Hot Water 101

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Disclaimer

- Speaker's Credentials
- Speaker's Prejudices:
  - Discuss primarily gas water heating
  - Focus on whole-home water heaters rather than point of use water heaters.
  - Economics is paramount.
- Speaker's Goal
  - Provide honest, objective information about water heating technologies.
  - Give the audience the background and understanding to make appropriate water heating choices.

Class Outline

- Introduction
  - High Performance Hot Water Systems
  - Why Hot Water?
  - The “Hot Water Problem”
  - Hot Water Systems
- Water Heating Technologies
  - Gas Storage
  - Electric Storage (HPWH)
  - Tankless
  - How Do I Choose?
- Hot Water Distribution
  - Typical Systems
  - Improving Distribution
  - Recirculation Systems
- What should a homeowner do?

High Performance Hot Water Systems?

- “Hot Water Now”
- Never Run Out of Hot Water
- Energy Efficient
- Water Efficient

Why should high performance hot water systems be installed in new homes?

- The homes built today will be around for the next 50 years or more.
- Every homeowner will grateful every time they use hot water!

Why should hot water systems in existing homes be upgraded?

- Your home is likely to be around a lot longer than you are.
- You will be pleased every time you use hot water or pay your water bill!

How Big is Hot Water?

Water heating is the 1st or 2nd largest residential energy end-use: 15 – 30% of a house's total energy pie.

- What is number 1? Number 3?
- Percentage grows as houses and appliances get more efficient

How does this compare to your:

- Cell phone bill?
- Internet bill?
- Cable or Satellite bill?
- Starbucks bill?

Annual Energy Use for Heating Water

	Natural Gas	Electricity
Gallons Per Day	60	
Gallons Per Year	21,900	
Energy into Water	16.4 Million Btu	
Efficiency	0.6	0.9
Cost per Unit	$1.00/therm	$0.10/kWh
Cost per Year	$275	$535

Assumes hot water is 90 degrees F above incoming cold water. Cost per year has been rounded off.

Add about $110 per year for water and sewer (at $0.005 per gallon combined)

Typical Water heating Costs

- Total hot water cost (gas) $35/month
- Water heating cost (gas) $25/month

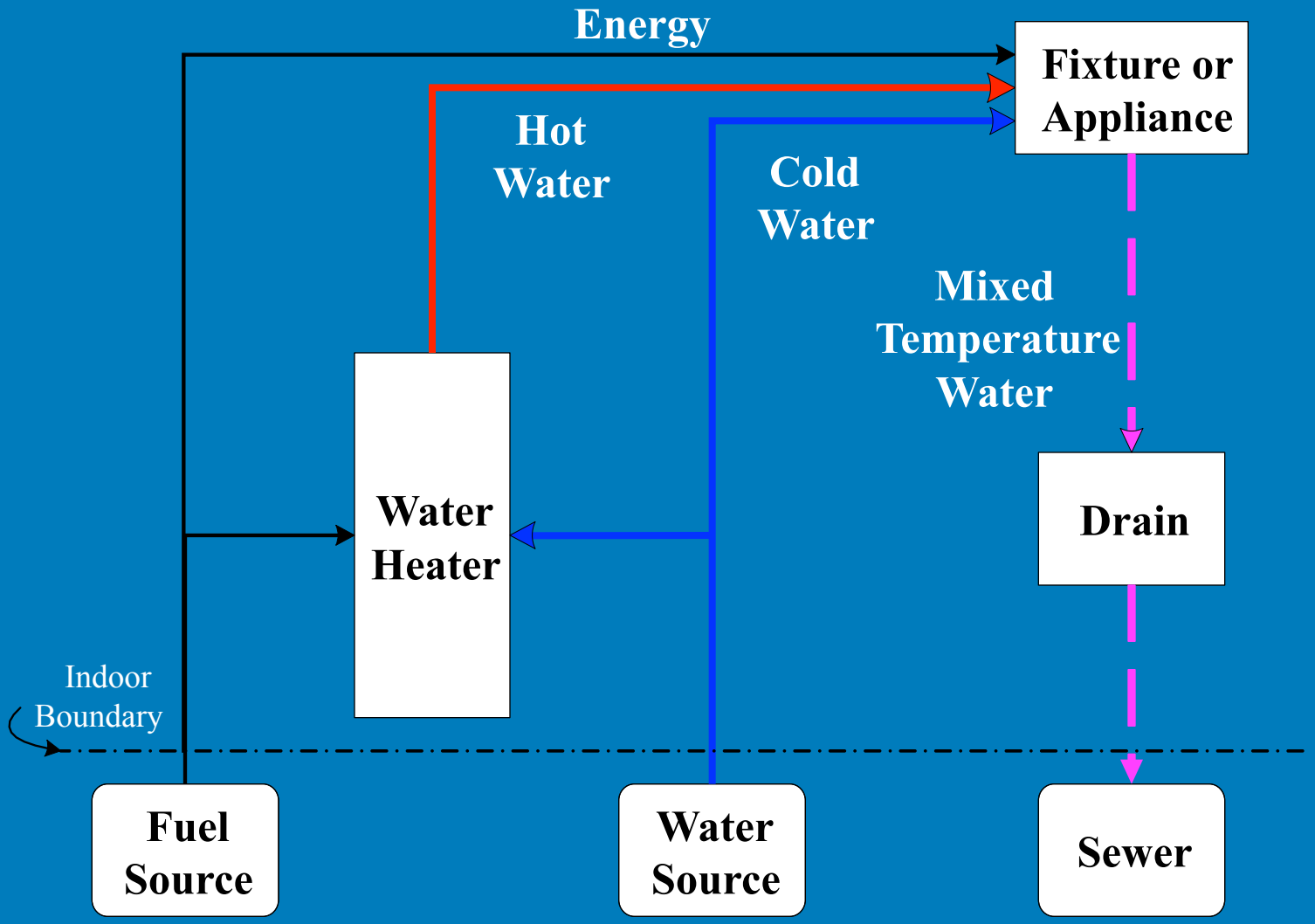
- Total hot water cost (elec.) $60/month
- Water heating cost (elec.) $50/month

The Residential Hot Water System

- Treatment and Delivery to the Building
- Use in the Building
  - Water Heater
  - Piping
  - Fixtures, Fittings and Appliances
  - Behavior
  - Water Down the Drain
- Waste Water Removal and Treatment

The ***interactions*** among these components affect ***system*** performance.

Typical "Simple" Hot Water System for Single Family or Single Unit Applications



Lessons from “The Shower”

- Delay at the fixture and water waste is due to cold water in the hot water line
  - More fixtures means larger pipes, more waste and longer waits
  - Larger homes typically mean longer pipes, more waste and longer waits
  - Excessive waits at the fixture leads to more behavioral waste (multi-tasking)

Lessons from “The Shower”

- Tankless water heaters increase delay due to their start-up sequence
- Temperature at fixture is determined by water heater set-point and heat losses in the pipes
  - Pipe insulation increases fixture temperature
  - Higher flow rates (smaller pipes) increase fixture temperature

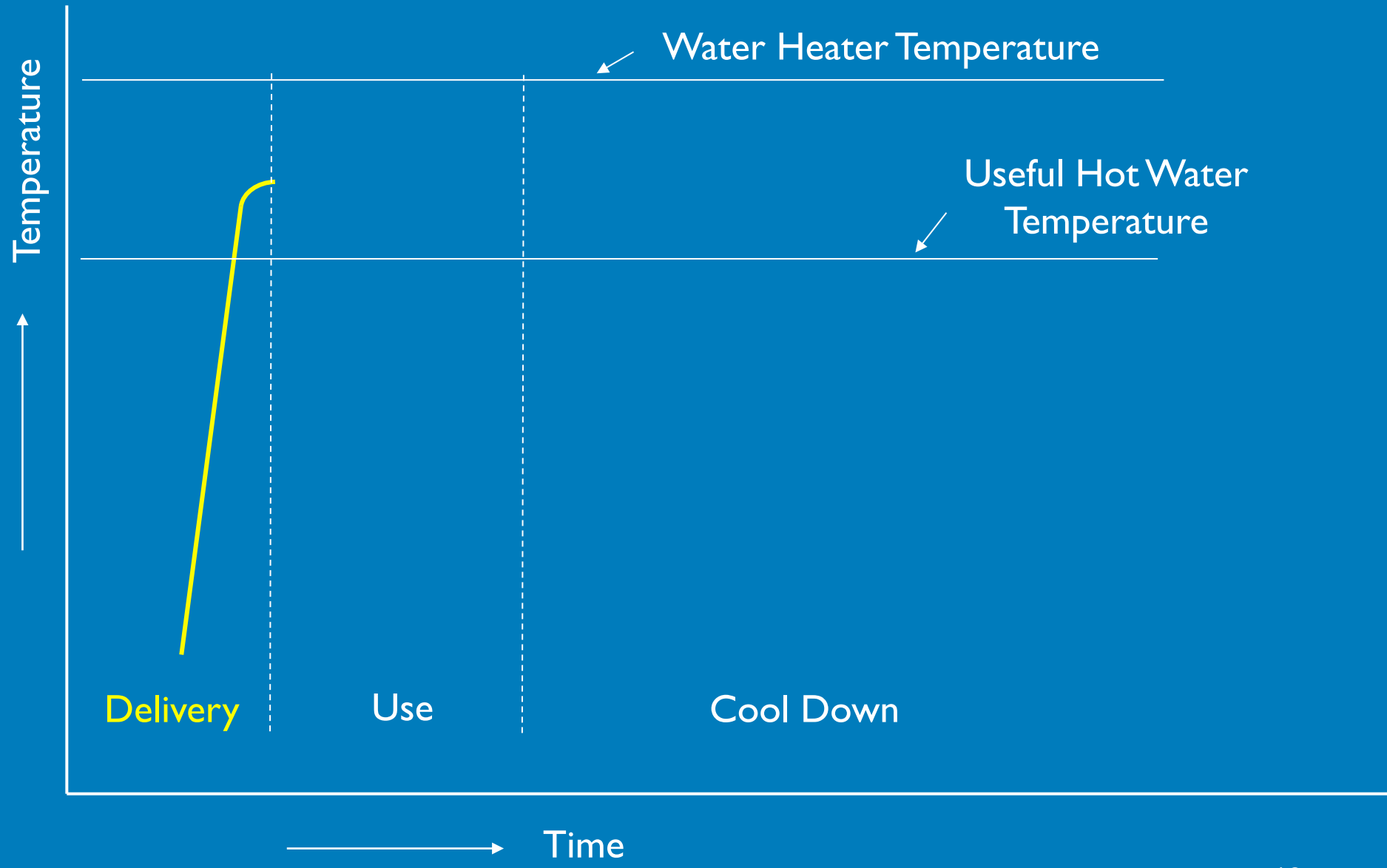
Lessons from “The Shower”

- Second Uses are important
  - Pipe insulation increases change of “hot starts” for second uses
  - Gas tankless heaters have the “cold water sandwich” effect on second uses
- In future, water pressures and fixture flow rates will be reduced
  - Longer waits and more waste
  - Lower flows may mean gas tankless heaters will not ignite

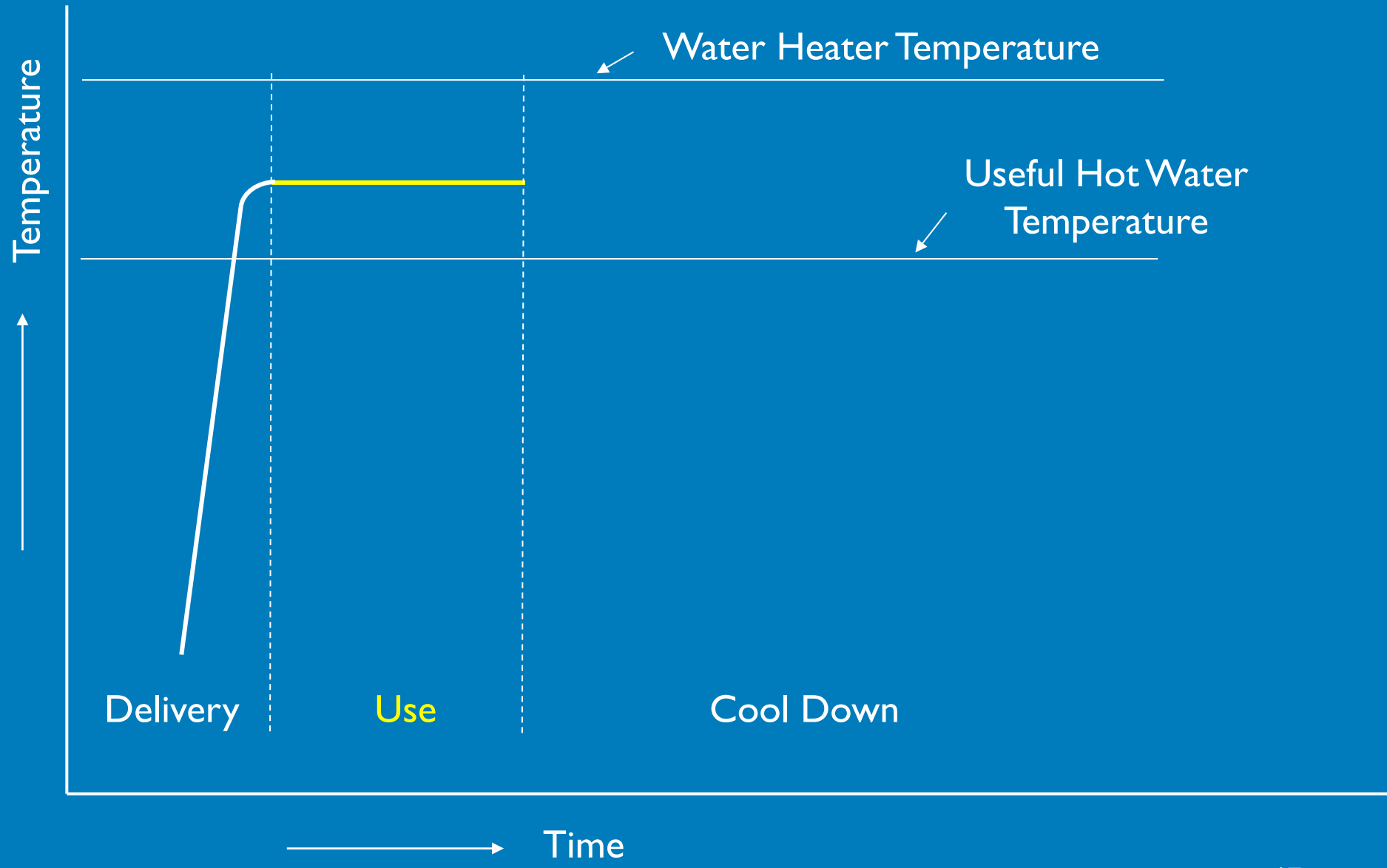
Lessons from “The Shower”

- Summary
  - Use small, short, insulated hot water pipes
  - Plan for future decreases in water pressure and fixture flow rates
  - To have instant hot water, there must be hot water in the system
  - Use On-Demand recirculation

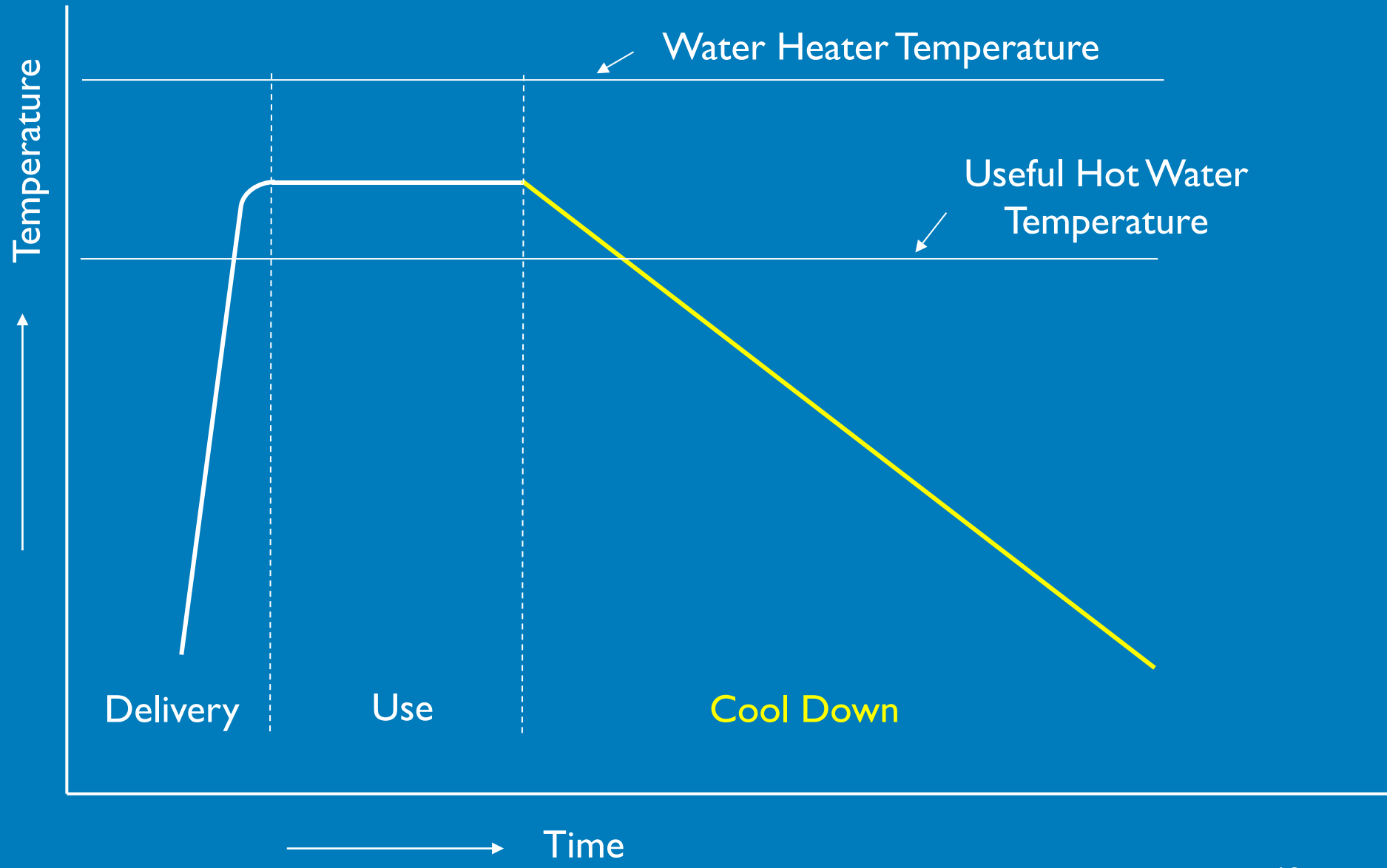
Typical Hot Water Event



Typical Hot Water Event



Typical Hot Water Event

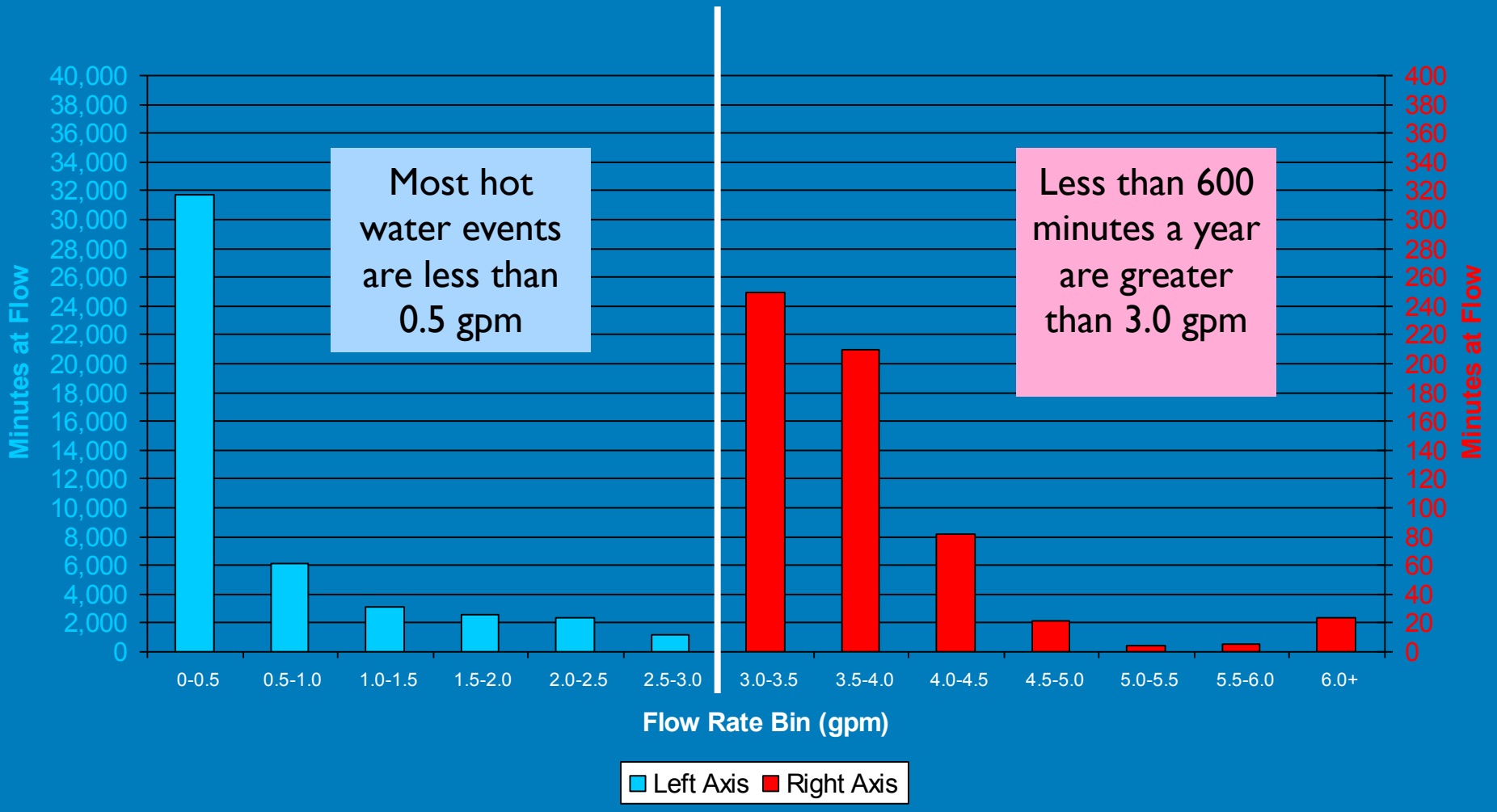


How do we use Hot Water?

What are Your Hot Water Usage Patterns?

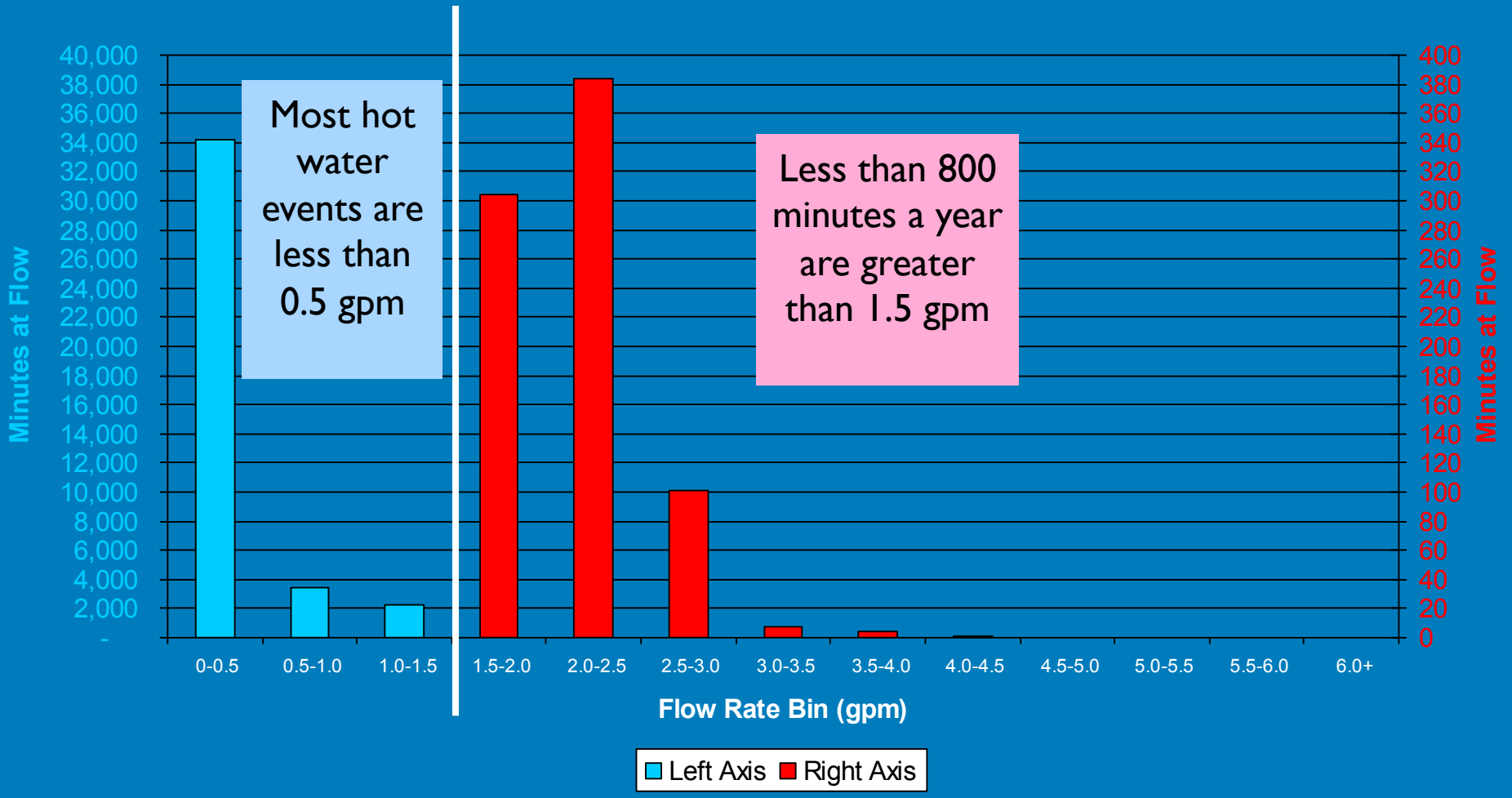
- Do you regularly take long showers? How long?
- When do you think you use the most hot water?
- Where do you use hot water most frequently?
- Have you changed your behavior to minimize your hot water usage?

Flow Rate Distribution of Hot Water in High Volume Home



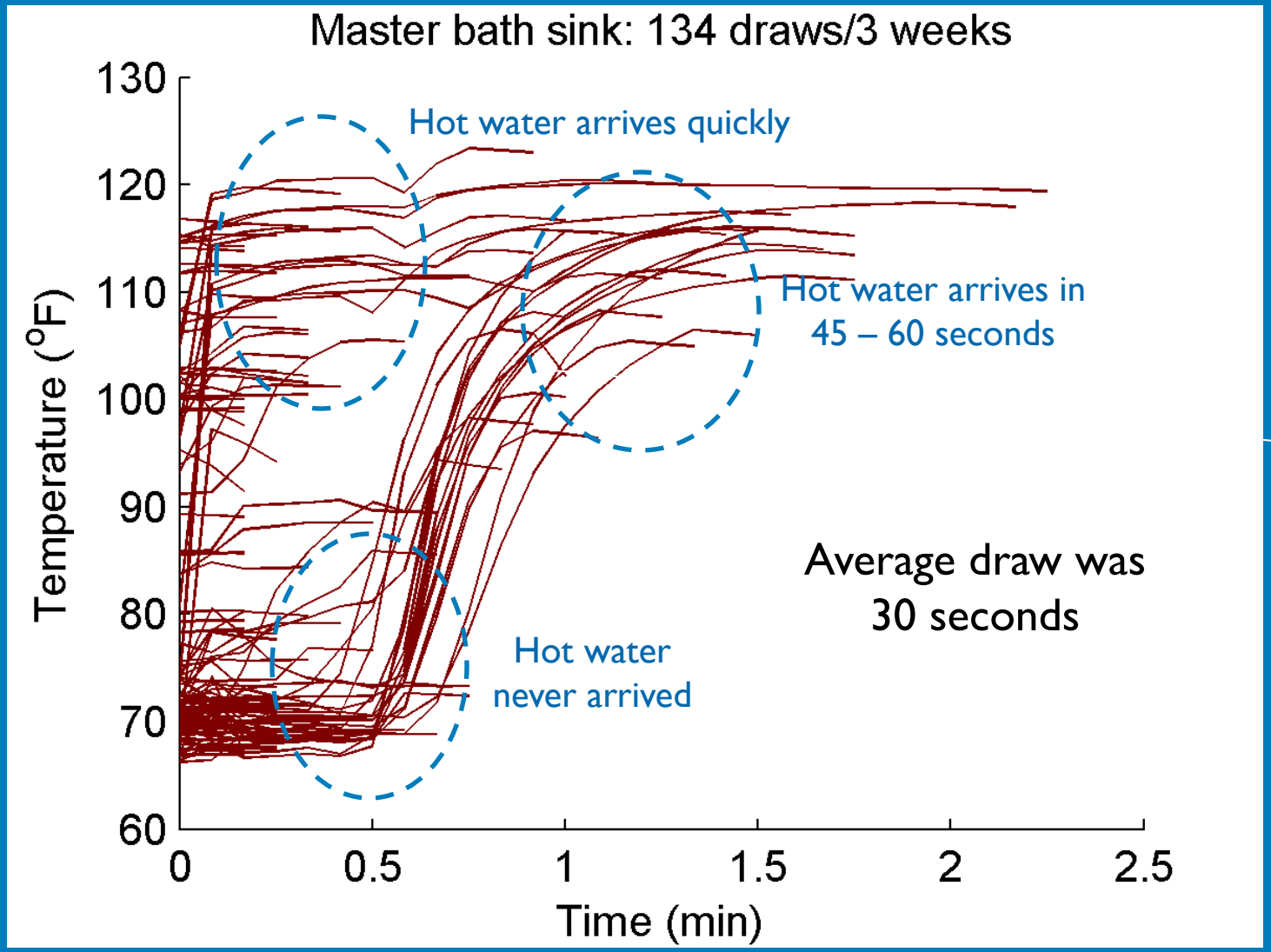
Source: NAHB Research Center, November 2002

Flow Rate Distribution of Hot Water in Low Volume Home



Source: NAHB Research Center, November 2002

Time and Temperature at the Master Bath Sink



Source: National Renewable Energy Laboratory

How do we use hot water?

- Frequent short, low flow-rate draws
- Occasional long draws at low flow-rates
- High flow-rate and high volume draws are rare!

Fuel Cost Comparison

Fuel	Cost	Cost/M BTU	Cost /M BTU H2O*	
Natural Gas	$1.20/Therm			
Electricity	$0.16/ KWHr			
Propane	$2.85/gal			

Fuel Cost Comparison

Fuel	Cost	Cost/M BTU	Cost /M BTU H2O*	
Natural Gas	$1.20/Therm	$12.00		
Electricity	$0.16/ KWHr	$46.88		
Propane	$2.85/gal	$31.32		

Fuel Cost Comparison

Fuel	Cost	Cost/M BTU	Cost /M BTU H2O*	
Natural Gas	$1.20/Therm	$12.00	$19.35	
Electricity	$0.16/ KWHr	$46.88	$50.96	
Propane	$2.85/gal	$31.32	$50.52	

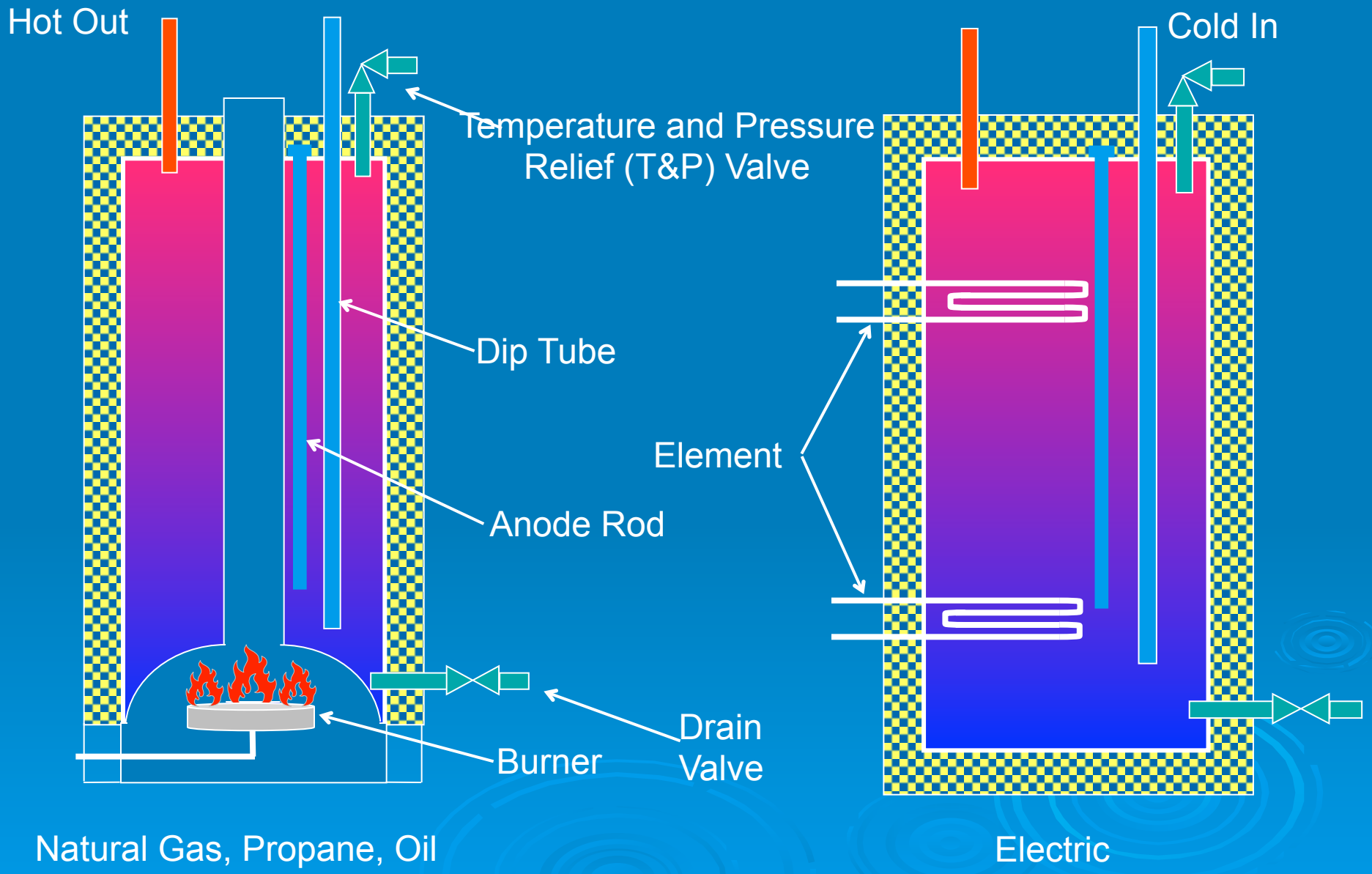
* 62% efficiency assumed for natural gas and propane water heaters. 92% assumed for electric water heaters.

Fuel Cost Comparison

Fuel	Cost	Cost/M BTU	Cost /M BTU H2O*	Cost /M BTU H2O HPWH**
Natural Gas	$1.20/Therm	$12.00	$19.35	
Electricity	$0.16/ KWHr	$46.88	$50.96	$23.44
Propane	$2.85/gal	$31.32	$50.52	

* 62% efficiency assumed for natural gas and propane water heaters. 92% assumed for electric water heaters.
** EF = 2.0 assumed for HPWH

Inside a Storage Water Heater



NAECA Water Heaters

	Tank (Storage) <4000 Btu/hr/gal	Tankless (Instantaneous) < 2 gallons
Natural Gas	≤ 75,000 Btu	≤ 200,000 Btu
Oil	≤ 105,000 Btu	≤ 210,000 Btu
Electric		
➢Resistance ➢Heat Pump	≤ 12 kW ≤ 24 amps	≤ 12 kW NA
Measure of Efficiency	Energy Factor (EF)	