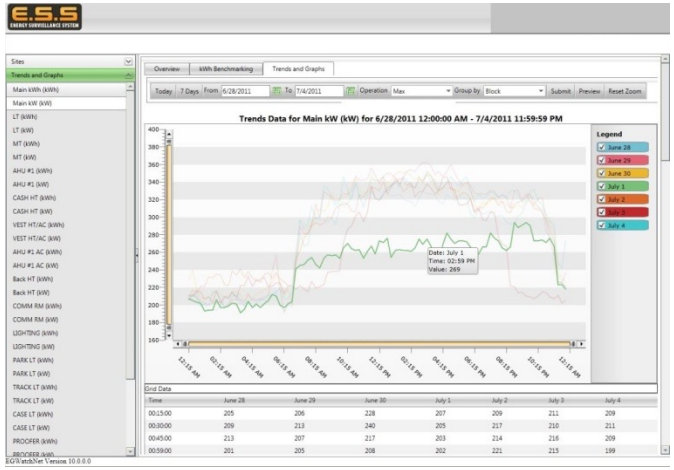
Measurement Tools & Verification of Savings Calculations

G. Sources of Data and Measurement

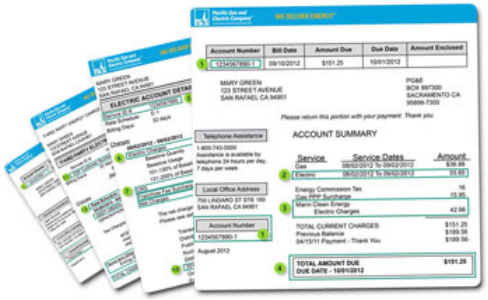
G. Sources of Data and Measurement Instruments

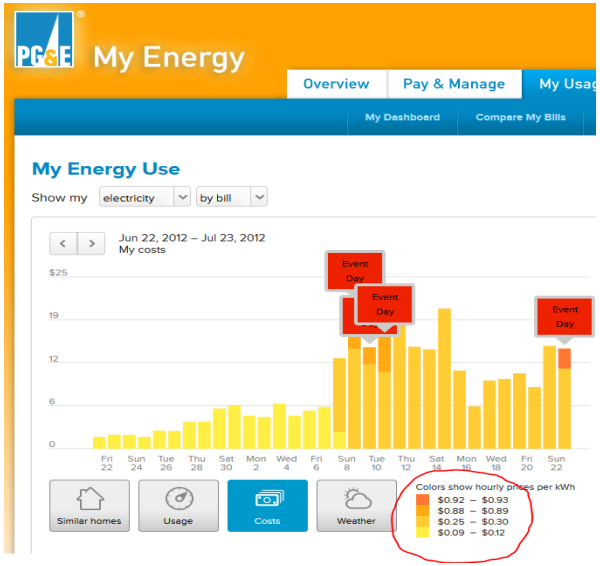


Whole Building

Electric/Natural Gas

1. Monthly bills
2. Time of use meters (large facilities)
3. Smart meters (everyone else)

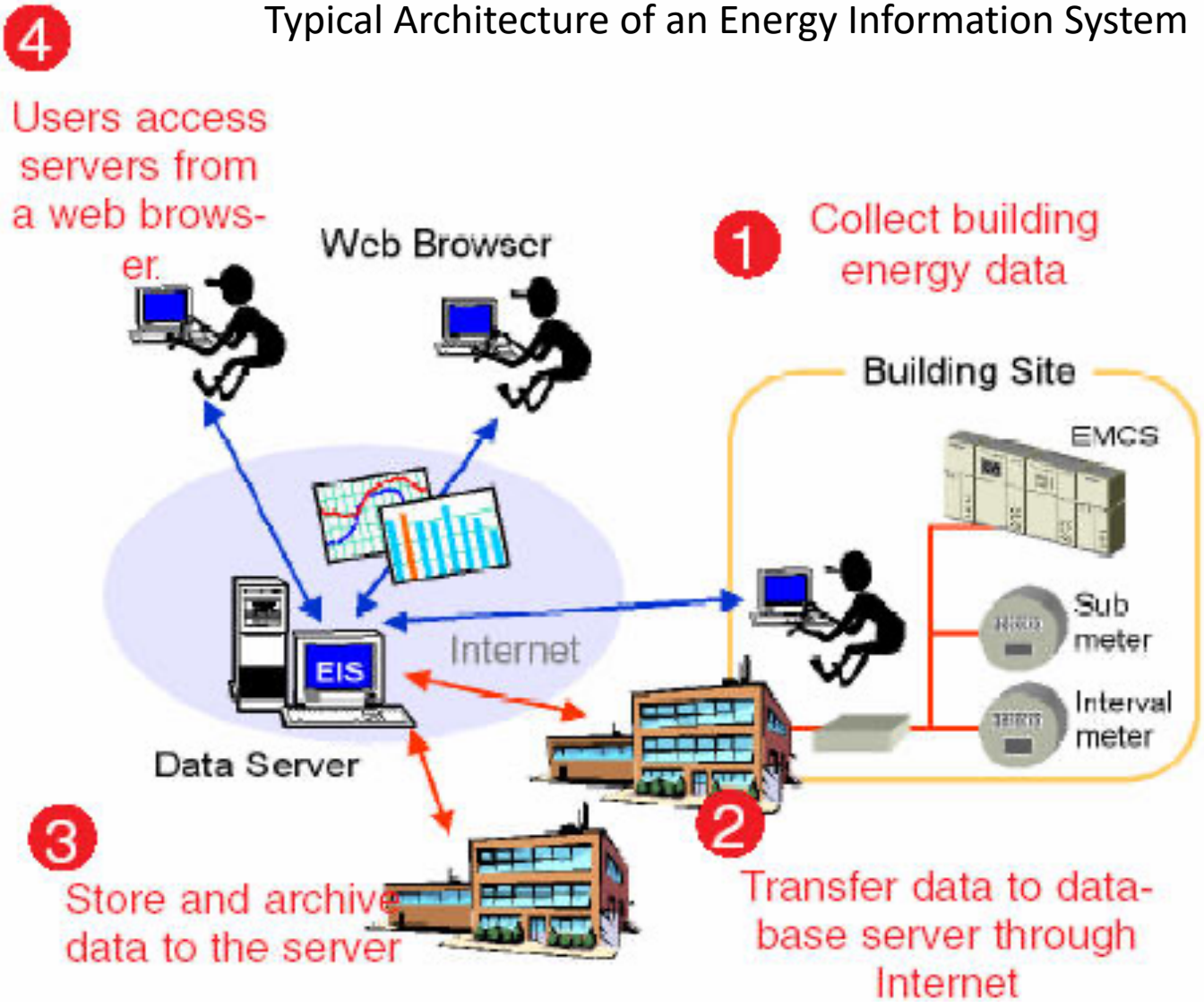




Whole Building

4. Advanced metering or Energy Information systems (EIS)
   a. customer owned, non-revenue grade
   b. System of meters, communication nodes, data storage
   c. User Display Screens

Typical Architecture of an Energy Information System



Building Subsystems

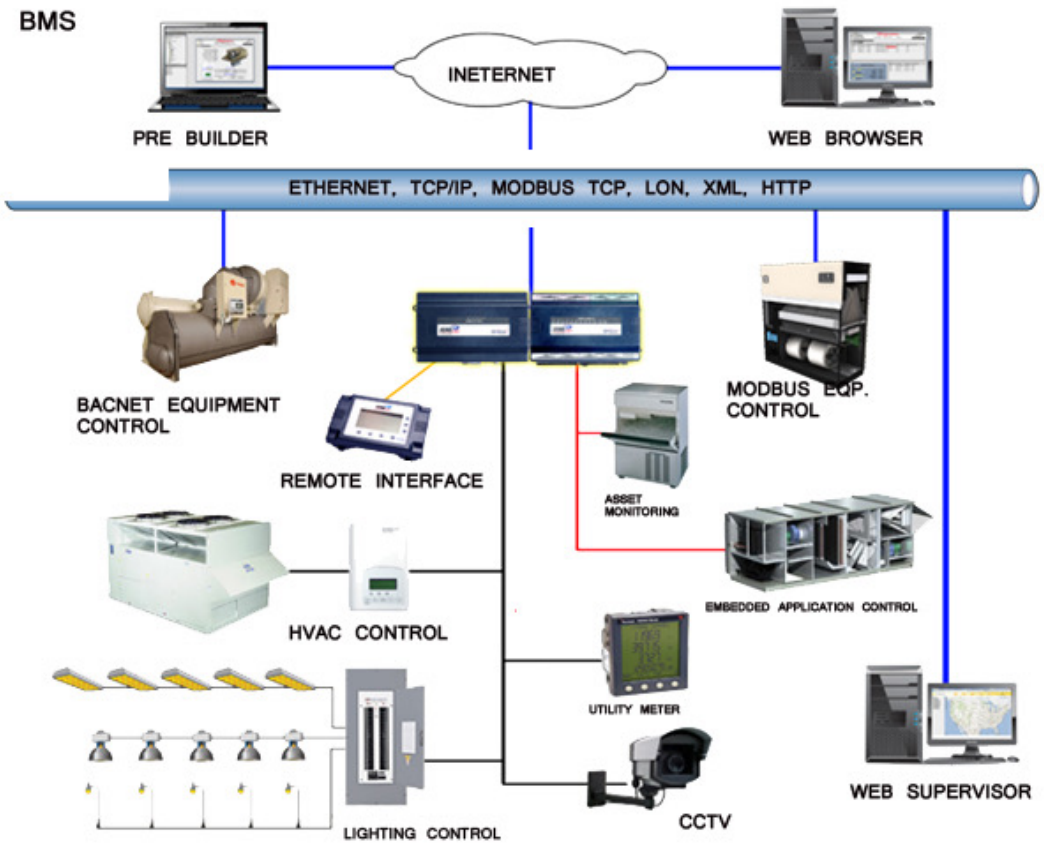
Building automation system (BAS)

- Metasys (Johnson Controls)
- Alerton Technologies
- Siemens Building Technologies
- Trane

See www.ddc-online.org

Energy Management and Information Systems

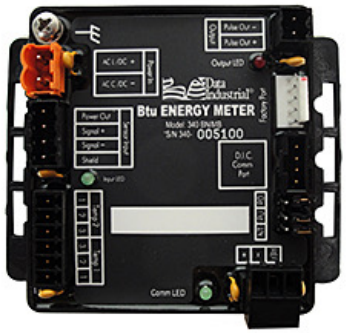
- PowerLogic ION Enterprise Software
- Obvius
- others



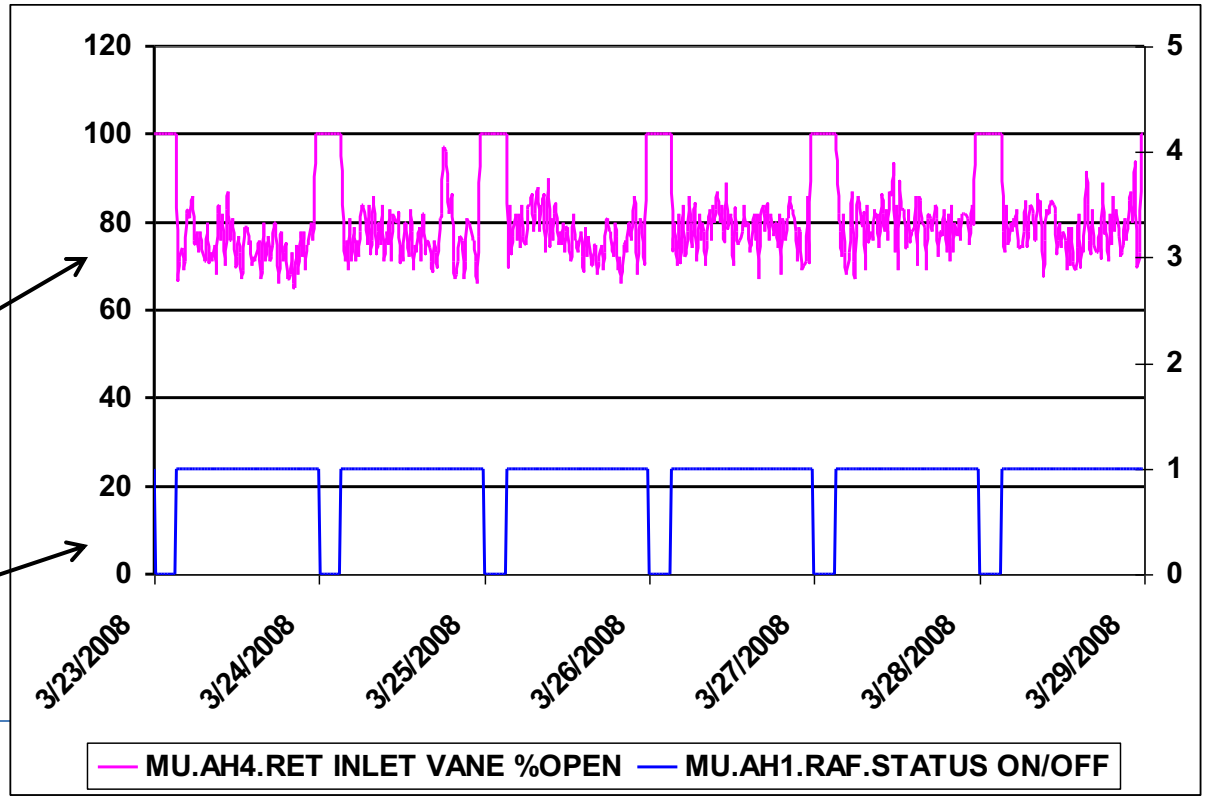
Building Subsystems

Typical data available

1. Sub-meters
   a. electric
   b. BTU meters from central plants
2. Status/feedback signals (from BAS)
   a. Variable load
      - VFD speed signal
      - inlet guide vane position
   b. Constant Load
      - equipment on/off



A Sub-Meter by Badger Meter Inc.



Building Subsystems

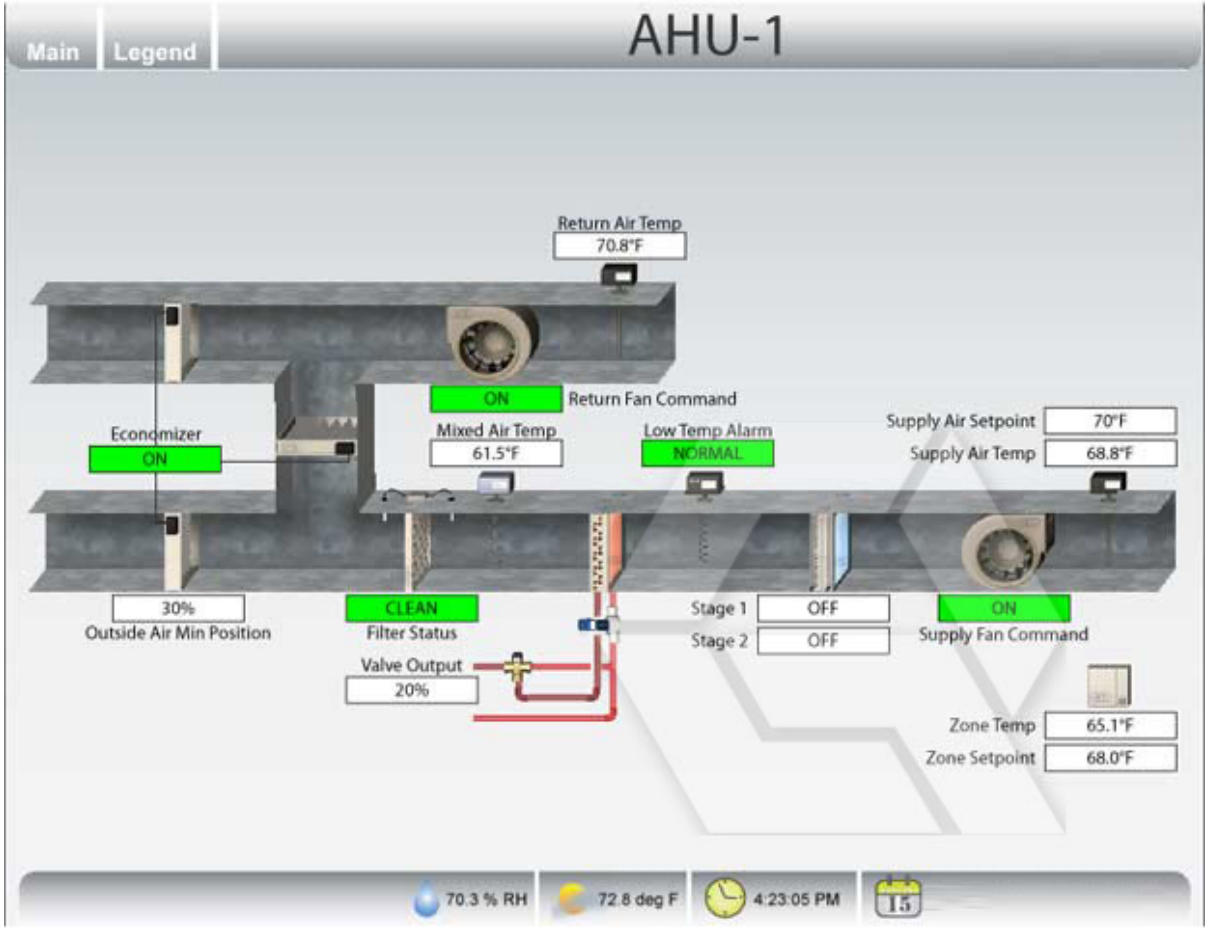
Sensor data:

a. Ambient temperature (local)

b. Indoor temperature

c. Supply and Return temperatures (water or air)

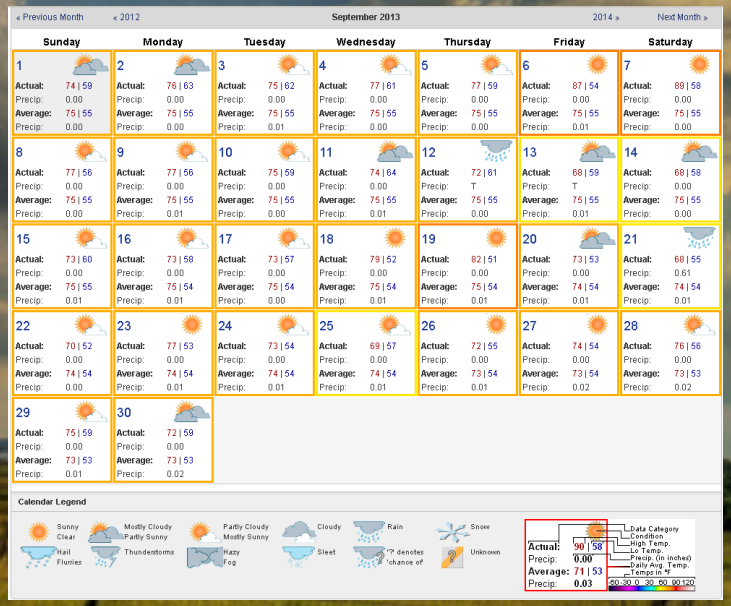
d. Make sure to check sensor calibration and for gaps or missing values in sensor data

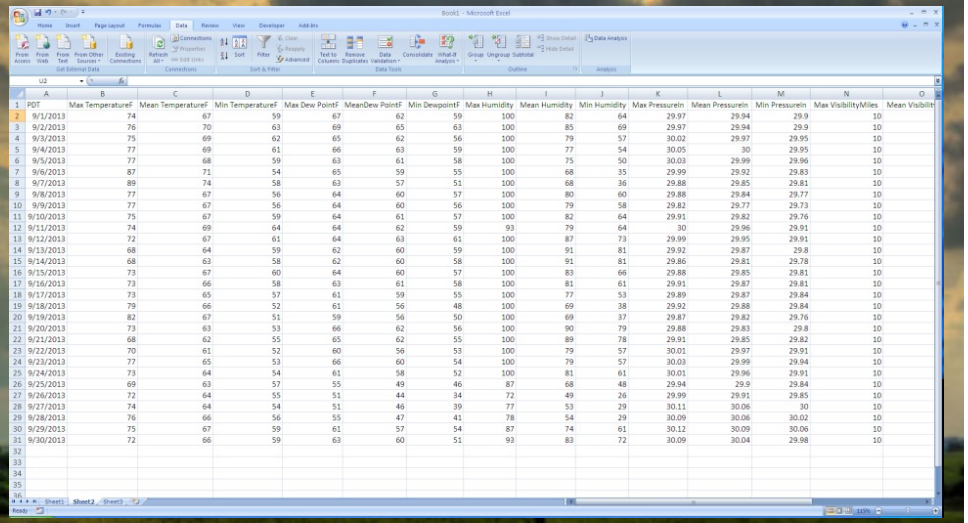


Weather Data

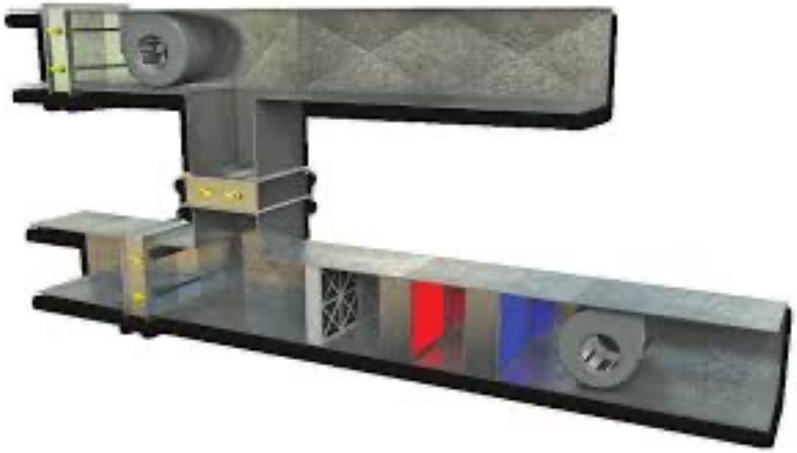
Websites – NOAA, weather underground

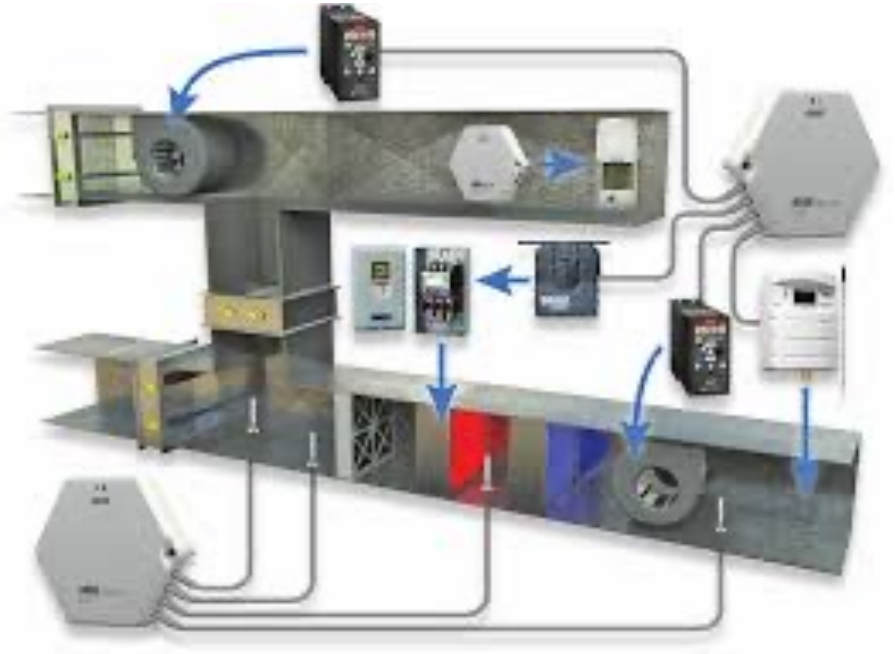
- TMY data (from NREL)





Measurement Devices





Electrical Metering

Watts = Amps x Volts x Power Factor

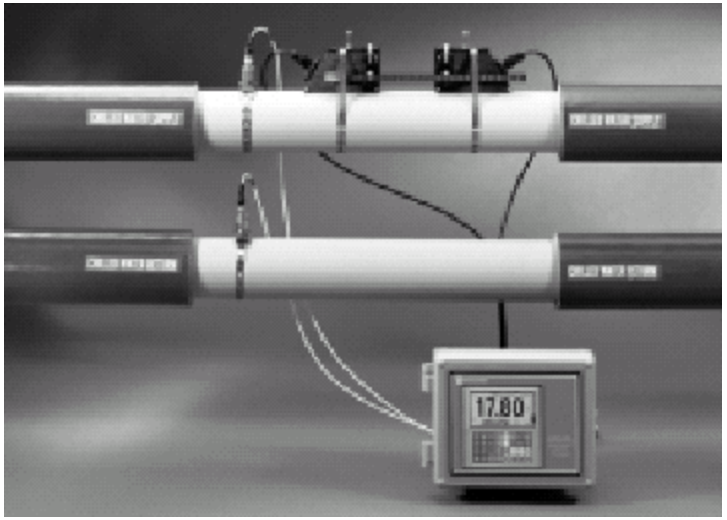
- Power factor is important. For restrictive loads (e.g. incandescent lighting), PF = 1.0 and amps and volts are all that must be measured. For inductive loads, PF must be measured or estimated
- Harmonic distortion may also influence readings

Always measure the **true RMS Watts**, not simply amps and volts, to include all possible power factor and harmonic influences.

Thermal Energy Meters

Thermal energy meters measure energy rate provided by hot and cold water, often from a central plant to a building.

- Require 2 temperature sensors and a flow meter
- Temperature and flow sensors may be intrusive or surface-mounted
- Sources of error from three measurement elements
- Expensive!

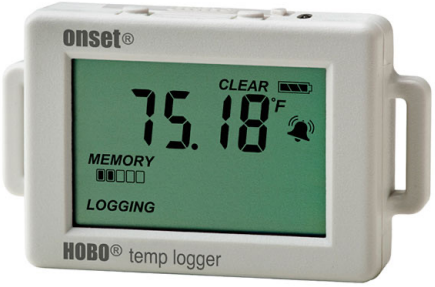


Measurement Devices

Data loggers

1. HOBO
2. Pace
3. Dent
4. Etc.

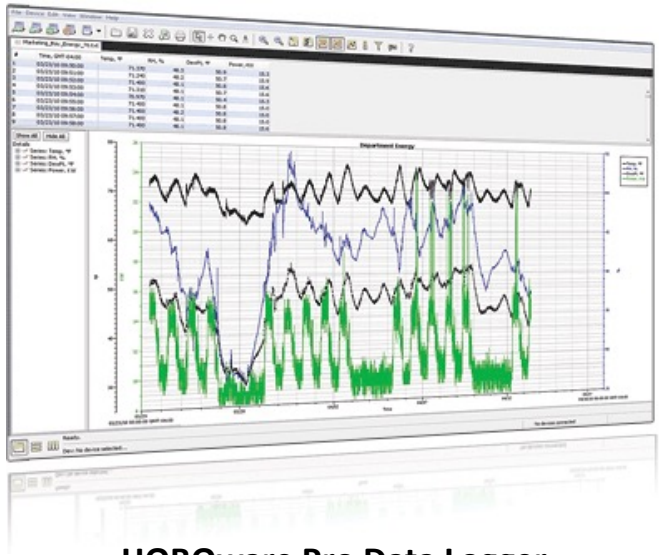
Outdoor Air Temperature Sensor



Indoor Temperature Logger

4-Channel Data Logger

Electrical Power Logger



HOBOware Pro Data Logger Software

Measurement Devices

Spot measurement instruments

1. Powersight
2. Fluke Meters
3. Raytek Laser Thermometer
4. Source: PG&E Tool Lending Library

http://www.pge.com/pec/tll/

PowerSight Power Analyzer

Raytek Laser Thermometer

BEST Center Curricula, Resources & Recordings

Academic Programs
Georgia Piedmont Technical College - Building Automation Systems
Milwaukee Area Technical College - Sustainable Facilities Operations
Laney College - Commercial HVAC Systems
City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos
National Institutes
Building Automation Systems Instructor Workshops
Webinars (e.g., BEST Talks)

Faculty Profile Videos
Reports & Case Studies
Marketing Resources

BEST
Building Efficiency for a Sustainable Tomorrow

NSF National Science Foundation