

Comments on the
Energy Star[®] Residential Water
Heaters: Draft Criteria Analysis
June 5, 2007

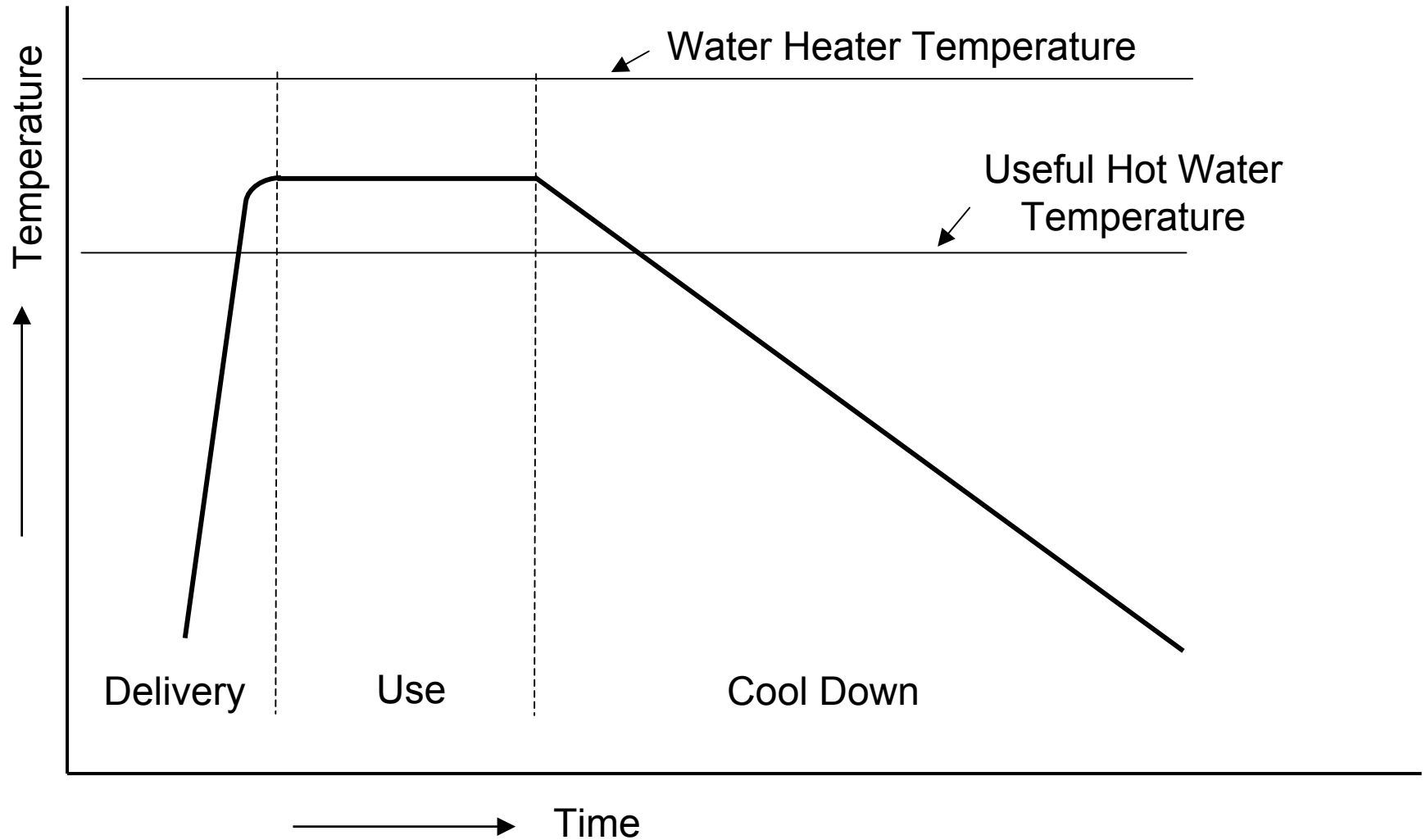
Revised November 26, 2007

Gary Klein
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814
916-653-8555
gklein@energy.state.ca.us

The **Hot Water** System

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

Typical Hot Water Event



What Do You **Want** from your **Hot Water** System?

- Clean clothes
- Clean dishes
- Clean hands
- Clean body
- Relaxation
- Enjoyment

The **service** of hot water

What Do You **Expect** from your **Hot Water** System?

Safety

- Not too hot
- Not too cold
- No harmful bacteria or particulates
- Sanitation

Reliability

- Little or no maintenance
- Last forever
- Low cost

Convenience

- Adjustable temperature and flow
- Never run out
- Quiet
- Hot water now

Incomplete Analysis

Discussions of each technology are:

- Not strictly comparative
 - Where are electric costs for gas tankless in Table 2?
 - Where are maintenance costs for each technology?
 - Why aren't implications of tax incentives or rebates treated consistently?
 - Why are product performance and reliability treated consistently?
 - Why are desired warranties so different?
- Legal requirement versus where the products are used.
 - As written, this is about water heaters that meet the legal definitions, sort of.
- Practically silent on pros and cons from the perspective of the potential buyer
- Limited to individual technologies although systems may provide greater service at very high efficiency

Incomplete Analysis

Conventional Technologies

- Legal definition is about unequal equipment.
 - Gas has twice the recovery rate of the electric
 - $40,000 * 0.75 = 30,000$ vs. $4,500 * 3.412 = 15,354$
- Electric Resistance Storage Water Heaters
 - Minimum EF is 0.82 – 0.88
 - Why excluded from consideration?
 - Savings would be large if all new were 0.95 EF
- Gas Storage Water Heaters: **These are now included**
 - Range for EF is 0.53 – 0.65
 - Why excluded from consideration?
 - Savings would be large is all new were 0.65 EF

Incomplete Analysis

Advanced Technologies

- Gas Whole Home Tankless
 - Start out with cold water resulting in additional waste of water, energy and time
 - Lower efficiency with small volume draws
 - Cold water sandwich
 - Mfg solution is to install electric resistance storage water heater downstream of gas tankless. Often in conjunction with recirculation system.
 - How much do these changes lower the EF?
 - Flow switch control and size of minimum burner makes them unsuitable as a booster for preheated water
 - What is impact on operating costs of:
 - Maintenance
 - Freeze protection
 - Continuous not instantaneous

Incomplete Analysis

Advanced Technologies

- Electric Whole Home Tankless
 - Analysis is limited by “residential” definition. Also unequal equipment.
 - Gas has four times the firing rate
 - $199,999 \times 0.8 = 160,000$ vs. $12 \times 3,412 = 40,944$
 - Homes with 100 amp service will have problems described, but most homes with 200 amp service will not.
 - Why isn't there a similar discussion on gas tankless?
 - Why has NAHBRC's 2002 study been overlooked which showed significant savings?
 - Temperature controlled systems are an excellent choice to boost preheated water
 - Solar, geothermal, heat pump

Incomplete Analysis

Advanced Technologies

- Solar
 - Analysis is not limited by “residential” definition
 - Why minimum 50% solar fraction?
 - Why is a 50 gallon electric storage water heater used as the back up?
 - Only minimum EF
 - Why not electric tankless (only temperature controlled)?
 - Gas tankless are currently a poor match as back-up to solar preheat
 - The low end of the burner range is too large when it is only necessary to heat the water a few degrees
 - What will be done to sort this out in Energy Star?

Incomplete Analysis

Advanced Technologies

- Heat Pump Water Heaters
- Gas Condensing Water Heaters
- Advanced Non-Condensing Gas Storage
 - Why 50 gallons per hour for 1st hour rating?
- Capacity based EF Criteria
 - Although energy consumption doesn't vary much, criteria seem based on relative EF. Customers get bigger water heaters so they don't run out, so EF of bigger units should be the same as those of smaller units.

Guiding Principle

Provide people what they want...

The Service of Hot Water

with what they expect...

Safety, Reliability and Convenience

as efficiently as possible

What Defines a “Good” Water Heating System?

Hot Water Flow Rates

- Peak periods, large demands, or multiple fixtures (high)
- Normal use (medium)
- Small demands (low)

Incoming water temperature

- Winter (cold)
- Summer (warm)
- Preheated (almost hot enough)

Provides the desired service under all combinations of these conditions.

A “Good” Water Heater

Residential

- Meets lifestyle requirements (maybe desires)
 - There are an infinite number of hot water use patterns that must be accommodated.
 - Water heaters stay with the building, so they must be efficient regardless of the use pattern.
- Does not have to be large enough for extreme peak periods, but it must have a large enough burner or element to keep up with the hot water needed for one shower.

Neither Tank or Tankless is the Answer

A combination of the two might be better:

- **Burner or element**

- Capable of at least 2 gpm of hot water
- Roughly 80,000 Btu gas or 20 kW electric

- **Modest tank**

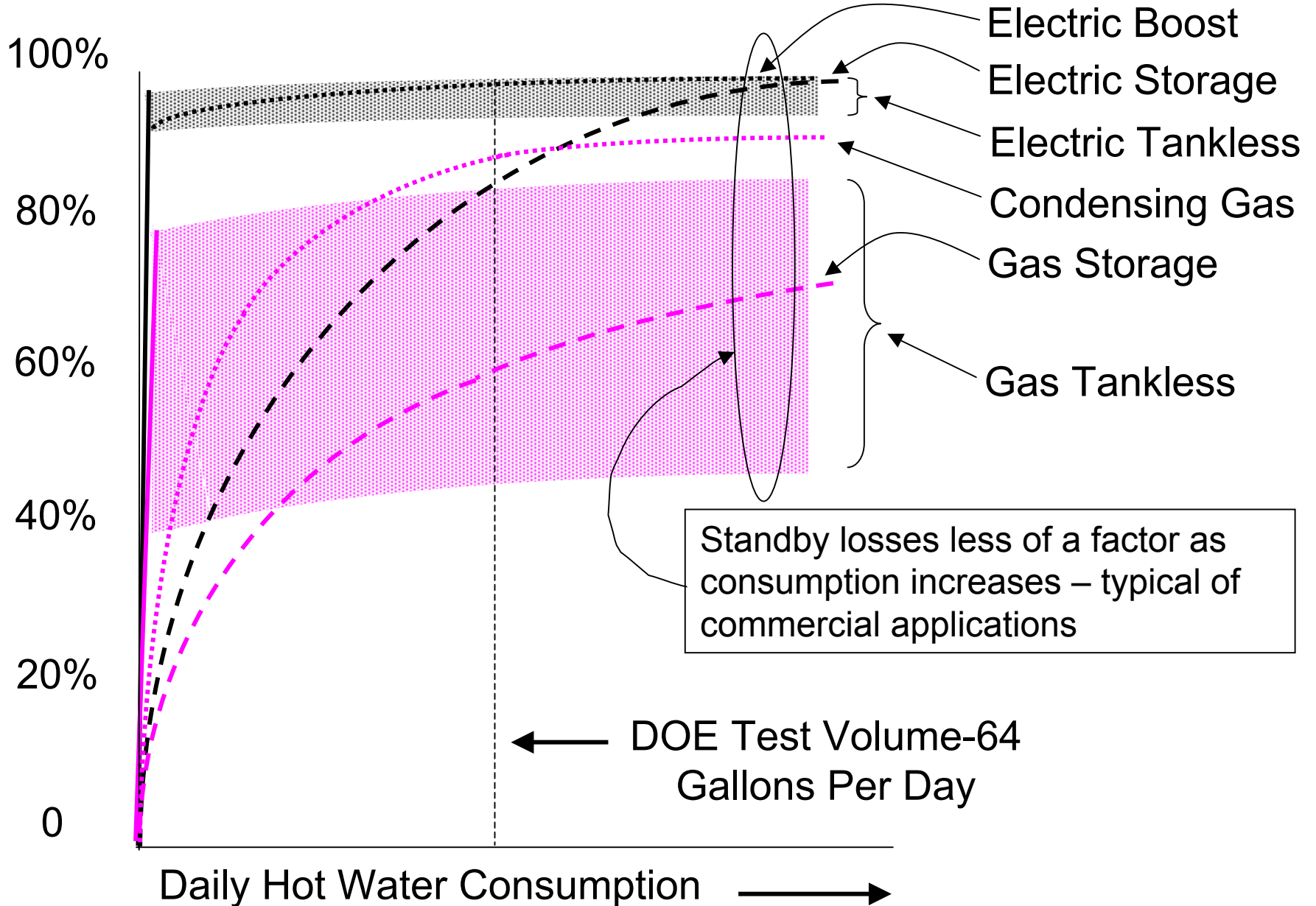
- Some volume for peak conditions
- Hot water available at the beginning of every draw

- **Possible in both gas and electric**

- **Preheat with Tankless**

- Combine tankless electric (temperature controlled) with solar, geothermal or heat pump to increase overall system efficiency (COP > 2)

Relative Efficiency of Water Heaters



Conclusions

- Energy Star[®] must help consumers understand the value of what they are buying
 - Same level of performance, reliability, maintenance, warranty, efficiency (not EF)
 - Focus on systems, not equipment
 - Products must be comparable based on what consumers may choose to buy, not on the rather arbitrary distinctions made by DOE in the definitions of energy factor
 - Must be consistent with efforts to reduce carbon footprint, such as Net Zero Homes
 - Solar thermal preheat with electric boost from renewables will be “good”
 - Any electric preheat from renewables will be “okay”
- As the proposal stands, it will make the market worse not better. Until these issues are resolved, this is not ready for prime time.