

**BASELINE RESULTS AND METHODOLOGY OF THE CONSUMER SUB-GROUP
ANALYSIS FOR
RESIDENTIAL WATER HEATER EFFICIENCY STANDARDS**

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INTRODUCTION

The Energy Policy and Conservation Act, as amended, provides energy conservation standards for water heaters among other products and authorizes the Secretary of Energy to prescribe amended or new energy standards for each type of covered product. This report is a part of the preliminary analysis/methodology for the water heater energy efficiency rulemaking. The report will be revised and completed as the work progresses.

Residential water heaters currently use 24% and 11% of the total gas and electricity consumed in the U.S. residential sector. Yet little is known about the actual patterns of hot water use in individual households. Most studies of residential energy consumption use a single national average daily value for hot water use, regardless of the number of people in the household, the number of hot water-using appliances, or the climate in which the house is located.

This analysis takes a snapshot of U.S. residential energy consumption in 1993 by presenting calculations for average hot water use, energy consumption, and fuel price which will allow DOE energy analysts to study the impact of potential residential water heater efficiency standards on consumers. The analysis disaggregates the evaluation process down to the household level in order to account for the variability of factors that affect hot water and energy use in the residential sector.

The analysis will be completed in two parts. The first, or baseline, part will characterize households with existing water heaters. The second part will identify changes in cost and hot water energy use for different proposed standard levels.

The Consumer Sub-Group analysis has one primary function: to describe and quantitatively identify the variation in energy consumption and life-cycle costs of water heaters under different standard levels due to household income level.

Life-cycle cost is defined as the total consumer expense over the life of a water heater, including purchase price and operating cost. Future operating expenses are discounted to the time of purchase, and summed over the lifetime of the water heater. Two factors that contribute to life-cycle cost, the hot water draw volume and energy usage, are defined below. Maps and charts illustrate aspects of each factor. More detailed descriptions of the inputs into the Life-cycle Cost calculation can be found in the life-cycle cost section of this report.

Hot Water Draw Volume is the quantity of hot water used by a household. The amount varies widely between households because it is dependent on the following household and water heater characteristics: (1) the number, age, and employment status of the people who live in the home, (2) whether the household pays for the water heating fuel, (3) the presence of hot water-using

Average Number of People per Household

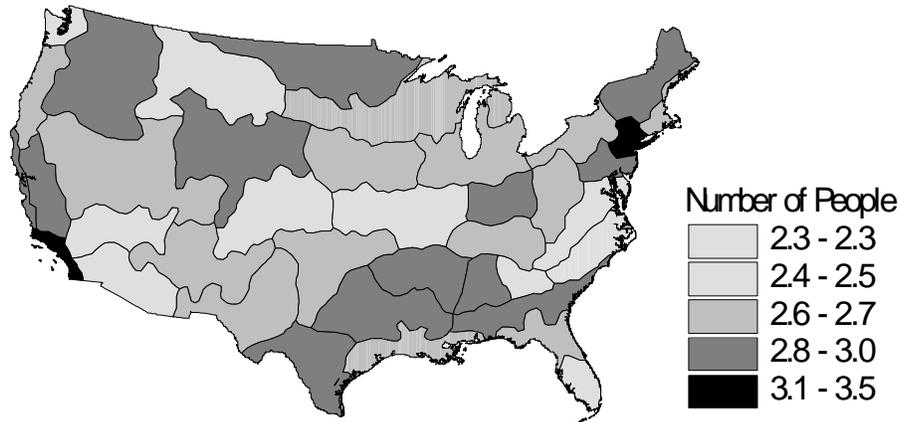


Figure 1

appliances, (4) the tank size and thermostat setpoint of the water heater, and (5) the climate in which the home is situated. By accounting for these four characteristics, a draw model calculates average daily hot water draw volume.

Average Daily Draw per Capita

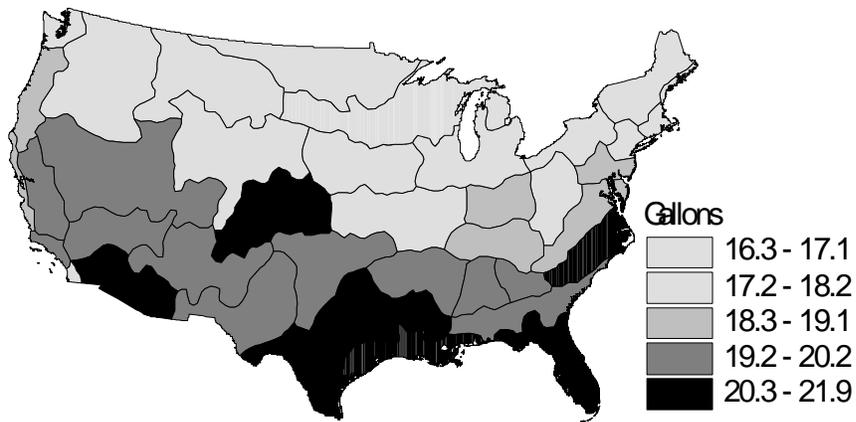


Figure 2

Figures 1 and 2 show the distribution of persons per household and the hot water draw volume per day per person. Based on the LBNL study and abstracted from the RECS database, there is a correlation between hot water use and climate. In areas with warmer climates, people tend to take more showers and wash more clothes, thereby increasing their hot water consumption.

Average Inlet Water Temperature

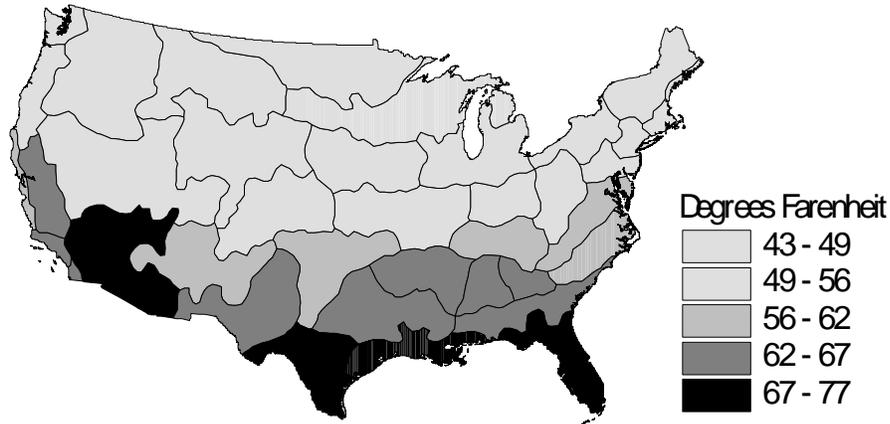


Figure 3

The water heater thermostat setpoint determines the level to which the water must be heated. The California Energy Commission data, used in the LBNL study, showed that people in colder regions of the country tend to turn up their water heater setpoint temperatures. The lighter areas in Figures 3 shows inlet water temperatures. Figure 4 indicates where the thermostat setpoints are higher.

Average Setpoint Temperature

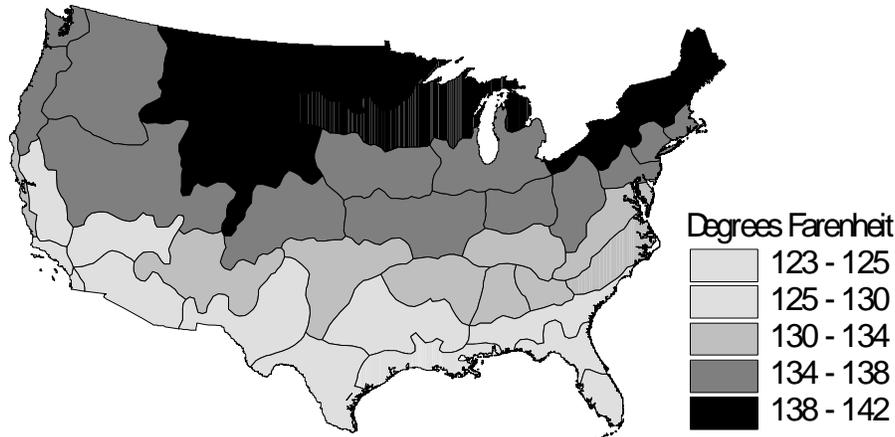


Figure 4

Energy Usage has two components: energy used by the water heater to (1) heat the water drawn by the household and (2) maintain the temperature of the stored water when no hot water is being drawn. Both components are functions of household and water heater characteristics. They are calculated using the Water Heater Analysis Model (WHAM), an energy consumption equation. The inputs to the energy consumption equation can be divided into two categories: (1) hot water draw volume and temperature variables associated with the hot water draw equation and (2) characteristics of the water heating equipment. See the Life-Cycle Cost Section for a detailed discussion of WHAM.

For this analysis, four different types of fuel for energy were studied: natural gas, liquid petroleum gas (LPG), fuel oil, and electricity. The most commonly used fuels for water heating are natural gas and electricity. Fuel oil is used the least.

Averages for hot water draw volume, energy usage and life cycle costs for all sizes of analytic baseline water heaters are shown in Table 1. A comparison is made between the total for all households and for low-income households. As can be seen in Figures 5 and 6, the range of life cycle costs for total households by region exceeds the range for low-income households only. This analysis has the capability to look at other sub-groups of the population, as well.

Table 1. Households in RECS sample

	Total Households	Low-Income Households
Average Hot Water Draw Volume	46.9 gpd (177.5 lpd)	47.0 gpd (177.9 lpd)
Average Annual Operating Cost in 2003 (98\$)	\$228 [†]	\$224 [†]
Average Annual Life-Cycle Cost in 2003 (98\$)	\$2031 [†]	\$1974 [†]

[†]AEO Fuel Rate Projection

Average Life Cycle Cost per Household for All Fuel Types

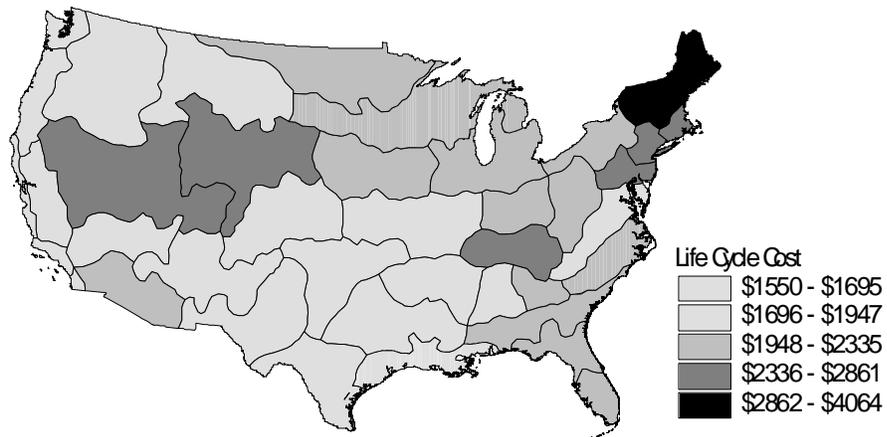


Figure 5

Average Life Cycle Cost per Household: Poor Households Only

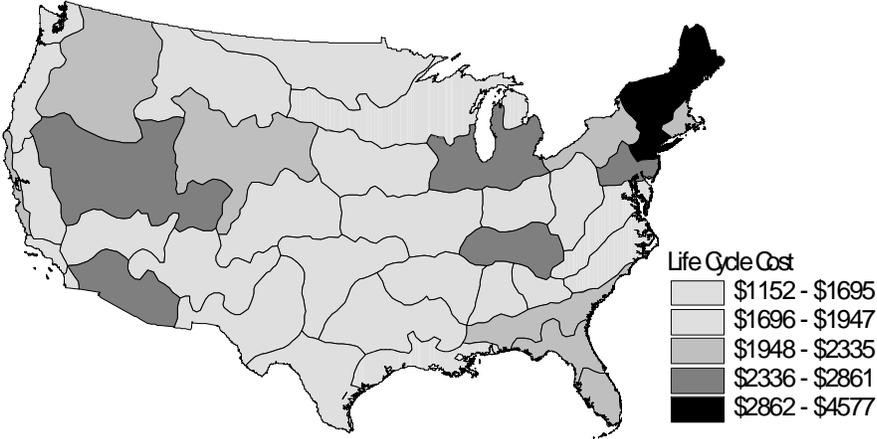


Figure 6