

# Charting a Course to Energy Independence

**Providence, RI**  
**August 9-12, 2009**

## *Submetering for Purpose and Profit*

Terry Sharp, P.E.  
J. Michael MacDonald  
Oak Ridge National Laboratory





# What Is Submetering?

- “Tracking energy usage past the point of the utility entrance”
- “Involves measuring and collecting detailed energy use data for one or more departments or production areas in a facility.” Energy Center of Wisconsin



# Why Submeter?

- “submetering typically reduces the consumption of electricity in apartments by 10-26 percent.” NYSERDA-2001
- “in FY09, the estimated annual steam use at this hospital is \$182k, but it’s steam plant allocation equates to \$1.1 mil”
- “you can’t manage what you don’t measure”



# Topics of Discussion

- Submetering applications - campus and building levels
- Examples
- Paying for submetering
- Future directions



# Why Campus Submetering?

- Improves billing equity
- Customers will desire it
- Provides/assigns more accountability
- Enables energy accounting
- Improves knowledge of building energy demands and performance
- EISA 2007 requires it



# Campus Submetering for Billing/ Utility Allocation: ORNL

- Oak Ridge National Laboratory (ORNL)
  - ▣ Over \$15 million energy bill
  - ▣ Billed internally to 67 customers
  - ▣ Average customer bill: \$224k
  - ▣ For billing:
    - Measuring electricity at buildings (prominent)
    - Allocating steam (natural gas)
    - Allocating water (measuring process water)
    - Metering being added to lessen allocations



# Campus Submetering for Performance Evaluation and Improvement

- LEED - Leadership in Energy & Environmental Design
  - ☐ Easy path to energy efficiency points is via building performance rating
- Energy Star
  - ☐ Building level data are required for performance rating
- Building level data can be used to track performance improvement



# Building Submetering: Prominent Applications

- Billing/Utility Allocation
- System or building efficiency
- Quantifying loads (building subsystems, process, thermal)
- Measurement and verification/quality control
- Cost avoidance



# Building Submetering: Billing Allocation in Computer Data Centers

Simulated Billing for a Data Center (\$1000s)

	Customer	Oct	May
TECHNICAL USAGE	1	1,324	1,276
	2	110	428
	3	0	107
	4	102	99
	Subtotal	1,539	1,914
COOLING USAGE	1	397	382
	2	33	129
	3	0	32
	4	30	30
	Subtotal	461	573
	<b>Total Bill</b>	<b>2,000</b>	<b>2,488</b>

} Large computer energy use

} Large cooling energy use

24% increase in 7 months

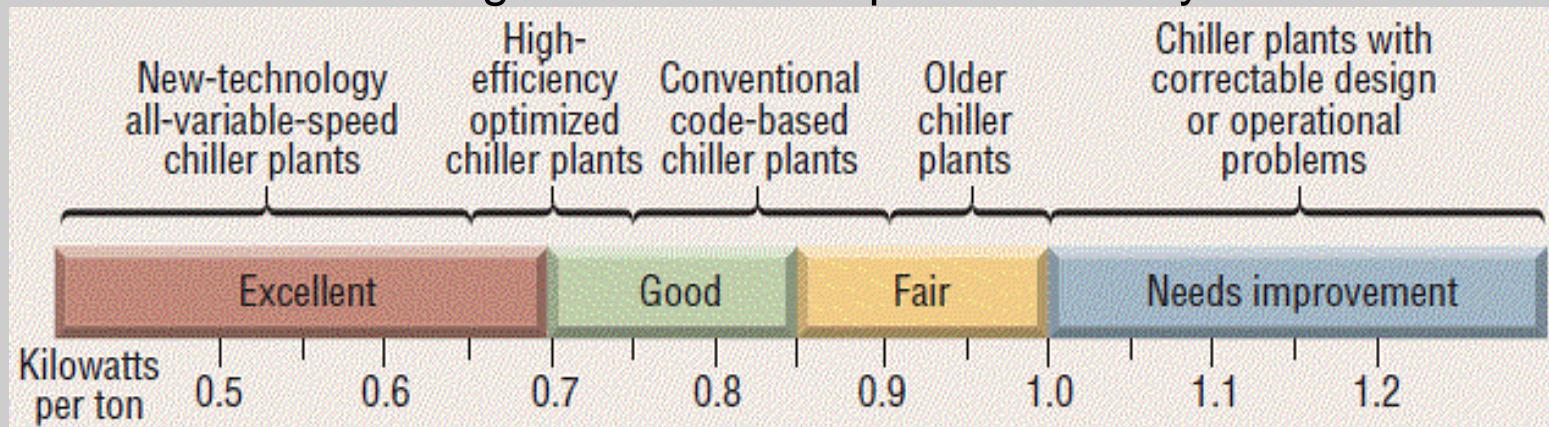
Note: Values are not accurate, but billing proportions are near actual.



# Building Submetering for System Evaluation: Chiller Plants

- Use submetered data to evaluate performance, monitor, and improve chiller plant efficiency

Average annual chiller-plant efficiency



Source: Ben Erpelding, "Ultraefficient All-Variable Speed Chilled-Water Plants", Heating, Piping, and Air Conditioning Engineering", March 2006.



# Building Submetering: Quantifying Loads and Generation

- Separating process loads
- Building analysis
- Simulation model calibration (audits)
- Building performance (mixed use buildings)
- Renewables



# Submetering for Measurement and Verification (M&V)

- Good candidates

- ▣ Building level

- Water efficiency upgrades in high-consuming buildings
    - Boiler replacements

- ▣ Process level

- Large motors converted to variable-speed drive



# Process Submetering for Cost Avoidance

- Cooling tower makeup water
  - ☒ A California hospital can save \$28k/yr via wastewater credit by metering makeup water
- Other wastewater credits via metering
  - ☒ Irrigation water
  - ☒ Steam plant makeup water



# Paying for Submetering

- Time to install is at construction/rehabilitation
- Justify based on risk reduction
- Justify for performance tracking
- Justify for process improvement or control
- Justify via expected savings: Guidance for Electric Metering in Federal Buildings, DOE/EE-0312

*Minimum  
Bill*

$$= \frac{\left[ \left( \frac{\text{Installed Cost}}{\text{Desired Simple Payback}} \right) + \text{Annual Cost} \right]}{\% \text{ Annual Savings}}$$



# Future: Construction Guidance is Promoting Submetering

- If renewable generation exceeds a threshold, submetering will be required
- If you are providing power to the grid, esp. for credit, it will need to be measured
- ASHRAE building performance specifications will push submetering (assessing mixed use buildings)
- Federal legislation requires meter installation at renovation (next up – submetering?)



# Summary

- Think outside the box -- beyond billing, submetering has many valuable applications
- More and more, buildings should be designed with energy metering in mind
- Metering/submetering should be considered in every renovation project
- Revised building design standards will promote submetering
- Submetering can range from very affordable to costly – submeter accordingly