

# Tank vs. Tankless Water Heaters: How's a Person to Decide?

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# Disclaimer

## ➤ Speaker's Credentials

## ➤ Speaker's Prejudices:

- Focus on cost effectiveness
- Discuss primarily gas water heating
- Focus on whole-home water heaters rather than point of use water heaters.

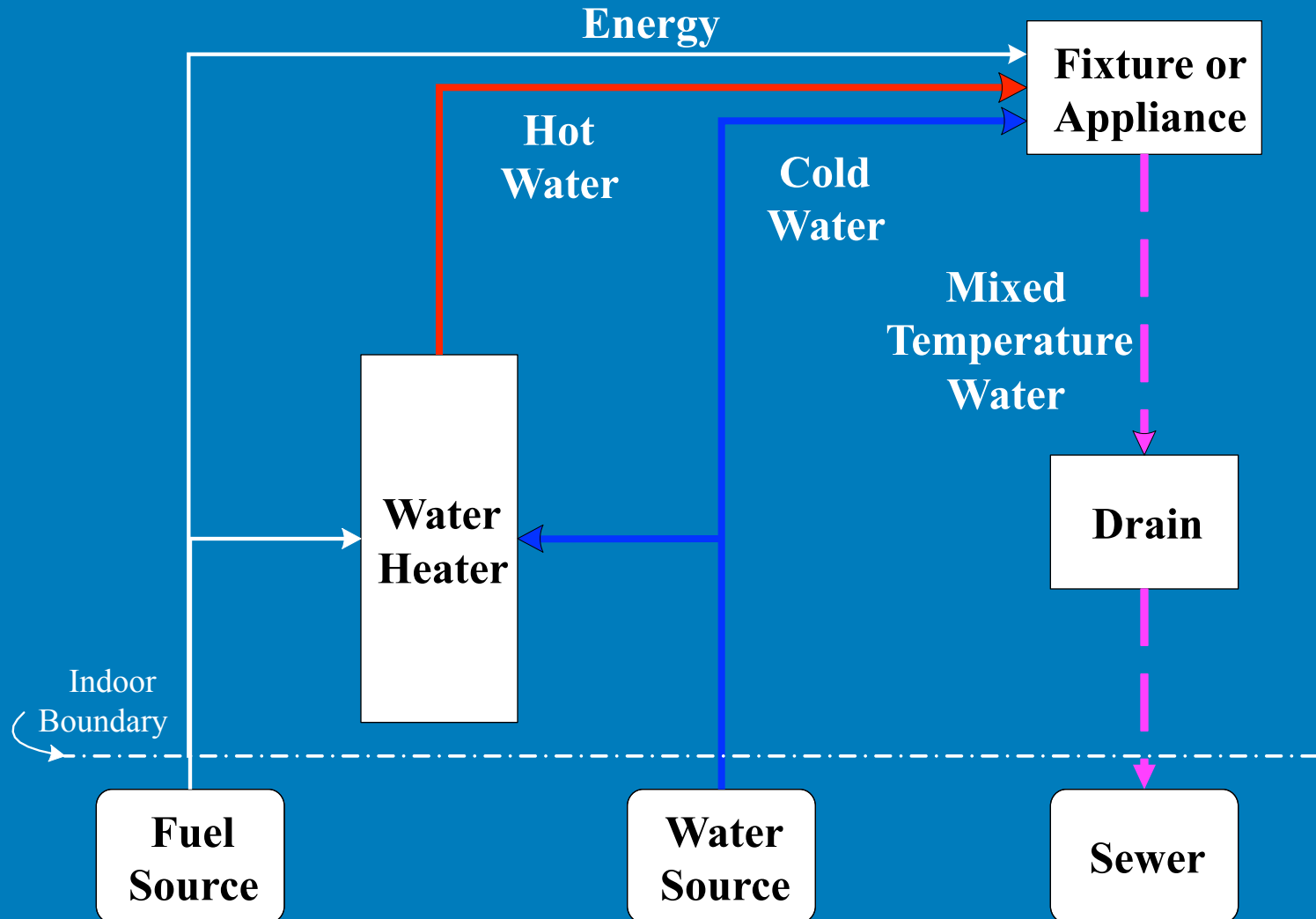
## ➤ Speaker's Goal

- Provide honest, objective information about water heating technologies.
- Give the audience the background and understanding to make appropriate equipment choices.

# Class Outline

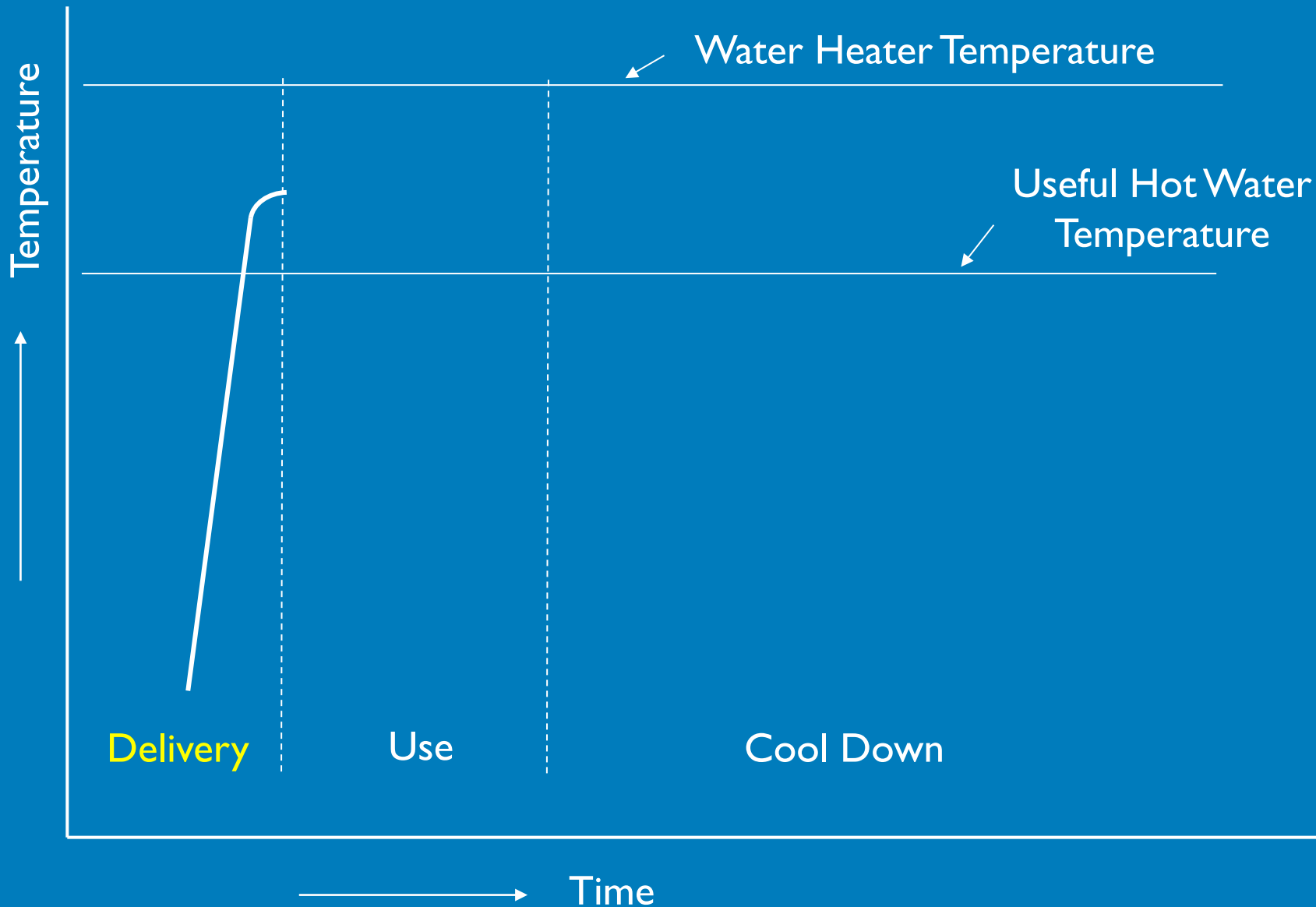
- The hot water event
- How big is hot water?
- How do we use hot water?
- How are water heaters tested?
- Storage water heater operation
- Tankless water heater operation
- How do you choose?
- What does the future hold?

# Typical “Simple” Hot Water System for Single Family or Single Unit Applications

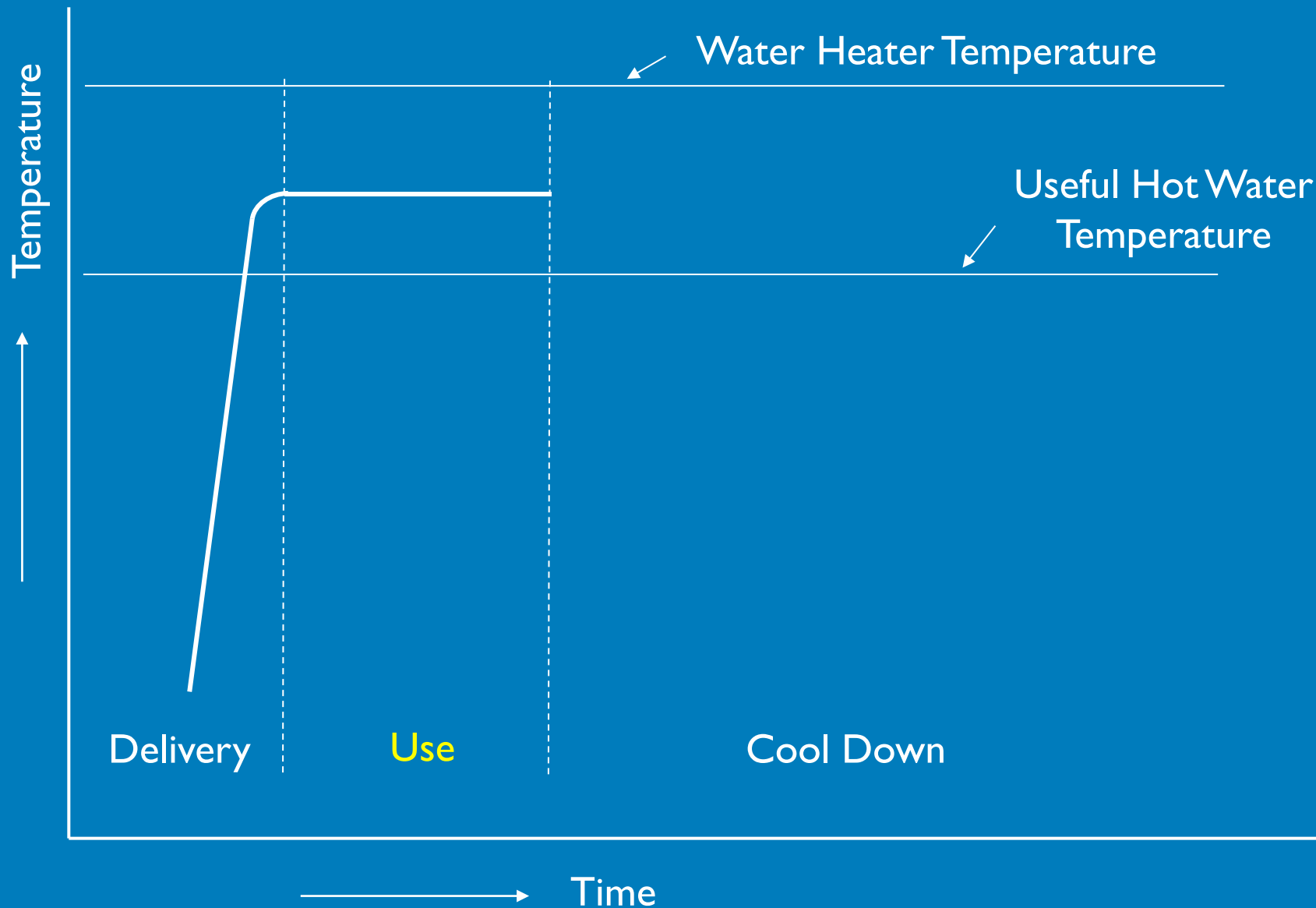


# Typical **Hot Water** Event

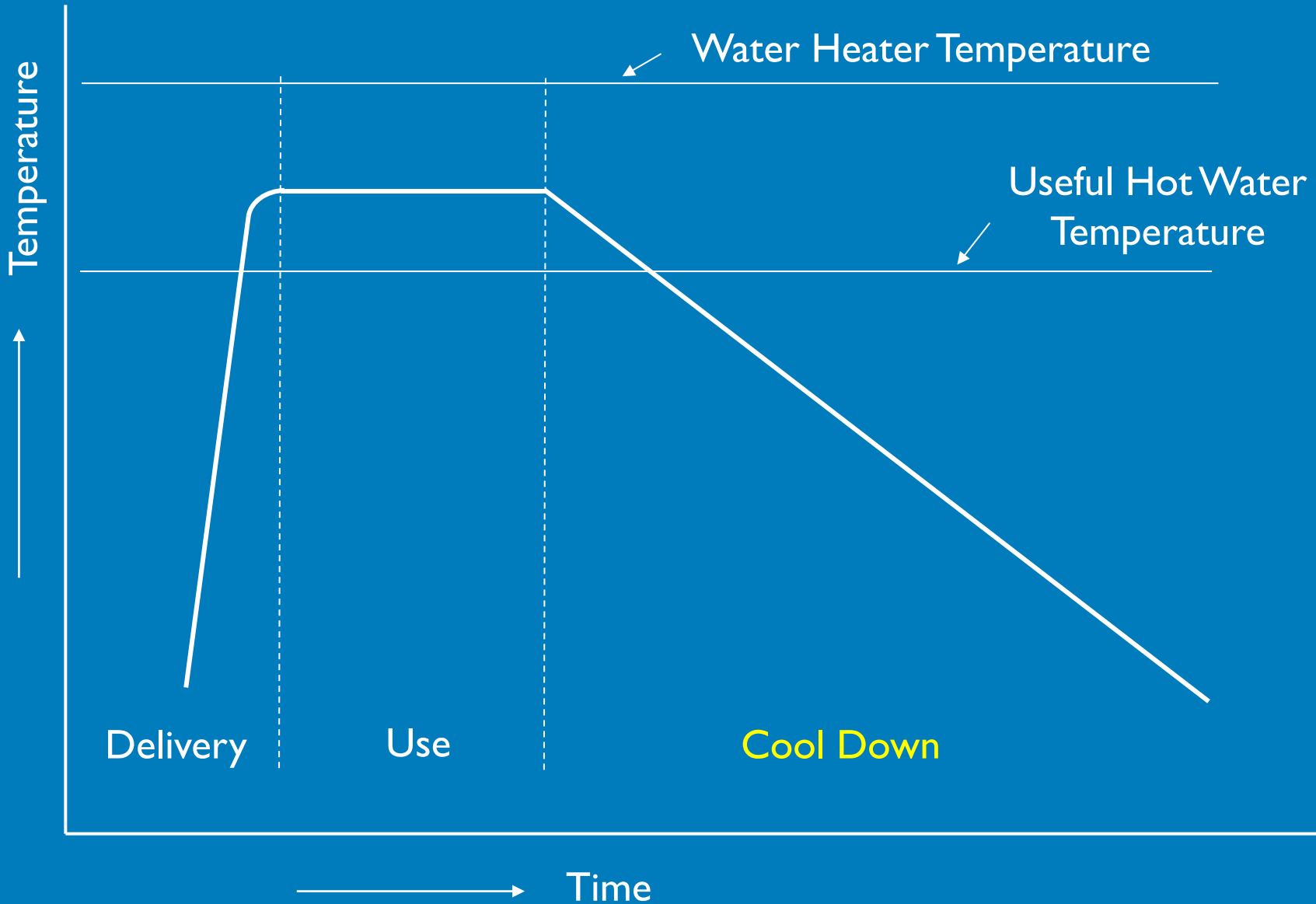
# Typical Hot Water Event



# Typical Hot Water Event



# Typical Hot Water Event







# What Phases in a **Hot Water** Event Does Your Water Heater Impact?

## ➤ Delivery Temperature

- Water heater temperature influences the temperature of the delivered water.
- Water heater does not directly influence the temperature drop in the piping during delivery

## ➤ Delivery Time

- If you do not have hot water when the fixture is opened, delivery of hot water will be delayed and water will be wasted.

How do we use **Hot Water**?

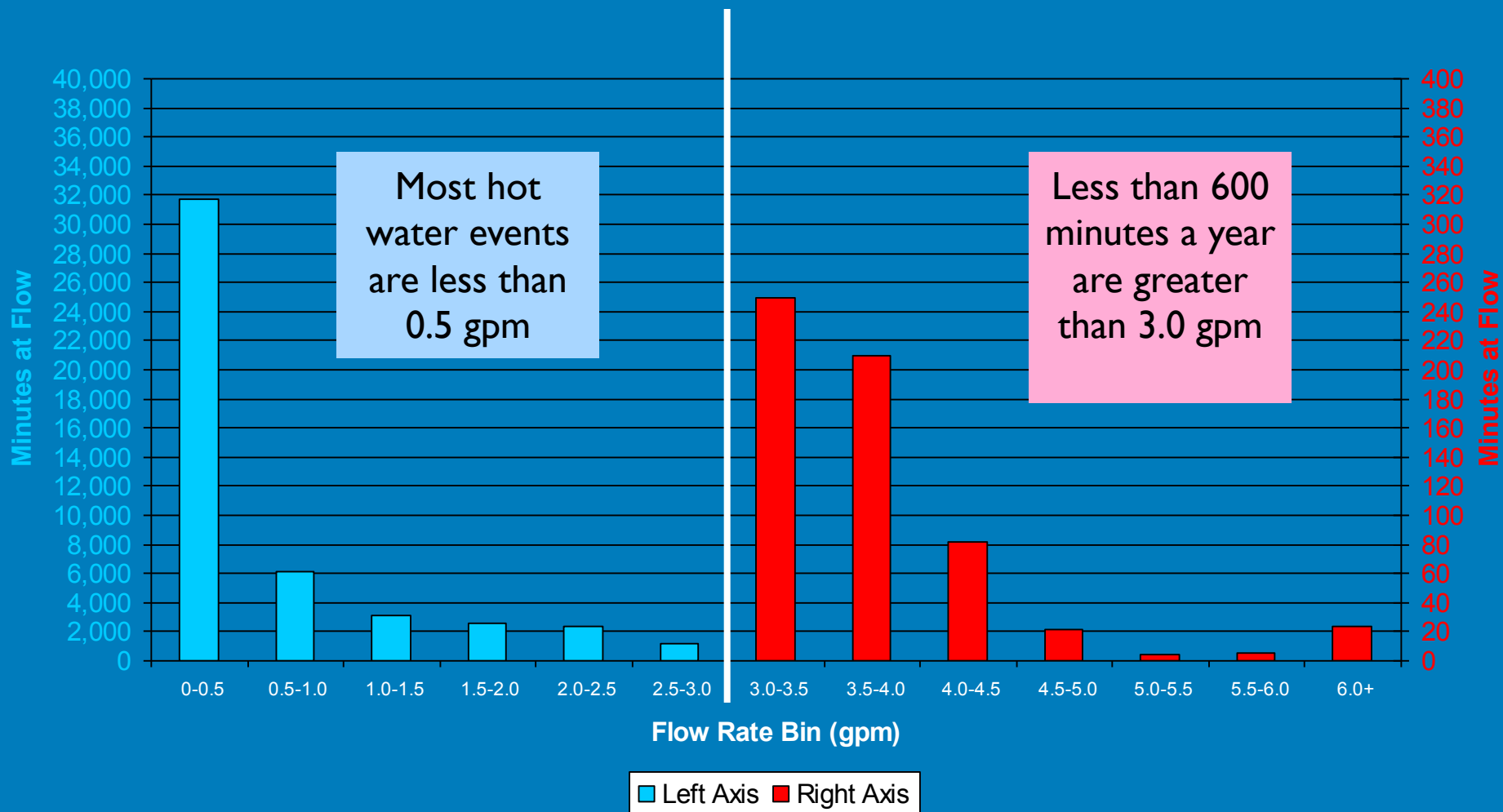
# What are Your Hot Water Usage Patterns?

- Do you regularly take long showers?
- What is the most common duration of your hot water use?
- 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?

# What do most people want from the hot water system?

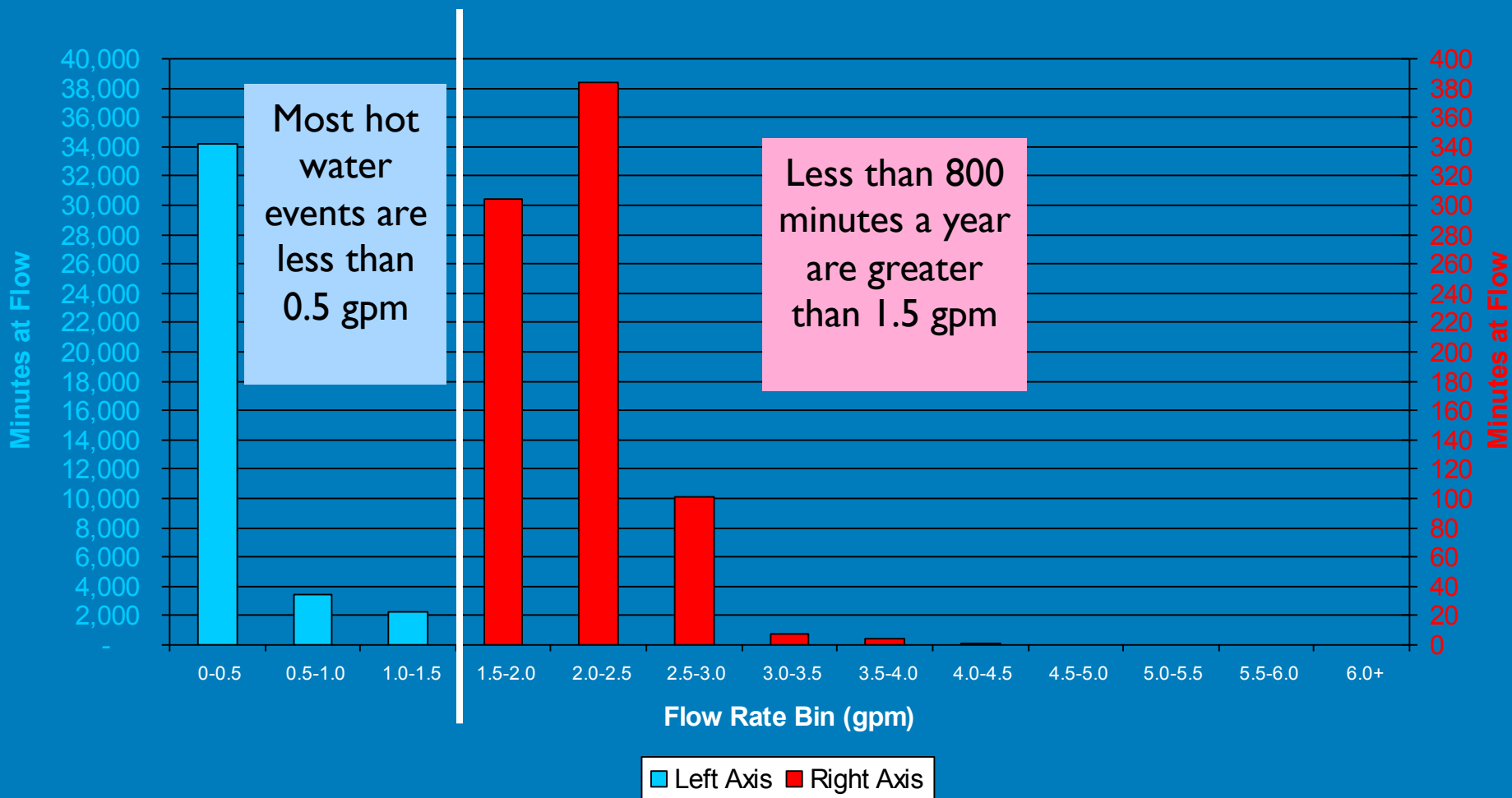
1. Hot water **NOW!**
2. Never run out.

# Flow Rate Distribution of Hot Water in High Volume Home



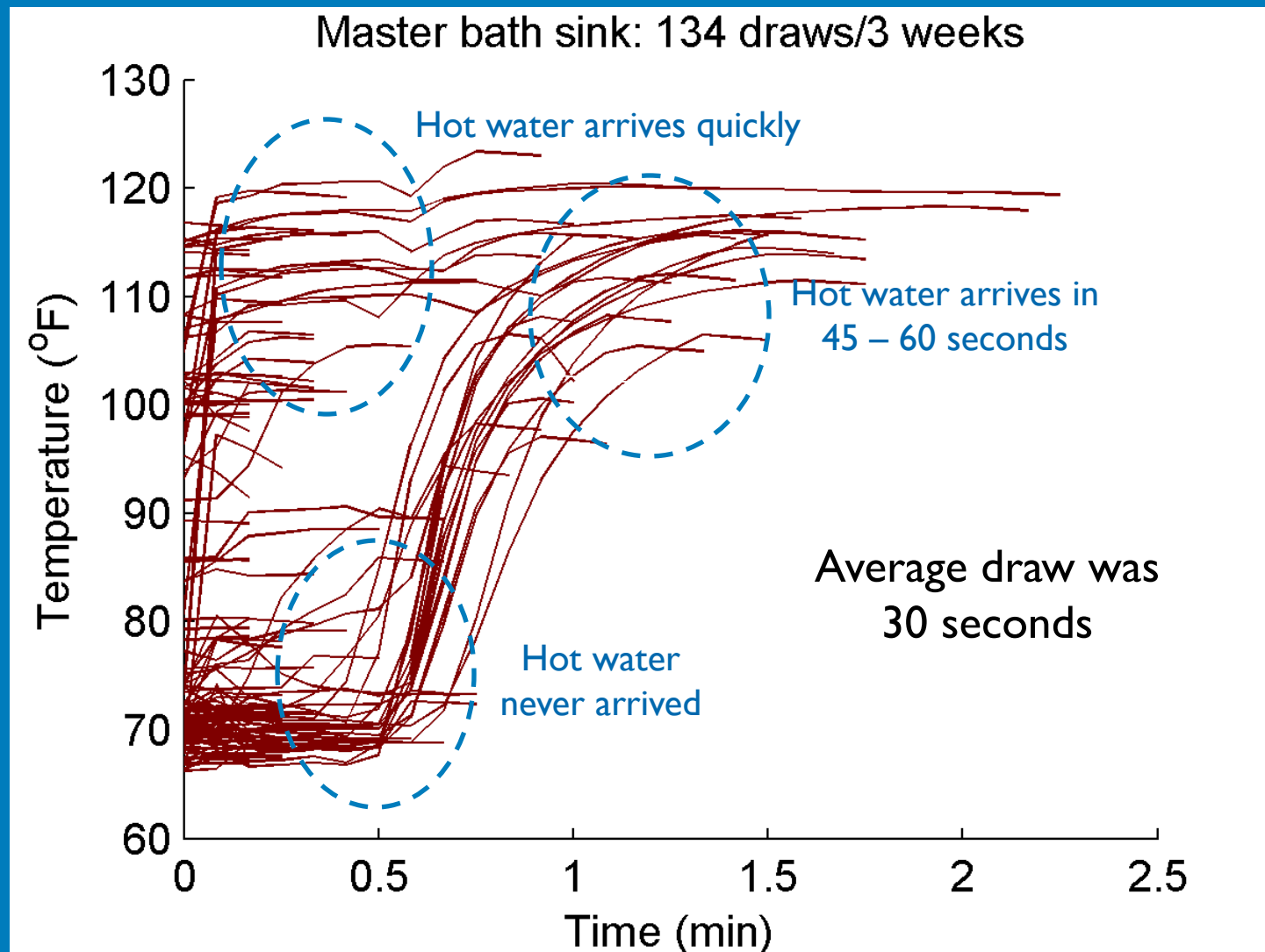
Source: NAHB Research Center, November 2002

# 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!

# How Big is **Hot Water**?

Water heating is the 1<sup>st</sup> or 2<sup>nd</sup> 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
  
- At these costs, it is difficult to justify spending much money to improve your water heater's efficiency.
- **But, if all 120 million water heaters in the U.S. were more efficient, the nation would save a huge amount of energy.**

# 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



# Testing Water Heaters

- How do we test water heater performance and what does Energy Factor, EF, mean?

# Testing NAECA Water Heaters

	Tank (Storage) <4000 Btu/hr/gal	Tankless (Instantaneous) < 2 gallons
Natural Gas	$\leq 75,000$ Btu	$\leq 200,000$ Btu
Oil	$\leq 105,000$ Btu	$\leq 210,000$ Btu
Electric		
<ul style="list-style-type: none"> <li>➤ Resistance</li> <li>➤ Heat Pump</li> </ul>	$\leq 12$ kW $\leq 24$ amps	$\leq 12$ kW NA
Measure of Efficiency	Energy Factor (EF)	

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Measure of Efficiency	Energy Factor (EF)	

# Energy Factor

- A test dictated by the U.S. Department of Energy which simulates residential usage.
- Incorporates both thermal (combustion) efficiency and stand-by loss
- Assuming 64.3 gallons per day, EF is determined by drawing 10.7 gallons at the rate of 3 gpm once each hour for 6 hours and then an 18 hour stand-by period.
- Test is very difficult to conduct accurately since so many variables must be accurately measured.
- **Energy Factor is the only legal way to describe the efficiency of a NAECA heater.**

# Range of Energy Factors

Volume (gallons)	Minimum EF	Maximum EF available
<b>Natural Gas Storage Water Heater</b>		
30	0.61	0.64
40	0.59	0.70
50	0.58	0.70
75	0.53	0.59
<b>Electric Storage Water Heater</b>		
40	0.92	0.95
50	0.90	0.95
66	0.88	0.95
80	0.86	0.95

# Your Mileage **Will** Vary...

- If actual use deviates from the test protocol, EF becomes a less effective measure of energy efficiency.
  - If very little hot water is used, stand-by losses will be underestimated.
  - If large amounts of hot water is used, stand-by losses will be overestimated
  - Test does not simulate residential use data...total hot water consumption of about 64 gals per day is OK but most homes have many more, short draws than the EF test has.
  - If you have no energy loss during stand-by, the EF value becomes the combustion efficiency.