Itron

Knowledge to Shape Your Future

California Experience: The Value of a Heat Metering Standard and Metering Accuracy

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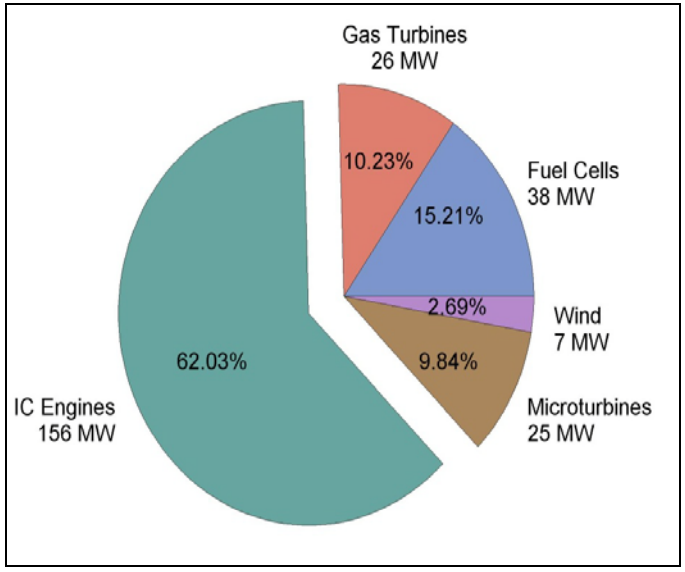
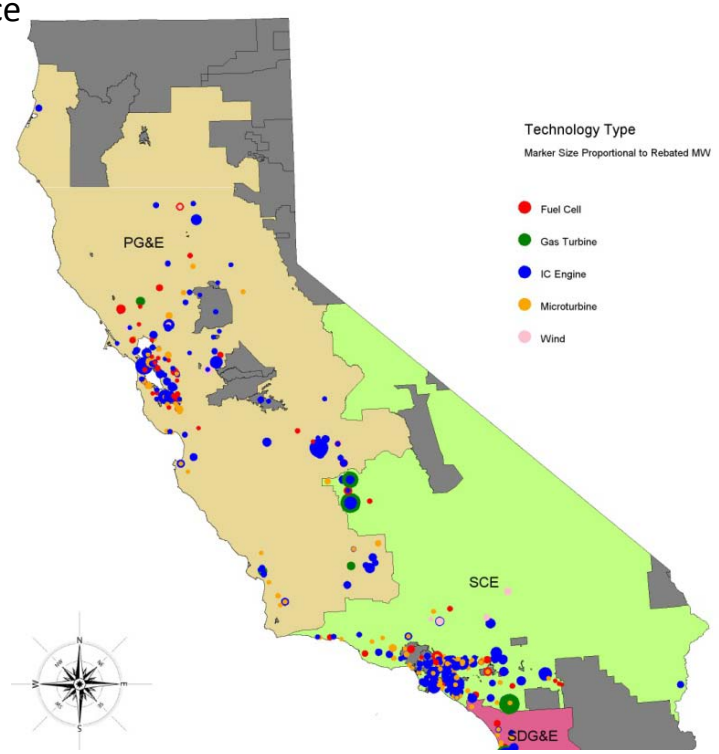
Itron's California Experience with Heat Metering

- Focused on California's Self-Generation Incentive Program (SGIP)
  - > Established as a peak demand program; primary goal now is GHG emission reductions
  - > More than 530 CHP projects representing over 240 MW of rebated capacity
  - > CHP technologies include conventional and renewable fueled IC engines, fuel cells, gas turbines and microturbines
- Since inception of the SGIP in 2001, Itron has been the prime evaluator
  - > Responsibilities include installation of electricity and heat metering; compilation of performance data; evaluation of technology and program performance



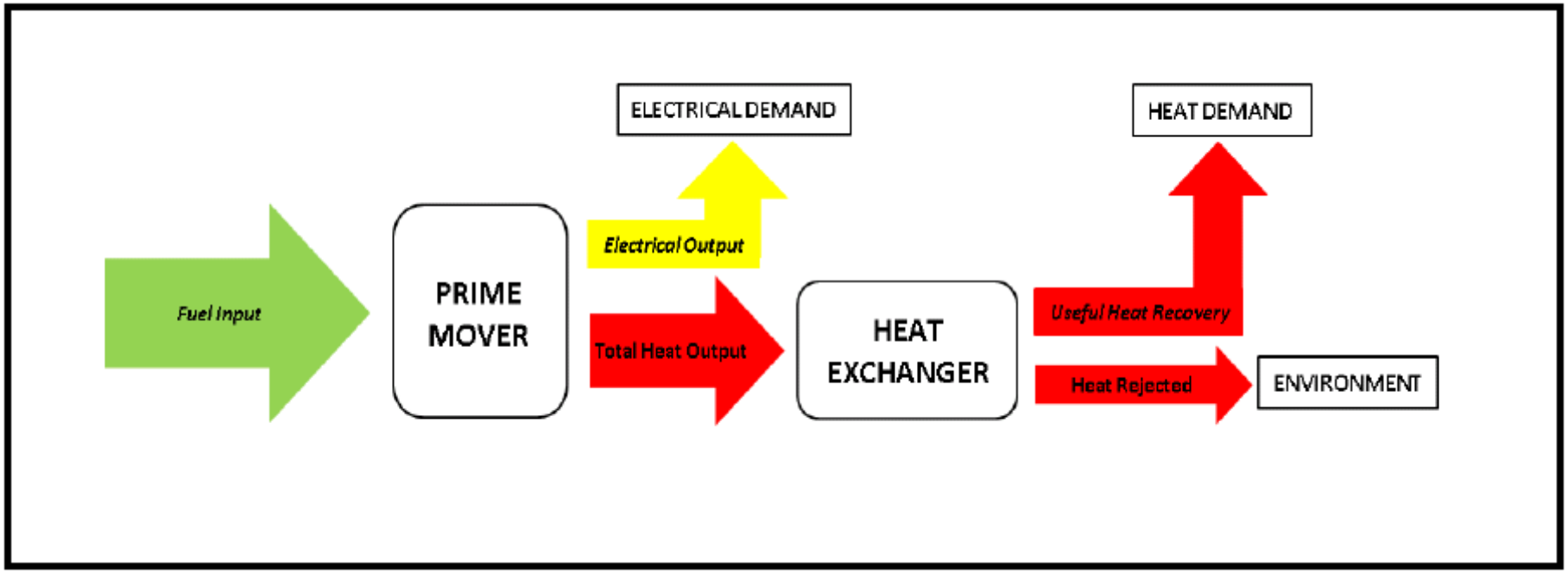


Heat Metering within the SGIP

- Metering useful waste heat recovery is important in SGIP on several fronts:
  - > Meeting program efficiency requirements
    - PUC 216.6(b) requires the sum of the electric generation and half of the useful recovery heat from the CHP project exceed 42.5% of the energy entering the project as fuel on an annual basis
    - ICE, MT and GT system efficiencies ≥ 60%
  - > Impacts on GHG emissions
    - Primary goal of SGIP is to achieve net GHG emission reductions
    - Useful waste heat recovery is key to obtaining net GHG emission reductions
  - > Economic viability
    - Appropriately high levels of useful waste heat recovery are needed to provide healthy financial returns to the project and ensure a sustainable CHP industry
- Waste heat is metered by hosts, project developers, third parties and Itron (as directed by PAs)
  - > Within the SGIP, nearly all waste heat recovery operations are hydronic (vs steam)
  - > Heat metering typically involves insertion meters as well as non-invasive systems (e.g., ultrasonic flow meters)

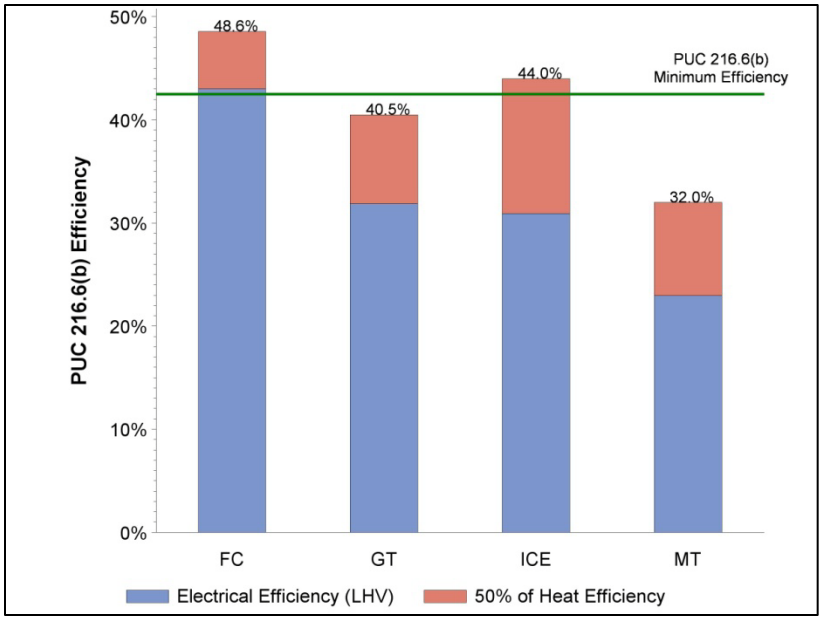
What is Useful Waste Heat Recovery?

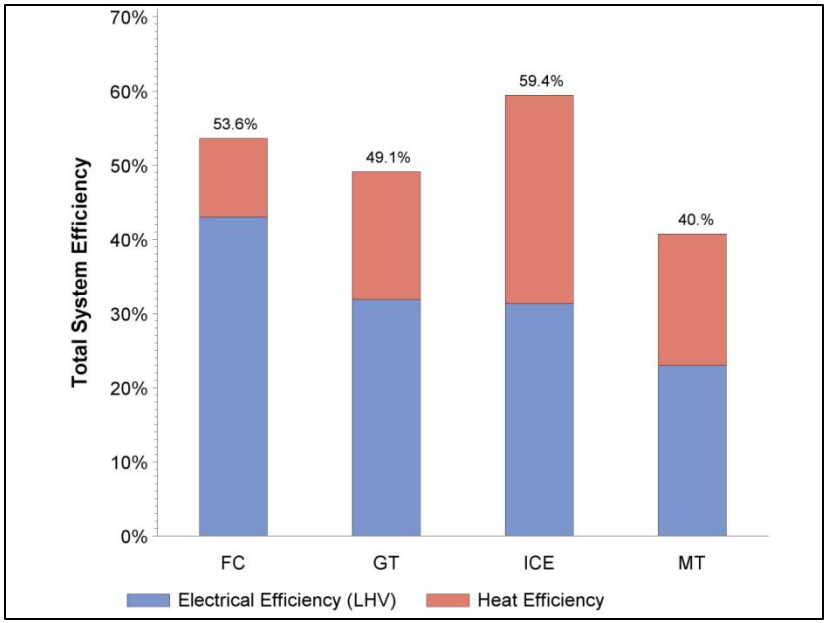
- Terminology can be confusing when going from equipment specifications to the field
- Equipment specifications often refer to total heat output (heat from the generator)
  - > May not be the same as useful waste heat recovered
  - > Useful waste heat impacted by many factors, including actual heat demand at the host facility (which can change daily or seasonally) and changes in the processes at the host facility



Useful Waste Heat Recovery and Efficiencies

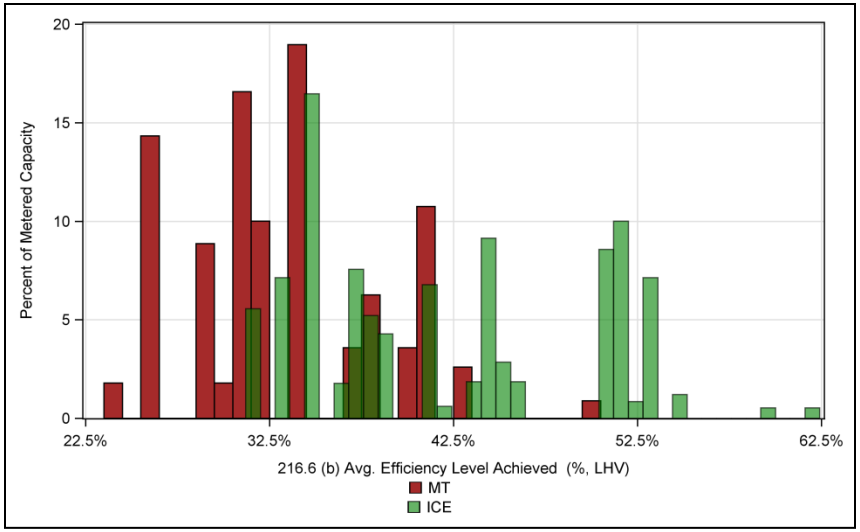
- For CHP systems with lower electrical efficiencies, useful waste heat recovery becomes of greater importance in achieving required efficiencies
- Across a fleet of CHP systems, policy makers and evaluators tend to look at average performances
- However, averages don't tell the whole story
  - > Distributions of CHP system efficiencies provides better insights

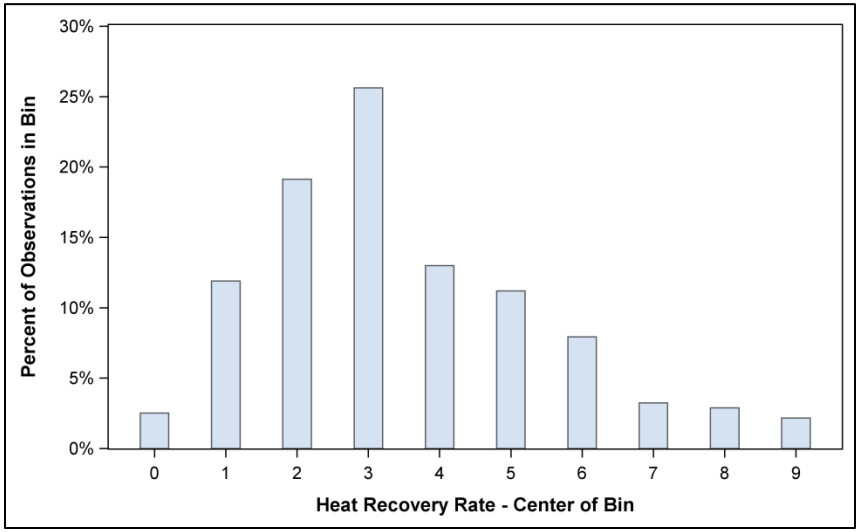




Efficiency Results with Distributions and Uncertainty

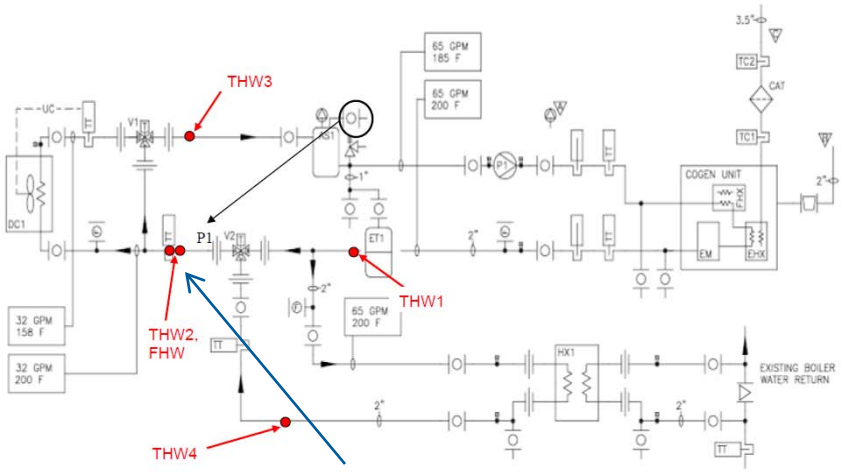
- Certainty of results is important
  - > Helps to measure progress towards goals
  - > Helps set future directions
- Statistical approach used to determine certainty of results across large populations
  - > We typically sample to achieve results with 90% confidence with 10% precision
  - > Sample size dependent on strata (e.g., PA & technology)
- Showing how results are distributed among the population helps identify frequency and magnitude of performance



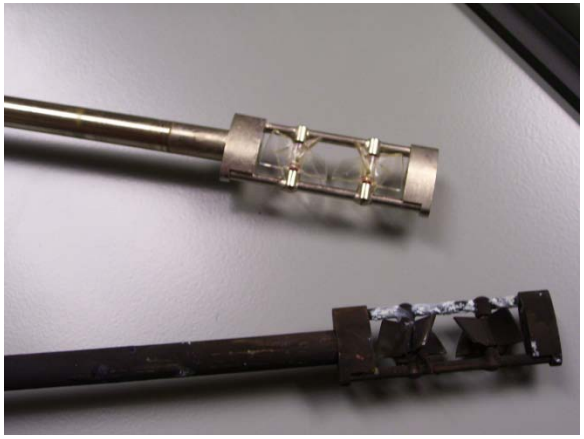


Factors Impacting Accuracy of Useful Waste Heat Recovery Performance Data

- Precision of metering equipment
  - > In field precision may not always meet manufacturer specifications
- Placement of sensors
  - > With more complex CHP systems, make sure temperature and flow sensor placement take into account side streams that impact UWHR
  - > System configurations may change over time
- Metering system performance over time
  - > Metering systems need to be maintained or will suffer from signal drift
  - > Insertion flow meter precision can deteriorate due to erosion/corrosion from fluids; max lifetime is 3 years w/o maintenance
- Instantaneous measurements versus performance recorded over time
  - > Instantaneous readings can give misleading results when compared to the same readings collected over time
  - > Performance over time also provides important trend information



Placement of flow meter here would not capture UWHR



Net GHG Emissions and Useful Waste Heat Recovery

- GHG emissions influenced by a number of factors
  - > GHG due to the electricity displaced from the grid by the CHP system
  - > GHG due to thermal energy displaced from on-site boilers/chillers from useful waste heat recovery by CHP system

GHG Impact = SGIP GHG– (Grid GHG + Thermal GHG)

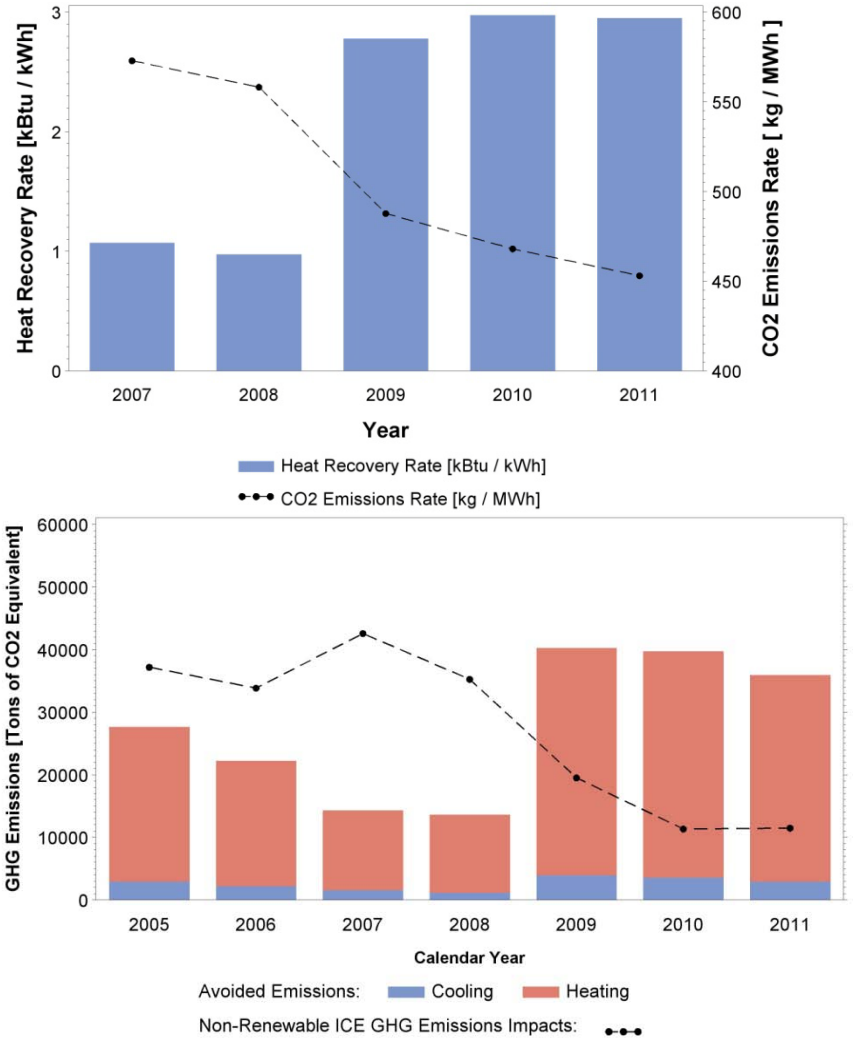
ENGO
FUEL

ENGO
GHG Baseline

HEAT
Heating End Use
Boiler Efficiency
Chiller COP

Impacts of Useful Waste Heat Recovery on GHG Emission Reductions

- Strong influence of UWHR on GHG emissions
  - > Since 2008, increasing heat recovery rates translate to reduced CO_2 emissions (GHG)
  - > Offset heating loads (reduced boiler fuel) has been the greatest driver to reduced GHG emissions



Economic Value of Useful Waste Heat Recovery

- We examined the costs and benefits of CHP technologies in the SGIP from different perspectives: owner, utility, rate payers (nationally at within CA) and society
- Useful waste heat provides value in different ways
  - > Avoided boiler fuel bills to owners
  - > Avoided gas costs to rate payers and society
- Example below shows one year (2015) results for 500 kW IC Engine (natural gas)