Energy Consumption Overview

Residential Water Heating
- Market Characterization
- Technologies
- Economics
- Energy Savings
- Market Potential

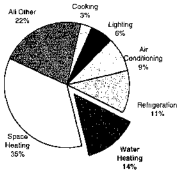
Commercial Water Heating
- Market Characterization
- Technologies
- Economics
- Energy Savings
- Market Potential

Appendices

780 B, 11, -
KWH

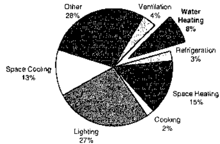
14% of residential and 8% of commercial primary[1] energy consumption is for service water heating.

Residential Water Heating Primary Energy Consumption 2.6 Quad[2], 14% of Total



Residential: 18.1 Quads[2] Total

Commercial Water Heating Primary Energy Consumption 1.10 Quad[2], 8% of Total



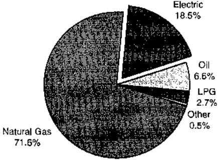
Commercial: 13.9 Quads[2] Total

1 Primary energy includes the energy consumed during generation, transmission, and distribution.
2 Quadrillion Btu

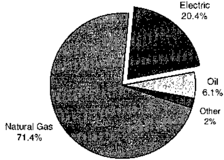
Source: EIA; AEO 1996 Tables A2 and A4; pp. 72–77, 78–81

18.5% of the residential and 20.4% of commercial service water heating primary energy consumption is electric.

Residential Water Heating Primary Energy Consumption by Fuel Type[1]



Commercial Water Heating Primary Energy Consumption by Fuel Type[2]



1 Source: DOE/EIA-0314(93), Housing Characteristics 1993.

2 Source: EIA; AEO 1996—Tables A2 and A4; pp. 72-77, 82-89.

If the entire stock of standard electric resistance water heaters were replaced by heat pump water heaters, a total of 0.81 quads of energy could be saved in the residential and commercial sectors.

Market Segment	Estimated Primary Energy Savings[1] (Quads/Year), for Best Available Current Technology
Residential	0.72[2]
Commercial	0.09[3]
Total	**0.81**

1 Savings calculations made assuming that HPWHs replace the entire stock of standard electric resistance water heaters.

2 DOE/EIA-0321(93), Household Energy Consumption and Expenditures, October, 1995.

3 Characterization of Commercial Building Appliances, R. Patel, ADL, 1993.

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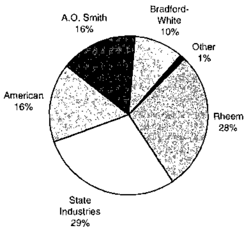
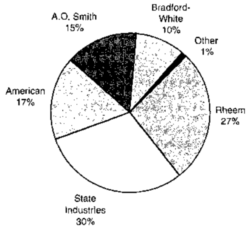
The residential water-heater market is dominated by five manufacturers, each having virtually identical shares of both the gas and electric water-heater markets.

1995 Share of Residential Electric WH Market

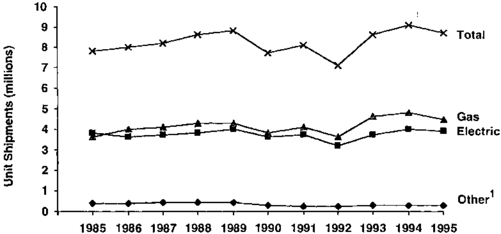


1995 Share of Residential Gas WH Market



Source: 1995 Market Profile, Appliance Manufacturer, April 1996

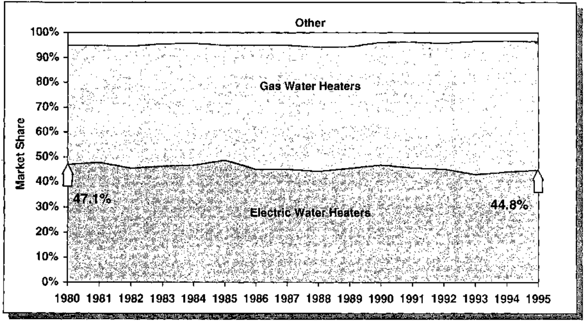
Annual residential water heater unit shipments have increased gradually (2.5% avg. annual increase) over the last 10 years.



1 Other includes: other fuel-fired, indirect, instantaneous and circulating water heating systems.

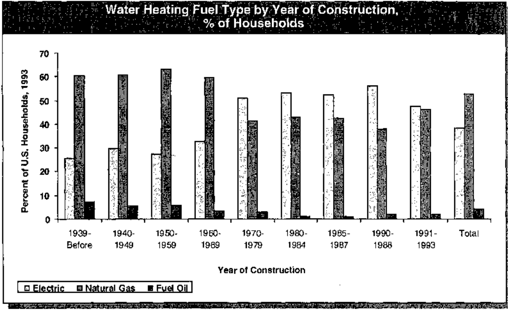
Source: U.S. Department of Commerce, Bureau of Census (1985 - 1994 Shipments); Appliance Magazine (1995 Shipments).

Over the last 15 years, the market share of residential electric water heaters has gradually dropped from 47–45%, averaging about 46%.



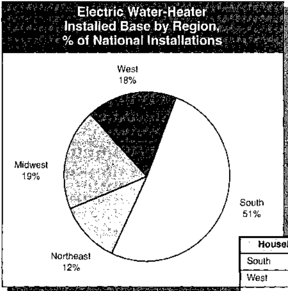
Source: U.S. Department of Commerce, Current Industrial Reports.

The electric water-heating share of the new-construction market appears to be dropping in recent years.



Source: DOE/EIA-0314(93), Housing Characteristics 1993.

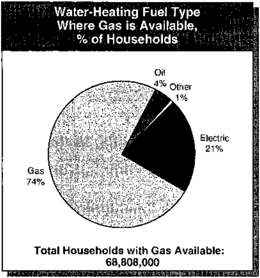
The Southern Region dominates in concentration of installed electric water heaters.

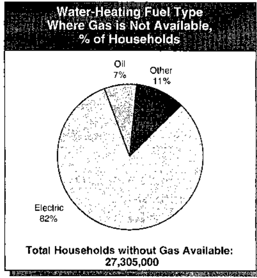


Households by Region	
South	34.7%
West	21.1%
Midwest	24.1%
Northeast	20.2%
Total Households (MM)	96.6

Source: DOE/EIA-0314(93), Housing Characteristics 1993.

Where gas is available[1], electric water heaters make up only 21% of the installed base, compared to 82% where gas is not available.

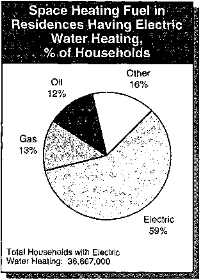


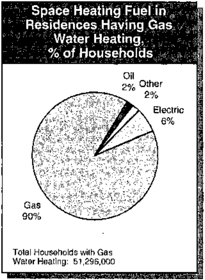


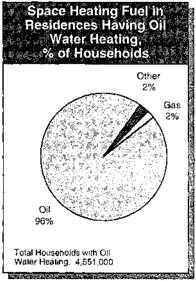
[1] Gas is considered to be "available" when pipelines are present in neighborhood.

Source: DOE/EIA-0314(93), Housing Characteristics 1993.

Households having gas or oil water heating generally use the same fuel for space heating as well.

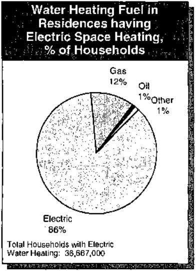


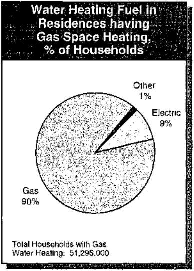


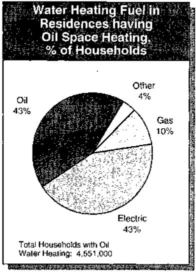


Source: DOE/EIA-0314(93), Housing Characteristics 1993.

Electric water heaters are generally used in homes having electric or oil space heating.



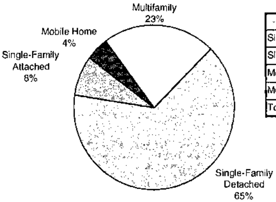




Source: DOE/EIA-0314(93), Housing Characteristics 1993.

Market segmentation by dwelling type shows single-family detached as the dominant water-heating energy user.

Residential Water Heating
Annual Primary Energy Consumption, % of Total

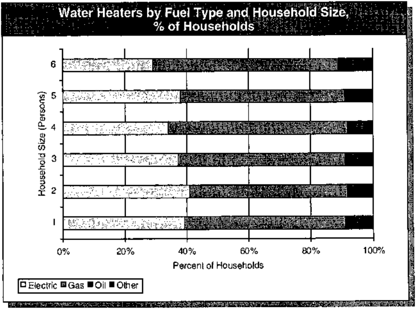


2.6 Quads Total

Households by Type	
Single-family Detached	61.7%
Single-family Attached	7.5%
Mobile Home	5.8%
Multifamily	25.1%
Total Households (MM)	96.6

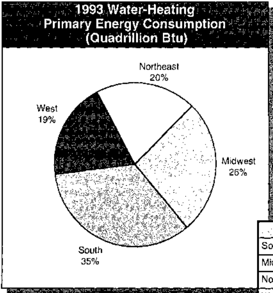
Source: DOE/EIA-0314(93), Housing Characteristics 1993.

There is only a weak correlation between water-heating fuel type and household size.



Source: DOE/EIA-0314(93), Housing Characteristics 1993.

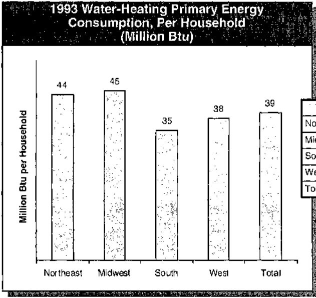
Of the total residential water-heating primary energy consumption, the South consumes the greatest percentage.



Source: DOE/EIA-0314(93), Housing Characteristics 1993.

Households by Region	
South	34.7%
Midwest	21.1%
Northwest	24.1%
West	20.2%
Total Households (MM)	96.6

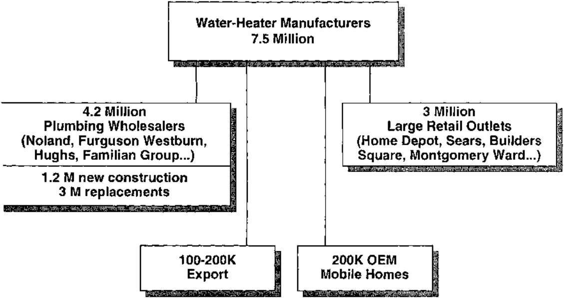
However, the Midwest is the largest water-heating energy consumer on a per-household basis.



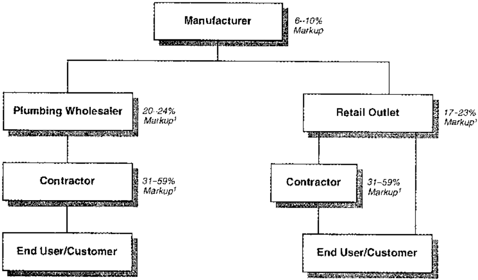
Households by Region	
Northwest	34.7%
Midwest	21.1%
South	24.1%
West	20.2%
Total Households (MM)	96.6

Source: DOE/EIA-0314(93), Housing Characteristics 1993.

esidential water heaters are sold through wholesalers and retail utlets. For new construction, the wholesaler channel is typically sed.



Mark-ups vary depending on the path to market, but the end-user sees little difference in price.



[1] Markups are presented as additive percentages.

Source: ADL interviews with water heater manufacturers, plumbing wholesalers, retail outlets and contractors.

How does one decide to buy an electric or gas residential water heater?

	Residential Water-Heater Purchasing Criteria
	(Homeowner or Landlord)
Replacement	• First cost (Homeowners not aware of water-heating energy costs) • Typically emergency replacement • Subcontractor's recommendation • Tendency to replace like with like • Has to fit in previous water-heater space
	(Developer or Builder)
New Construction	• First cost (Energy efficiency not necessarily a selling point) • Water heater is "invisible" • Consumers and builders are not aware of energy-efficient mortgages

As a purchasing criterion, first cost is much more important than payback on investment.

For a high-efficiency water-heater program, the following factors have to be considered to properly target end uses.

- Cost effectiveness
  - First Cost
  - Operating Cost
- Adequacy to meet water heating demand
- Impacts on electric/gas competition
- Perception of safety
- Impacts on space conditioning
- Environmental impacts

The single-family household is the key target market for high-efficiency water heating.

- Larger households (that realize greater cost savings) are more prevalent in the single-family sector.

- Single-family households tend to focus on life-cycle costs, balancing higher first costs versus potential savings.

- Higher income, able to afford the first cost. Also, potential savings evaluated more closely.

- Less space constraints, a potential drawback of advanced technologies.

Several barriers to high-efficiency technologies have been identified.

Factor	Market Need
Economics	The maximum allowable payback is typically 3–5 years. Even then, first-cost premiums must generally be modest.
Reliability	This is the most important criterion. The reliability of new equipment needs to be proven.
Maintenance	The service infrastructure must be developed adequately. Properly trained and educated service technicians is also important.
System Life	Service life should be comparable to that of current products.
Availability	Need to be able to purchase off-the-shelf to satisfy emergency replacements.
Installation	Installers will generally opt for equipment that is easily installed, with little risk of difficulty
Track Record	End-users often prefer the backing of a large, well-respected company/ utility.

Several trends are impacting the prospects for high-efficiency water heating in the residential market.

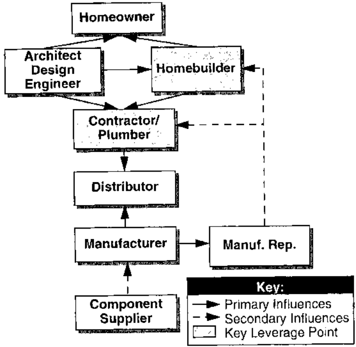
Driver	Trend	Direction of Impact	Attractiveness/ Seriousness	Certainty
Electric industry deregulation	Reduction of rebates and direct subsidies	↓	High	High
Gas industry deregulation	Reduction of rebates and direct subsidies	↑	High	High
Electric industry deregulation	Marginal electricity pricing (T.O.U/real-time rates)	→	High	Low
Electric industry deregulation	Lower average prices	↓	Low?	High
Building industry competition	Builders seek products to differentiate offerings, larger margins	↑	Low	High
Technology	Advanced technology is tested, more reliable	↑	High	High
Environment	Air emissions (favorable perception)	↑	Low	Low
Regulatory	NAECA	↑	Low	High
Demographics	Population growth in the South	↑	High	High
Performance (ESCO) Contracting	Pay-from-savings life-cycle costing	↑	High	High

Key success factors for high-efficiency water-heating technologies have been evaluated.

KEY SUCCESS FACTOR	CURRENT PERFORMANCE Major Strength		Neutral		Major Weakness	CURRENT IMPORTANCE High		Medium		Low
Decision-maker awareness[1]				✔			✔			
Previous experience with product					✔			✔		
Product availability (diversity)				✔				✔		
Product reliability			✔			✔				
Product installed cost					✔	✔				
Service/maintenance network					✔		✔			
Environmental impacts		✔					✔			
Promotion effectiveness			✔						✔	
Product feature (i.e., dehumidification)			✔						✔	
Noise level			✔					✔		
Production capacity				✔			✔			
Operating cost		✔					✔			
Product warranty			✔					✔		
Ease of installation				✔				✔		
Product durability				✔		✔				

1 Exception—Solar has high decision-maker awareness.

Single-Family New-Construction Participants



Roles of Key Participants

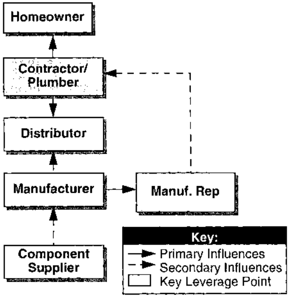
Homeowner
- Approves recommendations from
  - Homebuilders
  - Contractors

Homebuilder
- 40% of time builds speculatively
- Selects system and influences vendor
- Writes specifications
- Primary influence on homeowner
  - Builds for customer

Contractor/Plumber
- Selects vendor based on:
  - Meeting specification
  - Price
  - Product reliability
  - Proximity/relationship with distributors
- Influences system

Source: ADL Interviews.

Single-Family Replacement/Retrofit Participants



Roles of Key Participants

Homeowner
- Approves recommendations
- Often prefers "replacement in kind"
  - Less than 30% ask about features
  - Only mid to higher income consider life-cycle

Contractor/Plumber
- Selects vendor
- Influences homeowner by offering:
  - Products/features alternatives
  - Pricing alternatives
  - Advice

Source: ADL Interviews.