

# Measurement Tools & Verification of Savings Calculations

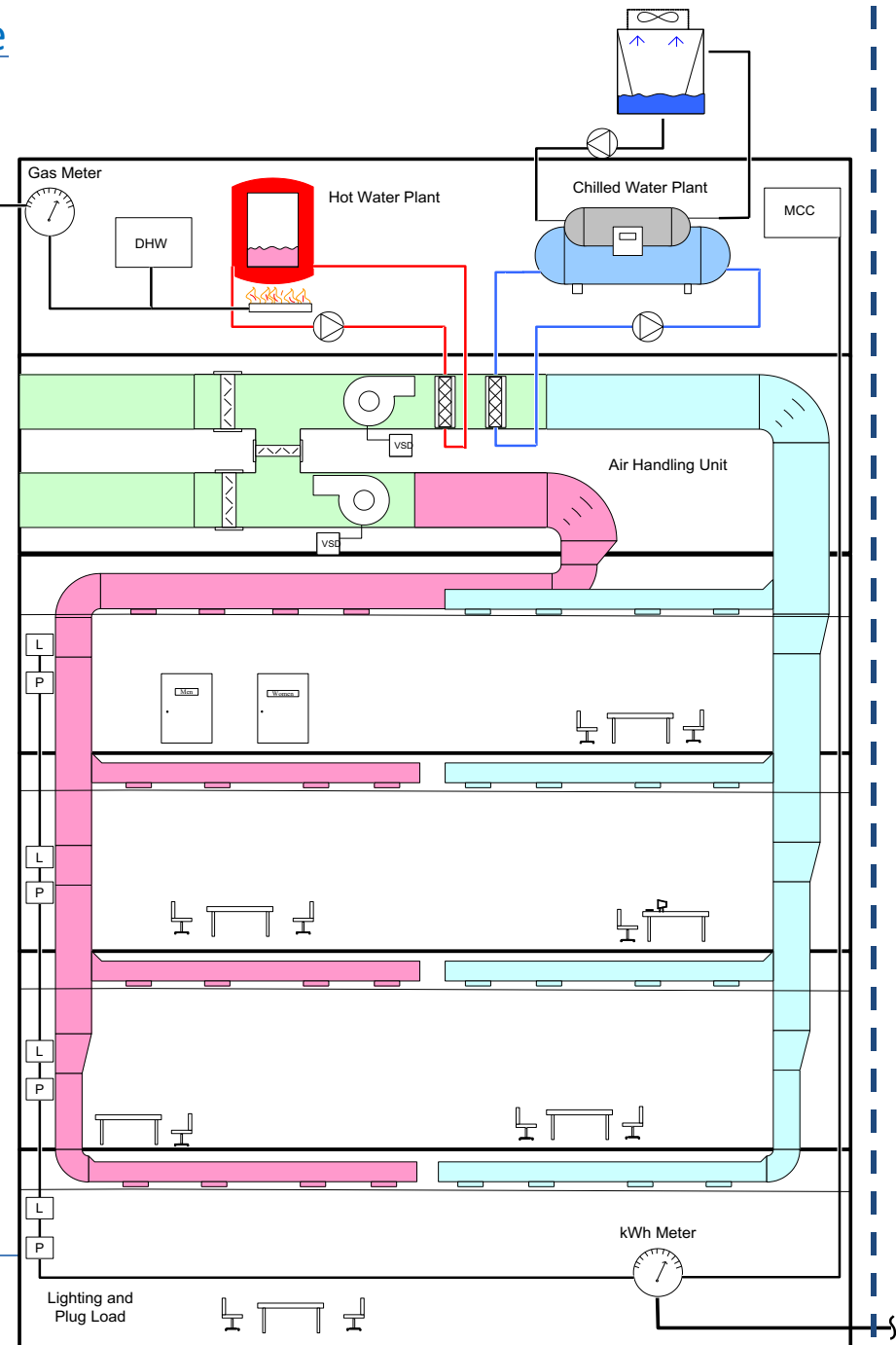
## D. Measurement Boundary

## D. Measurement Boundary

- Imaginary boundary around a building, a system, or a piece of equipment
  - EEM affects energy consumption within measurement boundary
  - Must account for all energy across the boundary
- Measurement boundaries are selected based on
  - Number of EEMs
  - Number of systems affected by the EEMs
  - Amount of savings
  - Availability of data / potential to obtain data
  - Goals of project

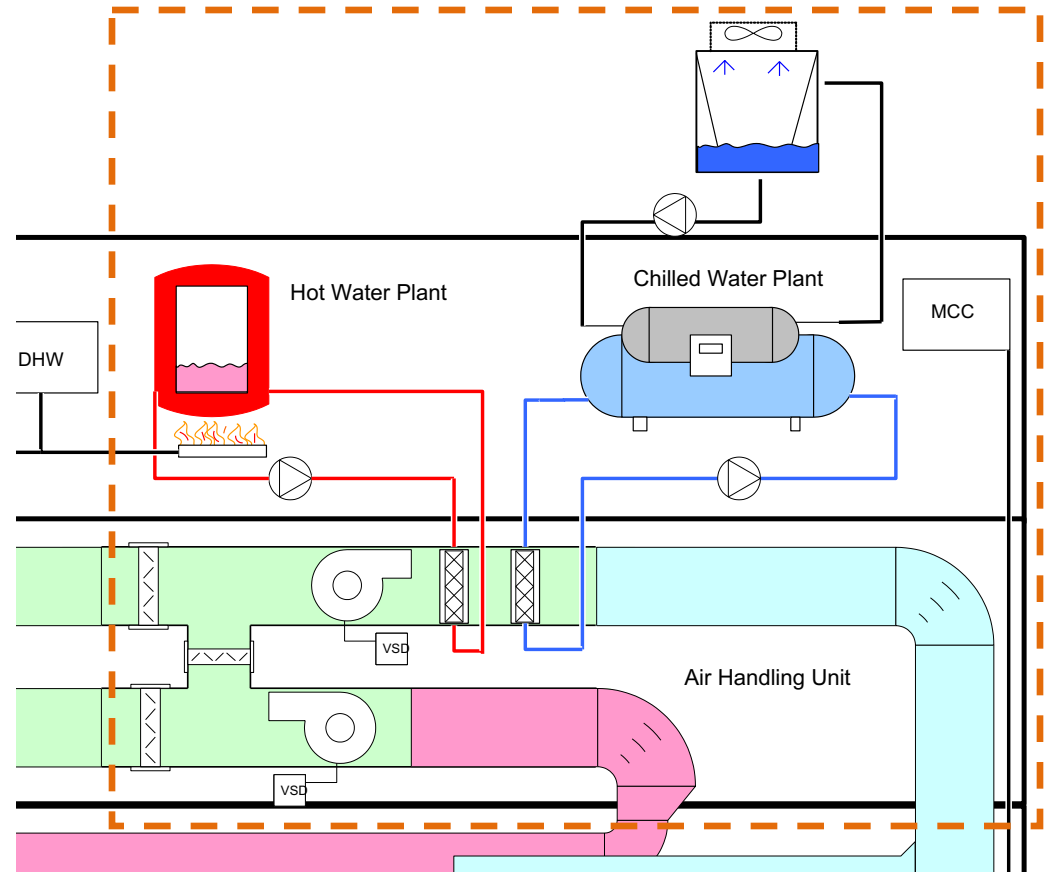
# Measurement Boundary

- Whole Building
  - Includes all systems
    - Good when multiple systems affected
  - Relatively few data sources:
    - Main utility meters (gas and electric)
    - Local weather data
  - Savings must be large (> 10%)
  - Includes
    - Interactive effects
    - All other effects



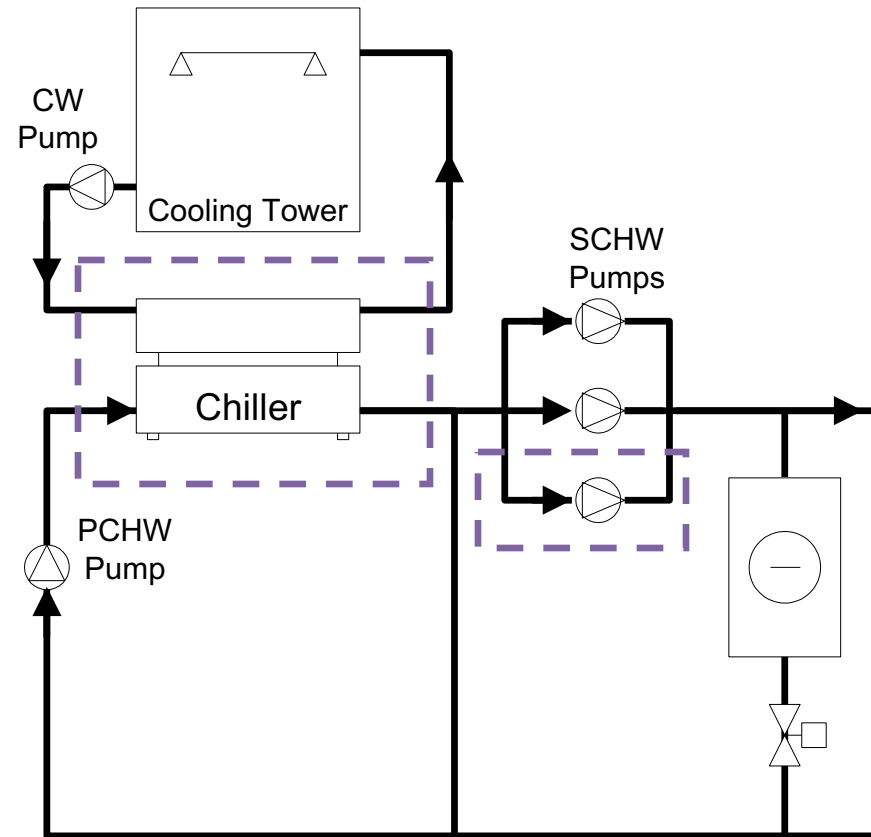
# Measurement Boundary

- Building subsystem (HVAC)
  - Chiller, CHWP, CT, CWP, HWP, Supply & Return fans
  - Multiple data points needed:
    - kW or status on each component
    - Sources: EMS trend logs, data loggers, submeters
  - Savings must be large only in relation to annual system energy use
  - Only accounts for savings within system



# Measurement Boundary

- Equipment
  - e.g. Chiller only, pump only, lighting, etc.
  - Few data points
    - Supply, return water temps, flow
    - Chiller kW, OAT
  - Savings for equipment only



# Convenient Boundary Definitions

- By California End-Use Survey End-Use Categories
  - Reference: <http://www.energy.ca.gov/ceus>

## HVAC

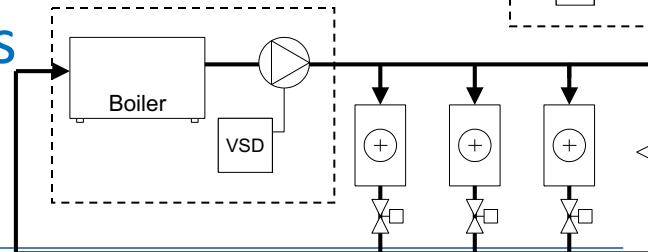
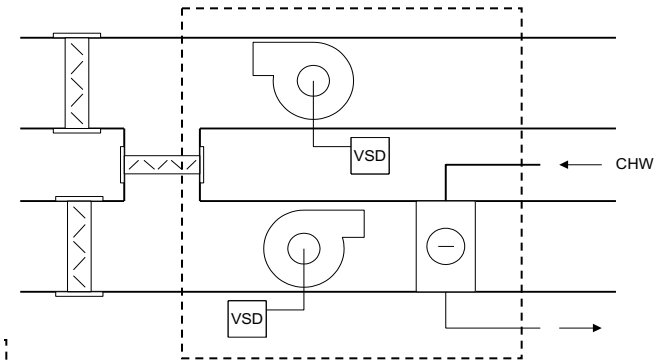
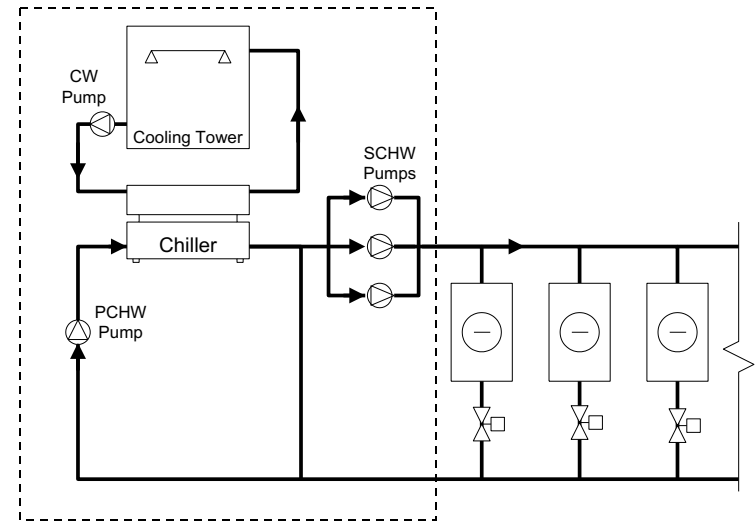
Space Heating  
Space Cooling  
Ventilation

## Non-HVAC

Cooking  
Refrigeration  
Air Compressors  
Domestic Water Heating  
Inside Lighting  
Outdoor Lighting  
Office Equipment  
Miscellaneous Equipment  
Motors

# System Boundary by 'Service Provided'

- Chilled water system:
  - Chiller, CHW pumps, etc.
- Air handling system:
  - Supply fan, return fan, exhaust
- Hot water system:
  - Boiler, HW pumps



# 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

© 2013-2025 by BEST Center: NSF National Center for Building Technician Education is licensed under Creative Commons Attribution-Non Commercial (CC BY-NC) 4.0 International.

To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc/4.0/>

 CC BY-NC 4.0

# Attribution-NonCommercial 4.0

