

# Determining Waste of Water and Energy in Residential Hot Water Distribution Systems

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LBNL

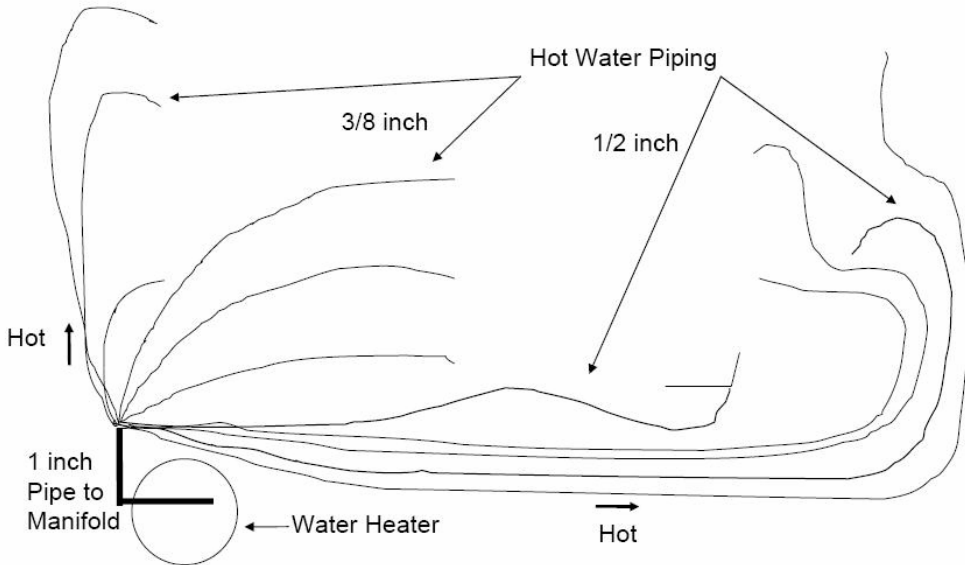
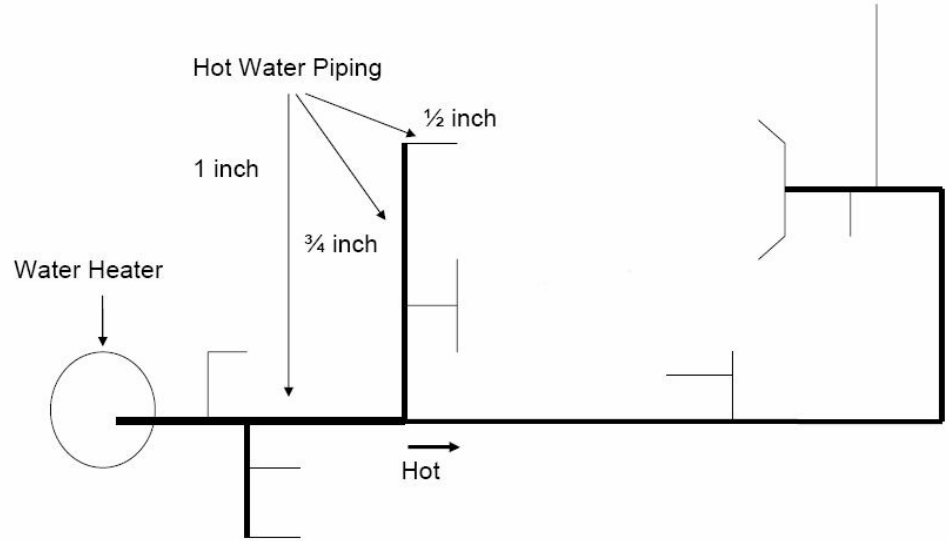
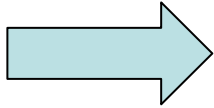
# Objective

- Measure how much water and energy is wasted in hot water distribution systems in California residences
  - Conventional plumbing
  - Structured plumbing
- Investigate effectiveness of retrofit options to reduce this waste of water and energy
  - On-demand recirculation system

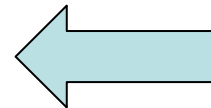
# Research Plan

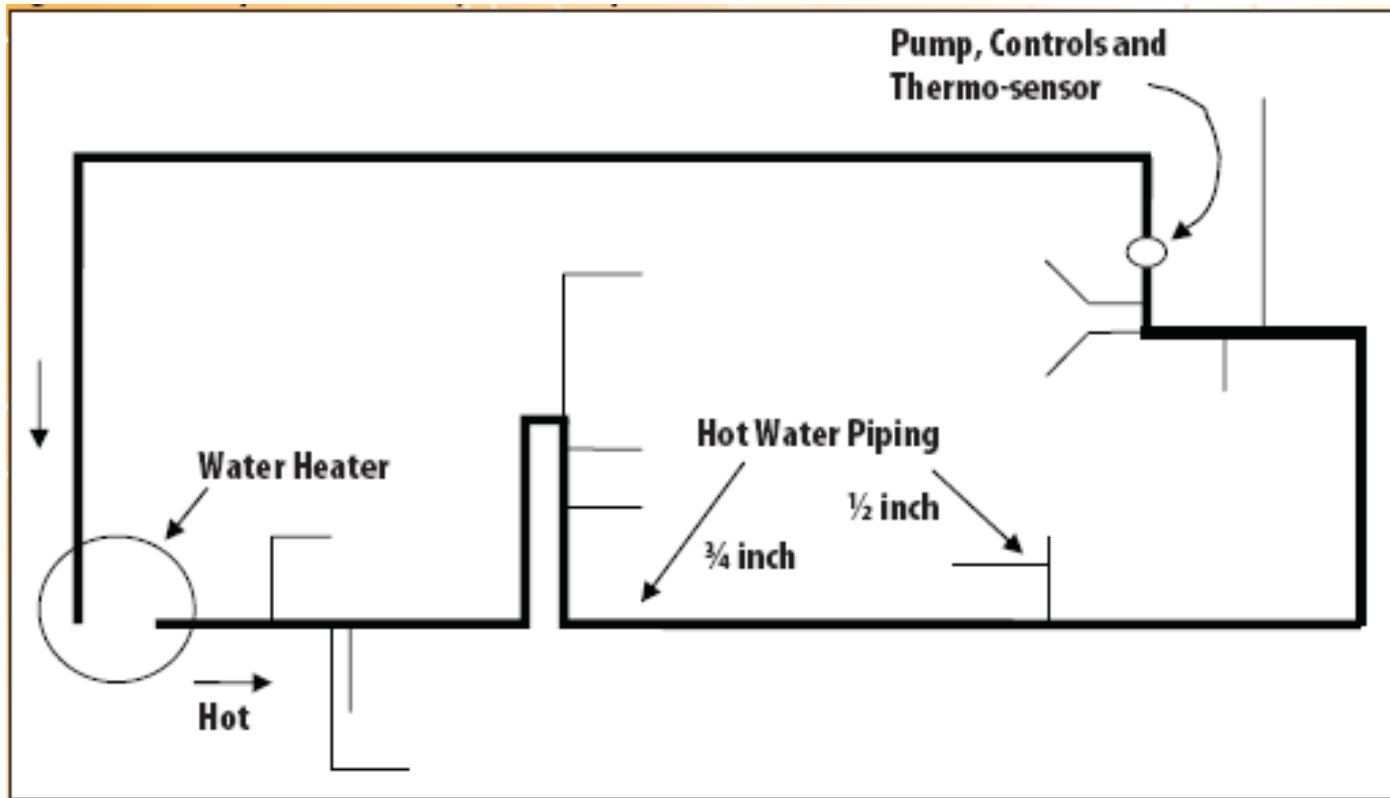
- Pilot phase – instrument a few houses
- Field study – up to 50 houses – mostly new houses
- New houses
  - Same floor plan but different plumbing so we compare
- Existing houses
  - After initial testing - retrofit existing system to on-demand recirculation

# Trunk & Branch

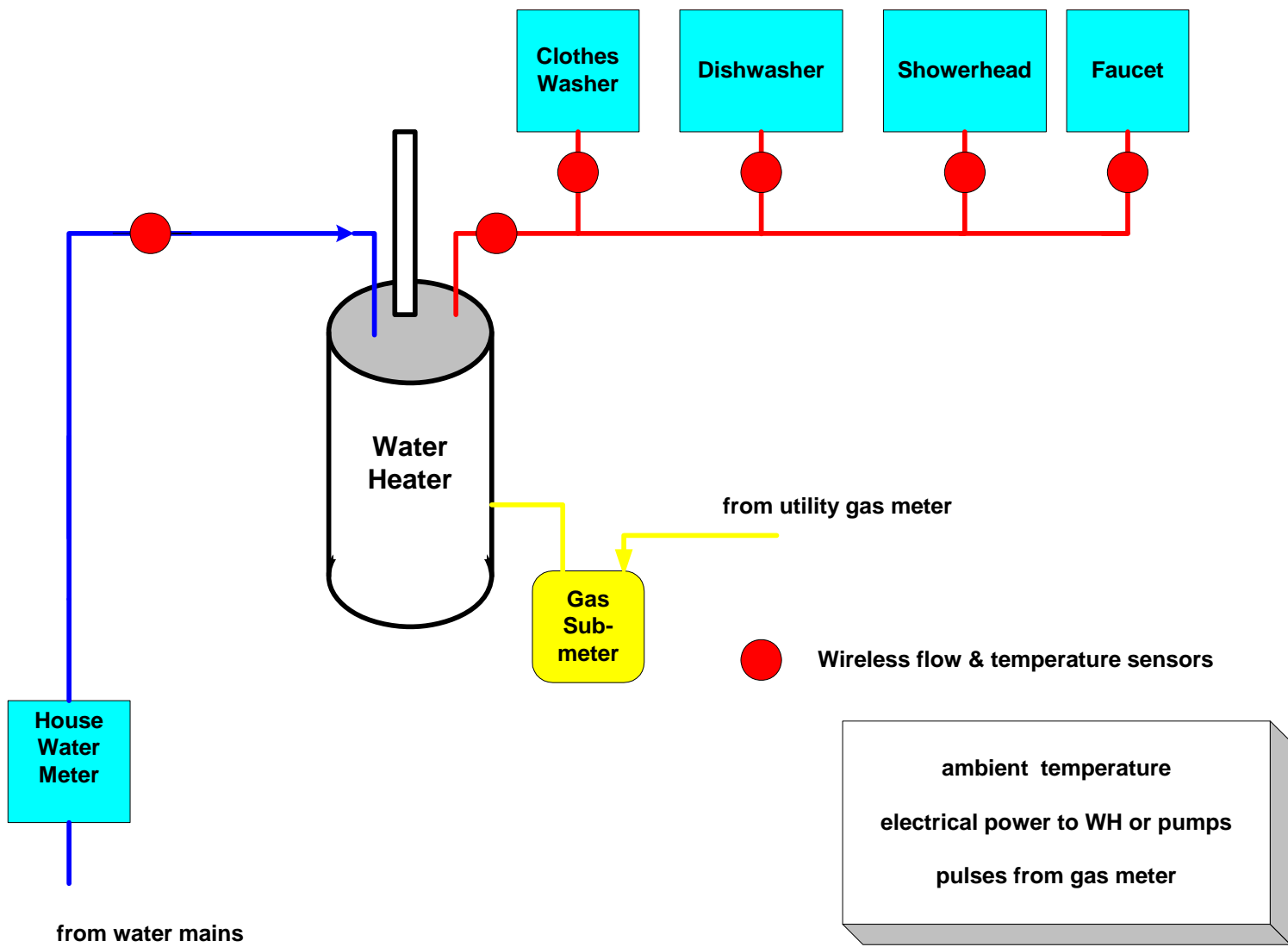


# Manifold or "Home Run"





Structured Plumbing

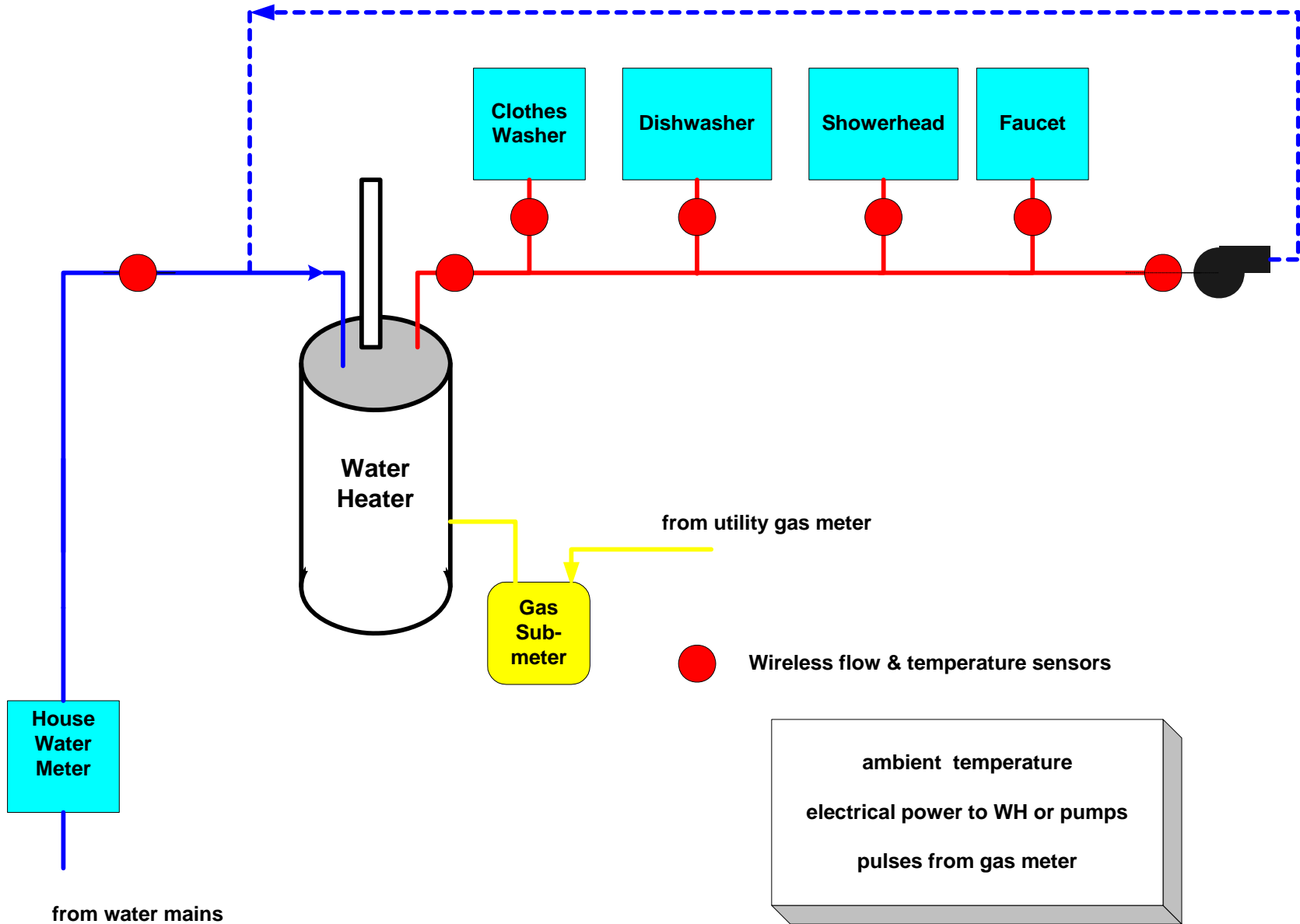


from water mains

from utility gas meter

Wireless flow & temperature sensors

ambient temperature  
electrical power to WH or pumps  
pulses from gas meter



House Water Meter

from water mains

Water Heater

Clothes Washer

Dishwasher

Showerhead

Faucet

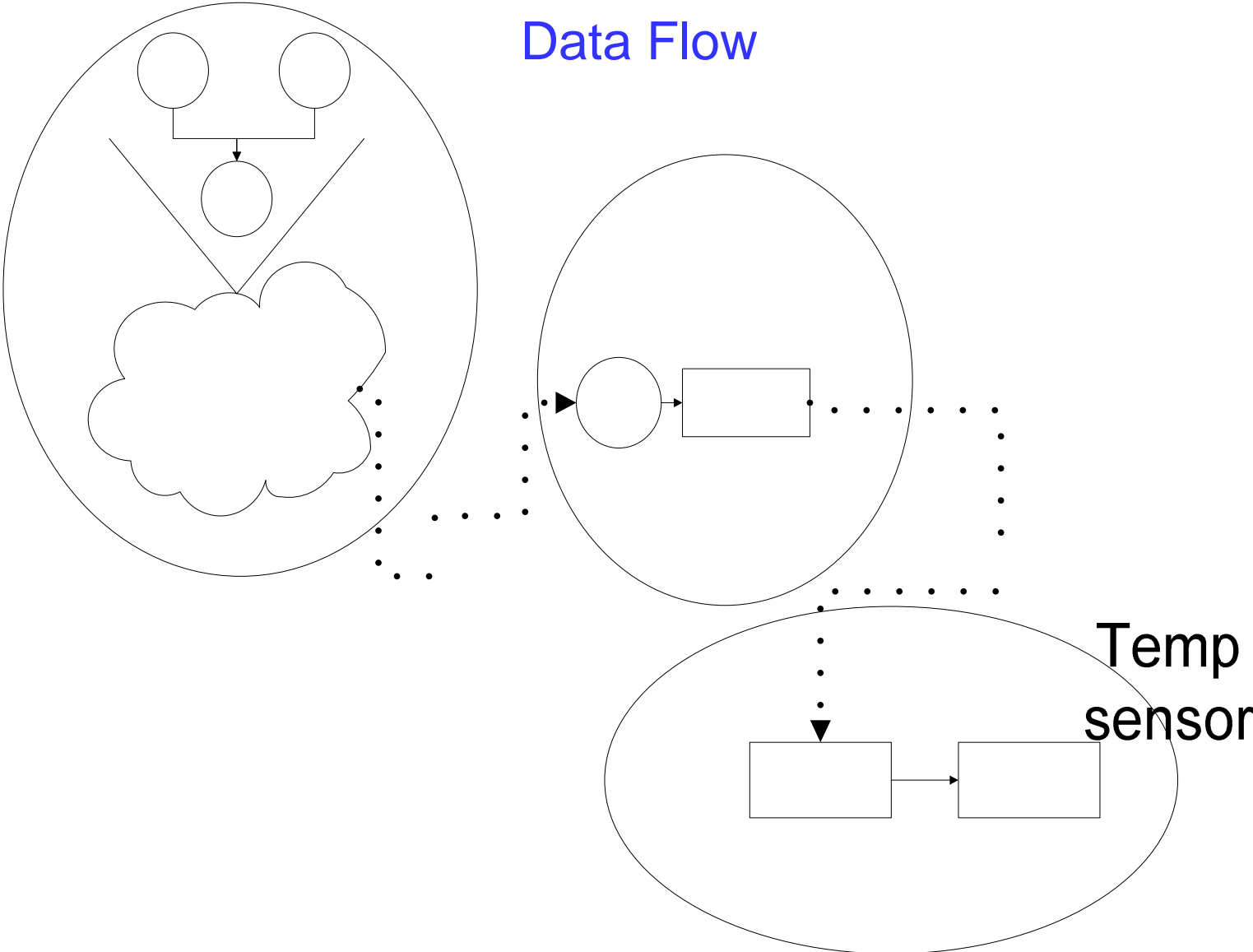
Gas Sub-meter

from utility gas meter

Wireless flow & temperature sensors

- ambient temperature
- electrical power to WH or pumps
- pulses from gas meter

# Data Flow



# Energy Wasted

- Heat loss as pipes cool down between hot water draws
- Heat loss from pipe during draw
- Hot water that never gets to the fixture for short draws
- Reheat of water by a dishwashers internal electric heater
  - (also for some clothes washers)

# Water Wasted

- The amount of water that goes down the drain while the user waits for the hot water to get to the end-use
  - E.g., at shower
  - At sink (if person waits for hot water)
- Water down drain after hot water reaches shower but person is not waiting at the shower (behavioral)

# What makes this research different?

- Measures flow and temperature at each end use at one second intervals
- Measures Water Heater efficiency & entire hot water system including plumbing to end-use

# Instrumentation

- Motes Data Acquisition
  - Wireless
    - 1 second intervals
    - Time synchronized
    - unobstrusive
- Thermistors
  - Probe in water – not pipe surface
- Wiegand pickoffs on turbine flow meter
  - No power consumption
  - High resolution flow meter
- Electrical power meter
- Gas meter
  - Temp
  - Pressure
  - HHV

# Benefits

- Data useful in determining how and where water and energy is wasted
- Results can be used in T-24
- Provide input to IAMPMO green plumbing code (UPS)
- Help water utilities devise programs to promote efficient HWDS

# Discussion

- Test parameters
  - Do we need to measure cold water at end-use as well?
  - Duration of test? One year?
  - Accuracy needed?
- How should the data be used?
  - If people wash their hands in cold water do we care as long as hot water is saved?
- Waste from shower pressure type mixing valves