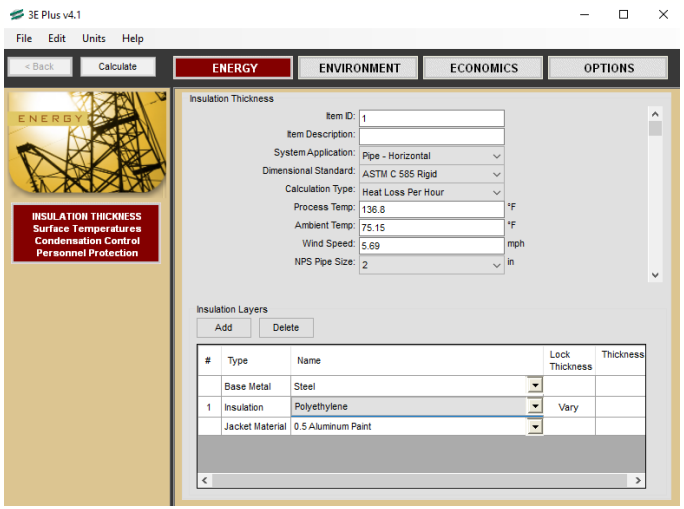
Pipe: Indoor > 4” & Outdoor > 1”

- Deemed: 83% of applications are 35% of the savings
- Hybrid: 17% of the applications are 65% of the savings
- Other Elements: degraded insulation, other liquid?

Pipe Insulation - Calculation

- Basic Calculations: $Savings = \frac{(Q_{base} - Q_{meas}) * opHr}{Boiler\ Eff} * length$
- Heat Loss Q = f(pipe/insulation conductivity, pipe diameter, insulation thickness, process temperature, ambient temperature, and wind speed)
  - NAIMA 3E Plus Pipe Insulation Software





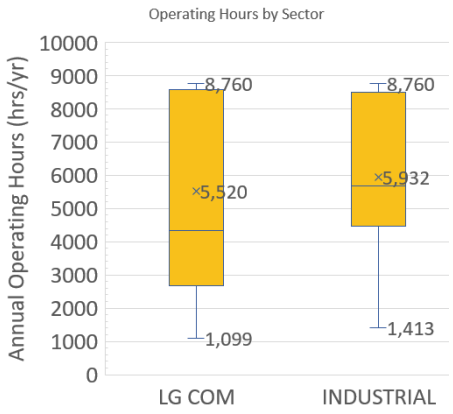
Outdoor Pipe: 1” < x ≤ 4”

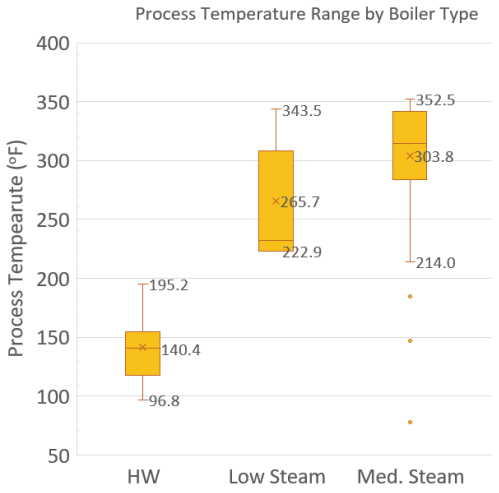
Pipe Insulation

- Deemed:
  - 1 – Sensitive variable (*Norm Unit* = length)
  - 3 – Categorizations
    - Location (Pipe location + CZ) – Wind speed
    - Boiler Type – Process Temp + Boiler Eff
    - Pipe Size – Average Pipe diameter
  - 1 – Additional documentation
    - Operating hours
- Hybrid:
  - 4 – Sensitive variables
    - Length
    - Pipe diameter
    - Operating hours
    - Process/Fluid Temperature
  - 1 Categorization
    - Pipe Location – Wind speed

Deemed	Windspeed
Indoor	0
Outdoor	Varied by CZ

Deemed	HW	Low Steam	Med Steam
Process Temp	136	242	294
Eff_{meas}	83.5%	80.7%	82.5%





Hybrid Chiller Measure

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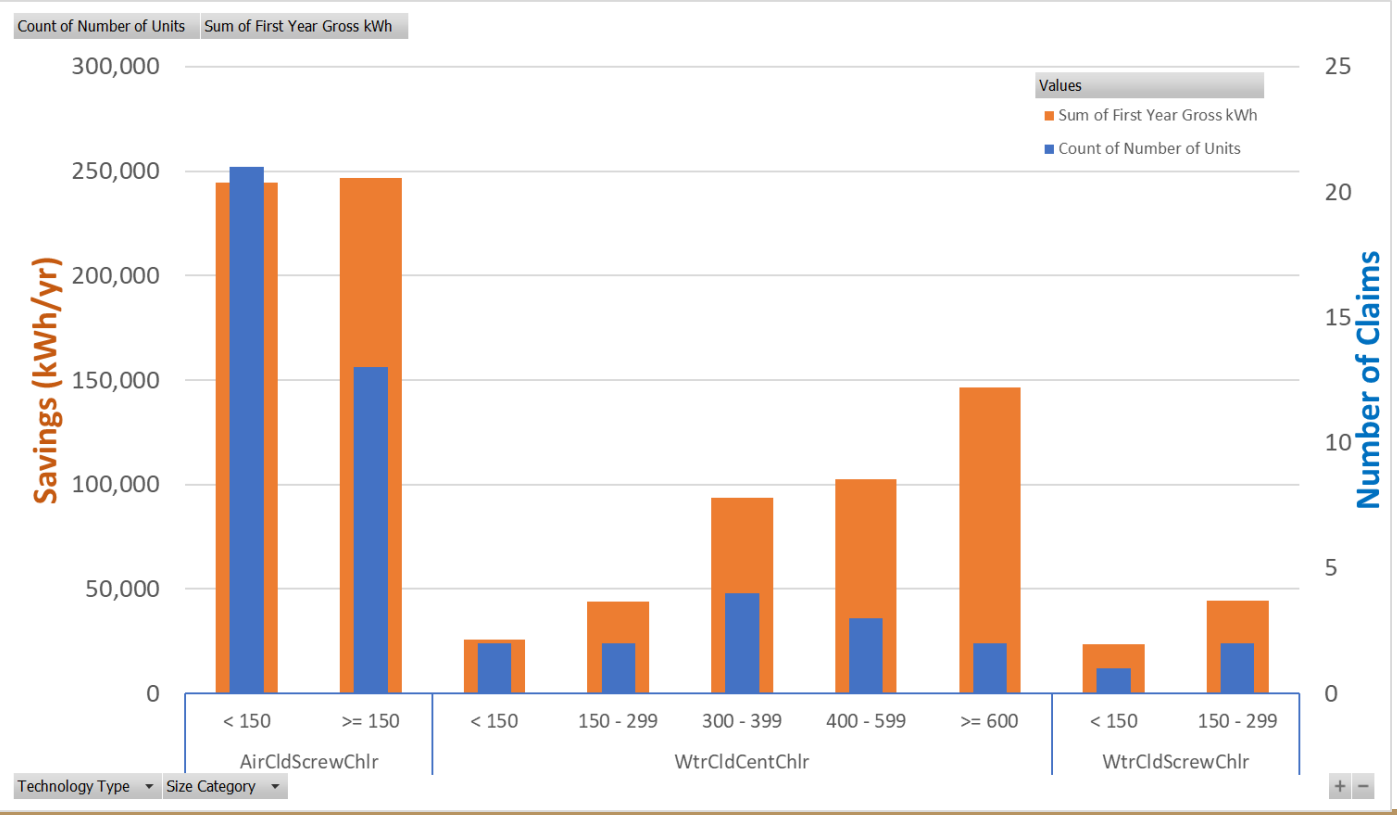
Hybrid Chiller – Histogram

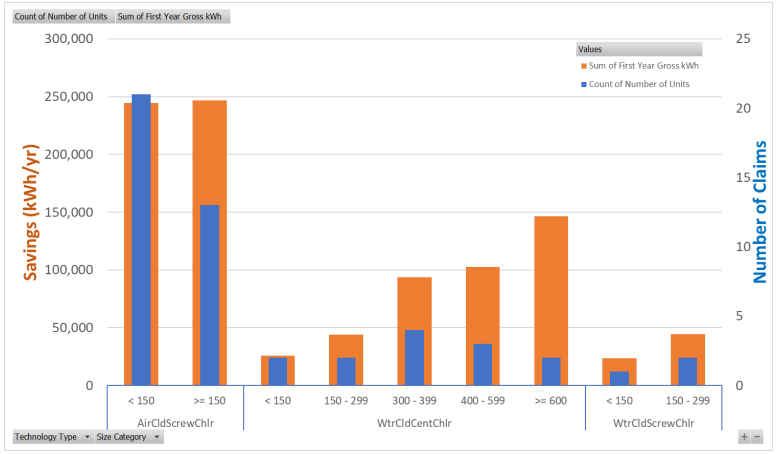
- Deemed Measures:
  - SWHC020 Air Cooled Chiller and SWHC005 Water Cooled Chiller
    - Normal Replacement (NR) of Air-Cooled Screw Chiller (Const speed -> Const speed)
    - NR of Water-Cooled Centrifugal Chiller and Water-Cooled Screw Chiller (Var speed -> Var speed)



IOU claims data – 2019, Q1-Q4

Hybrid Chiller – Measure Breakdown

- Measure continuum



Use Subcategory	Gross Savings (kWh/yr)
Ventilation and Air Distribution	6,300,125
Space Heating and Cooling	11,475,674
Product chilling	6,273,811
Space Cooling	36,589,431
Retro-Commissioning Services	1,889,998
Air distribution (fan systems)	223,138
Pumping	969,291

Deemed	Hybrid	Custom
NR - Chiller Replacement, One-for-One	AR - Chiller Replacement, One-for-One	System Upgrade

- Questions
  - Is this opportunity large enough (repeatable) to be considered Hybrid?
  - Are the savings significant enough to encourage these stranded opportunities?

IOU claims data – 2019, Q1-Q4 Custom and Deemed

Hybrid Chiller – Measure Breakdown

- Basic Calculation: *DEER2020_Chiller_Workbook*
  - CPUC Calculator discussed later in the presentation (included in appendix)

- Deemed: MAT is Normal Replacement (NR)
  - One for One replacement
  - 2 – Categorizations
    - Efficiency Tier
    - Capacity

- Hybrid: MAT is Accelerated Replacement (AR)
  - One for One replacement
  - 3 – Sensitive Variables
    - Efficiency Tier
    - Capacity
    - Baseline Efficiency (Full Load and Part Load)
      - Tbd if we use just standard existing efficiency (or in-field EER)

Hybrid Chiller – Workbook Iterations

- Ran iterations for a variety of parameter combinations using the CPUC calculator
- Parameters included:
  - Program Administrator (PA): SCE
  - Climate Zone (CZ): 9
  - Measure Application Type (MAT): AR
  - Chiller Type: Water Cooled - Variable - Centrifugal
  - **Capacity (tons)**: 200, 700
  - **kW/ton/IPLV**: 0.571 / 0.360, 0.526 / 0.342
  - Existing Chiller Manufacture Date: Dependent on Vintage
  - **Building Type**: Office - Large, Health/Medical - Hospital, Education – University
  - **Vintage**: old, ex
  - Non-standard rating: No
  - Lead Chiller: No
  - Square Footage: Dependent on Building Type

Chiller Information			Building Information	
Capacity (tons)	kW/ton	IPLV	Building Type	Vintage
200	0.571	0.360	Large Office	old
200	0.571	0.360	Large Office	ex
700	0.526	0.342	Large Office	old
700	0.526	0.342	Large Office	ex
200	0.571	0.360	Health/Medical - Hospital	old
200	0.571	0.360	Health/Medical - Hospital	ex
700	0.526	0.342	Health/Medical - Hospital	old
700	0.526	0.342	Health/Medical - Hospital	ex
200	0.571	0.360	Education -University	old
200	0.571	0.360	Education -University	ex
700	0.526	0.342	Education -University	old
700	0.526	0.342	Education -University	ex

Hybrid Chiller – Workbook Iterations

- Results:

Chiller Information			Building Information		Above Code/Standard		Customer/Above Existing Savings		Percent Difference Above Existing (%)		READI		Percent Difference (%)	
Capacity (tons)	kW/ton	IPLV	Building Type	Vintage	kWh/ton	kW/ton	kWh/ton	kW/ton	kWh/ton	kW/ton	kWh/ton	kW/ton	kWh/ton	kW/ton
200	0.571	0.360	Large Office	old	36.57	0.0153	85.13	0.0356	133%	133%	36.30	0.0152	0.7%	0.5%
200	0.571	0.360	Large Office	ex	33.46	0.0114	77.90	0.0266	133%	133%	33.2	0.0114	0.8%	0.4%
700	0.526	0.342	Large Office	old	33.71	0.0141	110.84	0.0463	229%	229%	33.4	0.014	0.9%	0.6%
700	0.526	0.342	Large Office	ex	30.85	0.0105	101.43	0.0347	229%	229%	30.6	0.0105	0.8%	0.5%
200	0.571	0.360	Health/Medical - Hospital	old	28.67	0.0156	66.74	0.0364	133%	133%	28.4	0.0155	0.9%	0.9%
200	0.571	0.360	Health/Medical - Hospital	ex	21.47	0.0133	50.00	0.0310	133%	133%	21.3	0.0132	0.8%	0.9%
700	0.526	0.342	Health/Medical - Hospital	old	26.43	0.0144	86.90	0.0474	229%	229%	26.2	0.0143	0.9%	0.9%
700	0.526	0.342	Health/Medical - Hospital	ex	19.80	0.0123	65.10	0.0404	229%	229%	19.6	0.0122	1.0%	0.7%
200	0.571	0.360	Education -University	old	35.84	0.0323	83.44	0.0751	133%	133%	35.6	0.032	0.7%	0.9%
200	0.571	0.360	Education -University	ex	29.11	0.0304	67.77	0.0709	133%	133%	28.9	0.0302	0.7%	0.8%
700	0.526	0.342	Education -University	old	33.04	0.0298	108.64	0.0978	229%	229%	32.8	0.0295	0.7%	0.9%
700	0.526	0.342	Education -University	ex	26.83	0.0281	88.23	0.0923	229%	229%	26.6	0.0278	0.9%	1.0%

- Two changes:
  - Constant Speed -> Variable Speed
  - DEER existing efficiencies used:

Chiller Size (tons)	Vintage	Existing Chiller kW/ton	Existing Chiller IPLV
200	Old	0.926	N/A
200	Ex	0.634	0.596
700	Old	0.926	N/A
700	Ex	0.577	0.550

Percent Difference between "Above Code/Standard Practice Savings" and "Customer/Above Existing Savings"

Percent Difference between READI data and "Above Code/Standard Practice Savings"

Hybrid Chiller – Workbook Iterations

- Conclusions:
  - Above Code/Standard Practice Savings were approximately equal to the READI data
    - This calculator is producing the same values that we use in our Deemed statewide measures
    - Note Deemed values come from READI
  - Accelerated Replacement savings (lower existing efficiency / constant->variable speed) significantly improve savings

Chiller Information		Percent Difference Above Existing (%)	
kW/ton	IPLV	kWh/ton	kW/ton
0.571	0.360	133%	133%
0.526	0.342	229%	229%

Questions:
Can we get in-field EER measurements to improve more?

    - Percent increase was independent of capacity, building type, or vintage
- Next
  - Run other cases: Over-ride base case efficiency, Lead chiller, Constant speed base case, Extended hours
  - Check TRC:
    - Savings increase, but AR will use a first baseline full measures cost (rather than incremental measure cost)

Next Steps

- Additional activities for existing measures
  - Understand TRC implications
- Are there other examples that we want to explore right away
  - Lighting
  - RCx
  - Ag Pump Overhauls
- Complete a Draft Guidance Document on the Hybrid measures
  - Allow for clearer review of the concept
- Next meeting – Planned for about 3 weeks

Chiller Calc Tool Back-up

CPUC Calculator – General Information

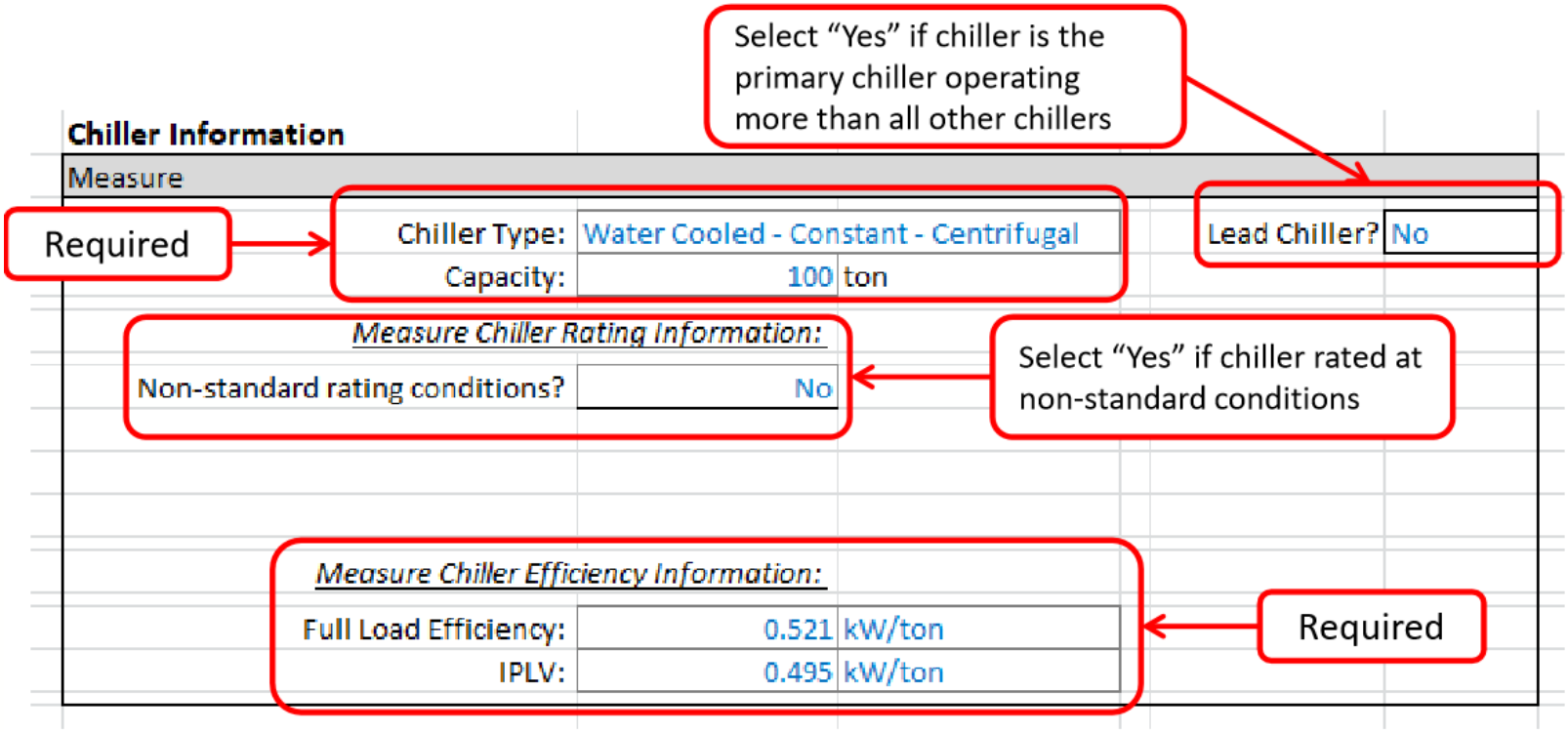
General Project Information:	
Program Administrator:	SDG
Climate Zone:	7
Measure Application Type:	Normal Replacement (NR)

- This is where the Program Administrator (PA), Climate Zone (CTZ) and Measure Application Type (MAT) are inputted
- PA is only used in the calculations if the building vintage “Existing” is selected
- Otherwise PA is only descriptive

CPUC Calculator – Chiller Information

- Chiller Type, Capacity, Full Load Efficiency and IPLV are specified in this section
- Non-standard rating conditions may be entered if the conditions are different from those used in the DEER simulations
- Standard rating conditions used in the DEER simulations:
  - Entering chilled water temperature: 54ºF
  - Leaving chilled water temperature: 44ºF
  - Entering condenser temperature: 85ºF (water-cooled), 95ºF (air-cooled)
- There is also an option to select the “lead chiller”
  - First chiller to operate
  - Highest full load operating hours
  - Only takes place in a central plant with multiple chillers

CPUC Calculator – Chiller Information



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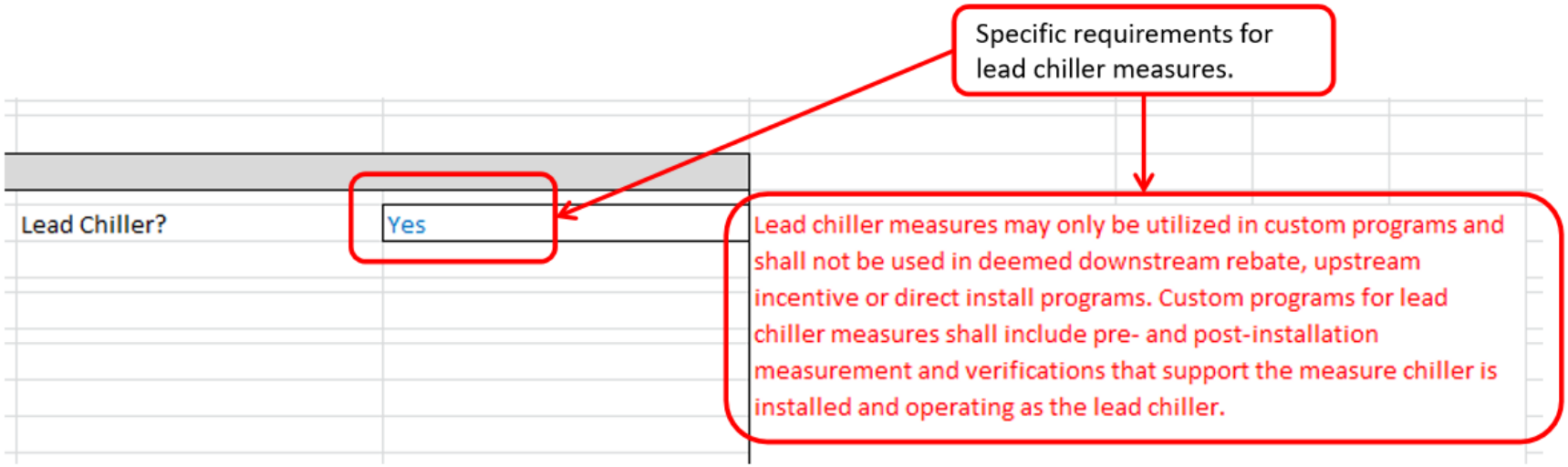

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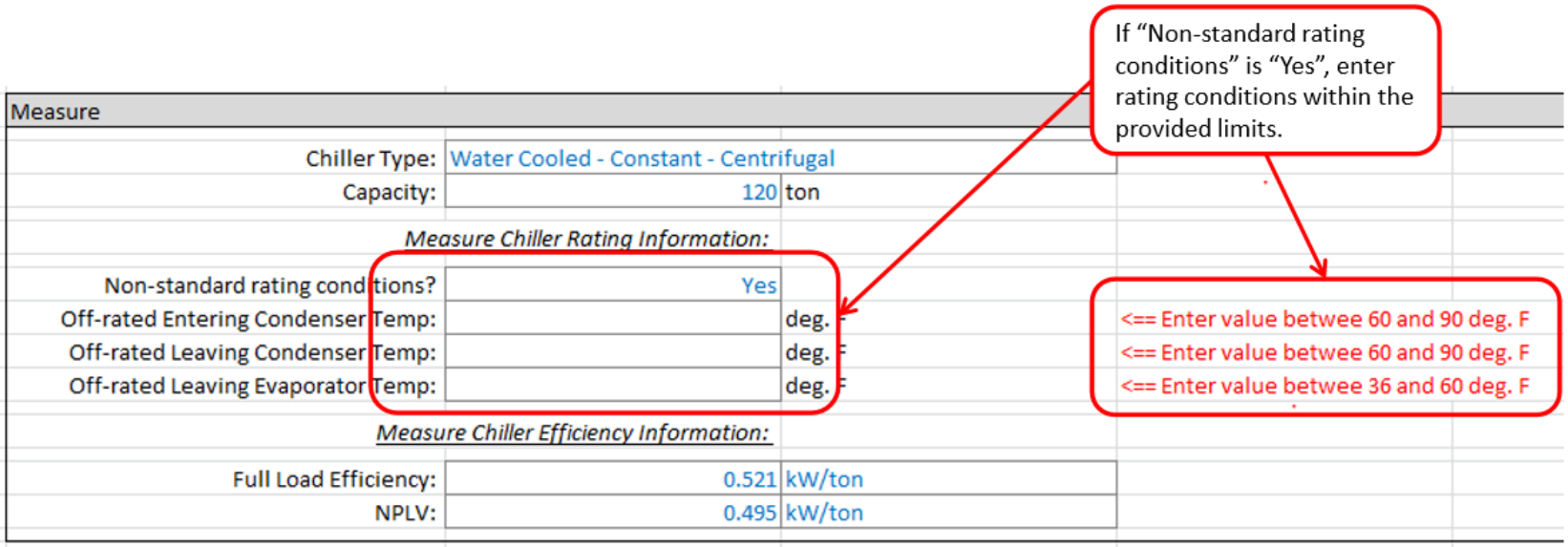
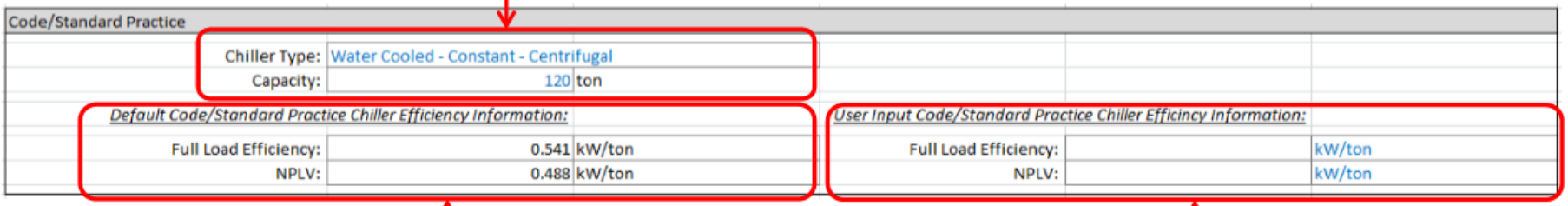


CPUC Calculator – Chiller Information

Chiller type and capacity should be identical to measure chiller

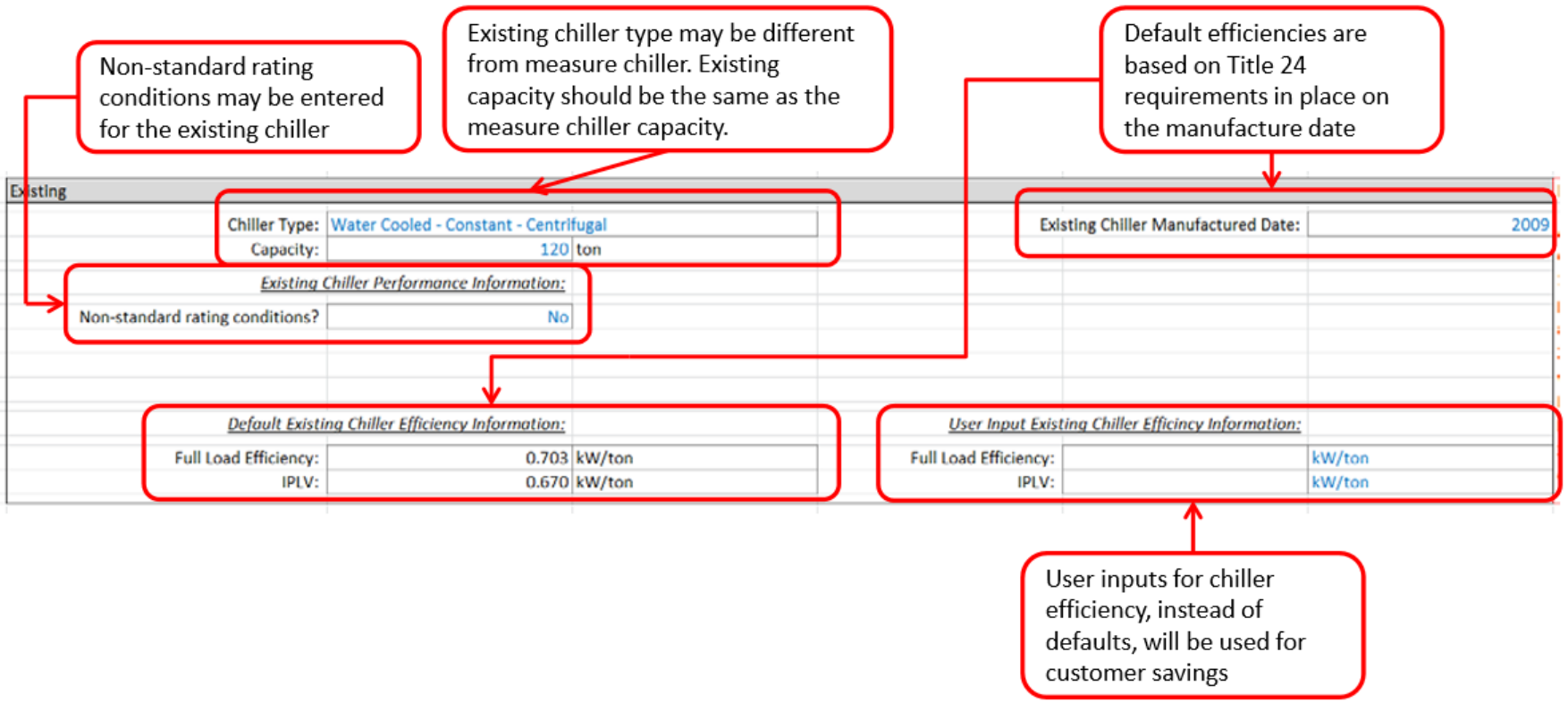


Code/Standard Practice					
Chiller Type:	Water Cooled - Constant - Centrifugal				
Capacity:	120	ton			
Default Code/Standard Practice Chiller Efficiency Information:			*User Input Code/Standard Practice Chiller Efficincy Information:*		
Full Load Efficiency:	0.541	kW/ton	Full Load Efficiency:		kW/ton
NPLV:	0.488	kW/ton	NPLV:		kW/ton

Default efficiency values based on 2016 Title 24 requirements, adjusted for off-rated conditions

Supporting documentation required if user-input code/standard practice values are entered

CPUC Calculator – Chiller Information



CPUC Calculator – Building Information

Building(s) Information			Ref Runs
Building Type	Vintage	Square Footage	Measure/Code Lower Boun
Office - Large	Recent	340,000	WtrCldCentChlr-Conv-0.74
Lodging - Hotel	Exisiting	300,000	WtrCldCentChlr-Conv-0.74

CPUC Calculator – Building Information

- Up to 10 different building information can be entered including DEER building type, DEER vintage and floor area
- Savings results are generated by weighting results for each building type by the user entered floor area
- If a New vintage is included, this implies the MAT is “Capacity Expansion”
- “Extended Hours” building type is only utilized in custom programs
- Savings are calculated per ton of capacity