California Residential Efficiency Market Share Tracking

Appliances 2007

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Table of Contents

Appendix A: Appliance Sales Data Analysis

1

Introduction

1.1. Overview

This report summarizes the analysis and results of the appliance component of the California Residential Market Share Tracking project (RMST).[1] Since 1999, the RMST project has monitored the market penetration of energy efficient measures in California and has helped California's investor-owned utilities (IOUs) measure statewide and utility program milestones for promoting short-term adoption of measures and longer-term market acceptance of energy efficient technologies.[2] In addition to appliances, the RMST project examines the market penetration of compact fluorescent and other medium screw-based lamps. The HVAC component of the RMST project has been discontinued.[3] In addition to the California IOUs, beneficiaries of this research include federal and state agencies, regional and state energy efficiency organizations, trade organizations, equipment manufacturers, distributors, and retailers.

This report presents the total estimated unit sales, average energy efficiency ratings, and market share of ENERGY STAR qualified clothes washers, refrigerators, dishwashers, and room air conditioners sold in California from 1998 through 2007. Wherever possible, the results are presented within the following categories: statewide sales, sales within IOU service areas, and sales by retailer type (national chain versus independent retailer). This report provides general market information and a review of data collection and analysis methodologies. Summaries of applicable efficiency standards are provided for each appliance type, including federal energy use standards, national ENERGY STAR program standards, and California appliance efficiency standards.

The market trends of ENERGY STAR qualified appliances are especially pertinent to the program administrators of California IOUs. California's statewide appliance program uses the ENERGY STAR threshold as the qualifying criterion for appliance eligibility and collaborates with the federal ENERGY STAR program for marketing and outreach. The

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[1] *California Appliance Trends* 2007, an eight-page companion report, summarizes the findings in this report.
[2] This project is managed by Southern California Edison and funded by the California Public Goods Charge.
[3] Annual RMST reports detailing CFL sales, residential appliance sales, and HVAC sales in California since 2000 can be downloaded from www.calmac.org.

statewide market share of ENERGY STAR qualifying appliances indicates program success and is used to support the evaluation of the statewide program.

1.2. Highlights

Figure 1-1 illustrates the trends in market penetration of ENERGY STAR qualified appliances since 1999. Significant decreases in market share are the result of upward revisions to the minimum ENERGY STAR efficiency criteria. The most notable instances occurred with refrigerators in 2001 and dishwashers in 2007.

Figure 1-1: Market Shares of ENERGY STAR Qualified Appliances in California
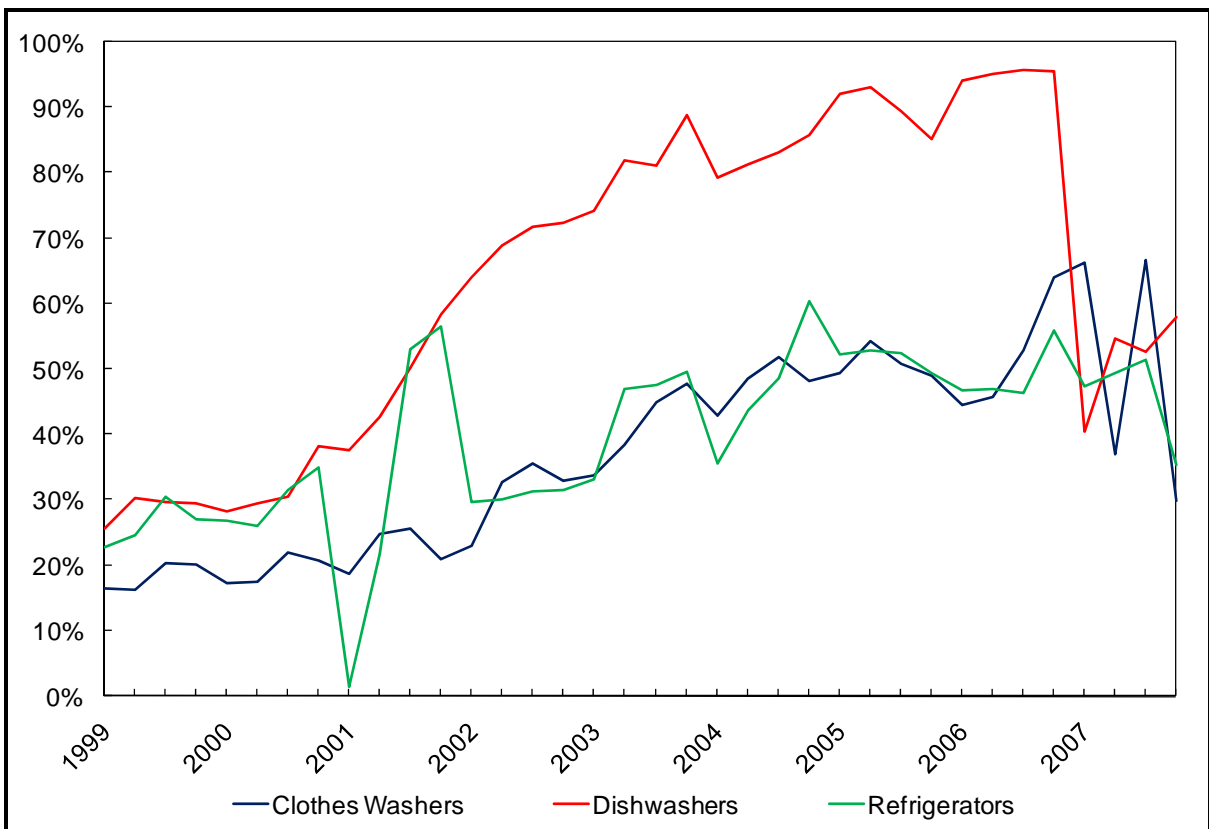
The sales data obtained in this study reveal differences in the share of ENERGY STAR qualified units sold through national chains compared to independent retailers. The percentage of ENERGY STAR sales through independent retailers has generally been greater than the percentage of ENERGY STAR sales through national chains in California.

Since the inception of the RMST study, efficiency levels of clothes washers, dishwashers, and refrigerators have increased. Figure 1-2 presents the average energy factor (EF) for clothes washers, dishwashers, and refrigerators sold by independent appliance retailers from

1999 through 2007. During this period, the average EF for clothes washers increased from 2.0 to 4.9 and the average EF for refrigerators increased from 12.2 to 18.2. Also, the average EF for dishwashers increased from 0.52 in 1999 to 0.66 in 2007, despite a revision in how dishwasher EF was calculated.

Figure 1-2: Average EF of Appliances Sold by Independent Retailers in California
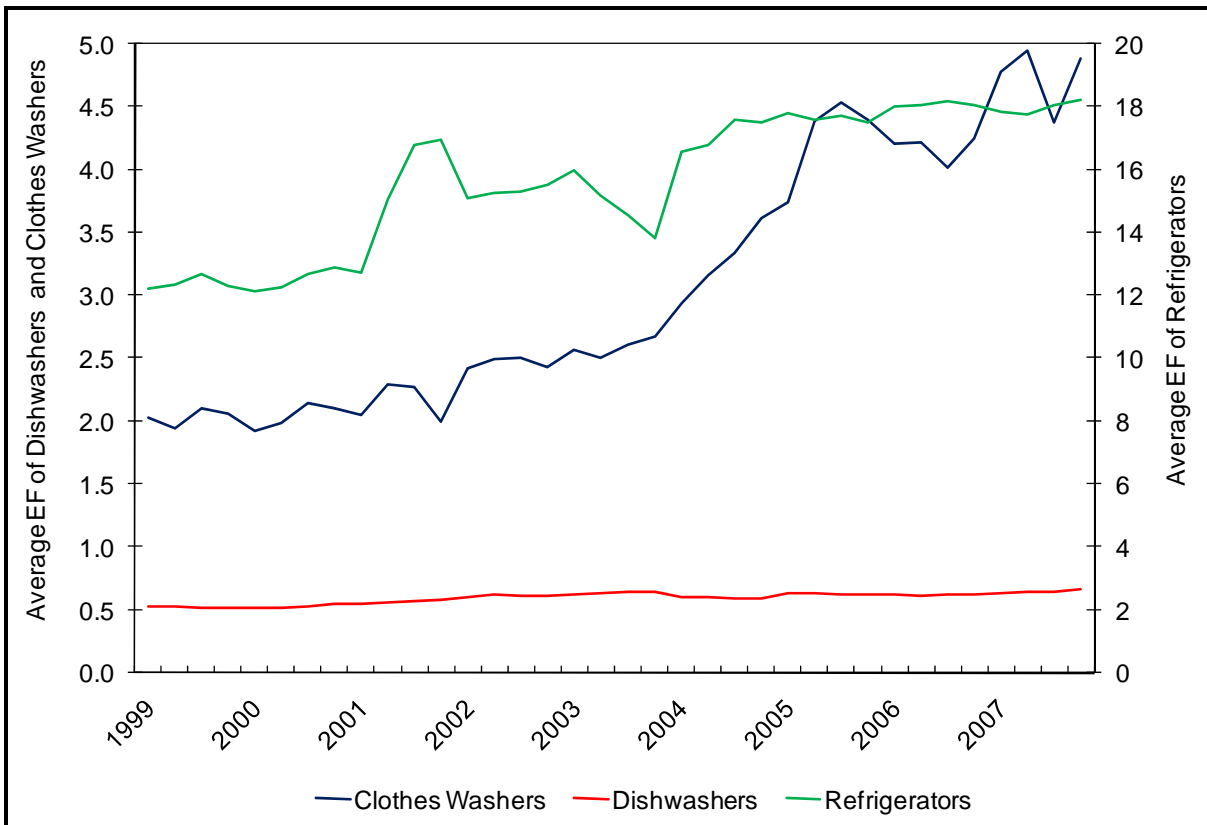
1.3. Organization of the Report

The remainder of this report is organized as follows.

- Section 2 details the data collection and analysis methodology for developing the market share and average efficiency estimates.

- Section 3 presents the results for clothes washers.

- Section 4 presents the results for dishwashers.

- Section 5 presents the results for refrigerators.

- Section 6 presents the results for room air conditioners.

2

Data Collection and Analysis

2.1. Overview

The RMST project determines the share of ENERGY STAR qualified units sold and average efficiency ratings from retailer point-of-sale (POS) data. For the purposes of this report, the appliance retail market is divided into two retailer types: national chain stores and independently owned retailers, which include regional chains and single storefronts. POS data are obtained from a representative sample of both retailer types. Since the inception of the RMST project, Itron has obtained sales data from a panel of independent appliance retailers throughout California. D&R International,[4] a firm contracted by the U.S. Department of Energy (DOE), provides data obtained from national appliance retailers.

The remainder of this section provides an overview of California's appliance retail market and describes data collection and analysis methodologies. Appendix A provides an in-depth description of the sales data analysis.

2.2. Summary of California's Appliance Retail Market

The analysis of appliance sales relies on collecting POS data from a representative sample of appliance retailers. Table 2-1 presents the estimated 2007 population of appliance retailers and the number of appliance storefronts in California. The table distinguishes between national chain retailers, independent regional chains and single-storefront retailers. All national chain storefronts are assumed to be ENERGY STAR partners. ENERGY STAR partnership entails an agreement between the participating retailer and EPA/DOE to uphold certain standards in promoting qualified products. Although trends vary according to appliance type, the data suggest that national chains sell approximately half of the appliances sold in California.

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[4]   www.drintl.com

Table 2-1: Estimate of California Appliance Retailers

	National Chains	**Independent Regional Chains**	**Independent Individual Stores**	**All Retailers**
Companies	6	21	330	357
ENERGY STAR Partners [a]	6	1	0	7
Retail Storefronts	541	85	330	956

a. All national chain storefronts participate in the ENERGY STAR program once the corporate home office has agreed to participate. Individual storefronts do not make the decision to participate.

The RMST study distinguishes between national chains in California and independent retailers because the data source is different for each retailer type. The methodology for obtaining data from each retailer type is explained below.

2.3. National Appliance Retailer Sales Data

D&R International tracks the sale of ENERGY STAR products by collecting sales data from national chain retailers under contract to support the ENERGY STAR appliance program. D&R provides Itron with aggregated sales data by ZIP code from national chain retailers for each of the appliance types covered by the RMST project.[5] The extent of the analysis is limited because the provided data do not specify detailed efficiency characteristics. The data include the total number of units sold and the total number of ENERGY STAR qualified units sold for each appliance type by ZIP code. For the 2007 analysis, the integrity of this sales data was compromised by errors in the data submitted by retailers. According to the ENERGY STAR website, "The validity of the clothes washer data for quarter one and quarter three is questionable. It is expected that the incorrect coding of previously qualified units for these two quarters resulted in a higher than actual market share projection. The drop in refrigerator market share in the fourth quarter is also due to data from one retailer."[6]

2.4. Independent and Regional Chain Retailer Point-of-Sale Data

Itron collects POS data from a panel of independent storefronts and regional chains throughout California to represent the trends of appliance sales through the independent retailer channel. The sampling strategy, recruiting strategy, and characteristics of the 2007 retailer panel are described below.

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[5] Appendix A presents further information on methodology used in weighting the national chain data.
[6] http://www.energystar.gov/ia/partners/manuf_res/2007FinalSalesData.xls

Independent Retailer Sample Frame and Sample Design

Itron developed the sample frame of independent retailers by acquiring a marketing database from USA Data.[7] The database was generated by using the Standard Industrial Classification code for household appliances, and subsequently eliminating second-hand retailers and repair services. This effort produced an independent retailer database containing more than 300 store locations. Table 2-2 summarizes the independent retailer sample frame used to recruit independent retailers for the RMST panel.

Table 2-2: Independent Appliance Retailer Sample Frame

	IOU				
	PG&E	**SCE**	**SDG&E**	**Other**[a]	**Total**
All Areas					
Storefronts	159	87	80	89	415
Percent of Total	38%	21%	19%	22%	100%
PG&E, SCE, and SDG&E Only					
Storefronts	159	87	80		326
Percent of Total	49%	27%	25%		100%

a   "Other" includes the service territories of municipal utilities such as LADWP, SMUD, LMUD, and others.

The 2007 participant panel includes eight of the nine retailers that made up the 2006 participant panel. In addition to these retailers, Itron also recruited two additional retailers. These ten retailers account for 25 storefronts throughout California. The retailers in the panel provided data in various formats, including electronic spreadsheets and hard-copy sales reports. Monthly sales data included appliance type, manufacturer, model number, quantity sold, and date of sale. Table 2-2 provides the sample for each utility service territory.

Table 2-3: 2007 Independent Appliance Retailer Sample

	IOU			
	PG&E	**SCE**	**Other**	**Total**
Storefronts	21	3	1	25
Percent of Total	84%	12%	4%	100%

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7   USA Data extracts business names from the Dunn & Bradstreet Wholesale Business List, which is a compilation of information retrieved from yellow pages, credit inquiries, Internet, business registrations, payment experiences, public records, Secretary of State files, and other sources.

ENERGY STAR Sales by Independent Retailers

The results of this study indicate that independent retailers generally sell a large proportion of ENERGY STAR appliances. National chain appliance retailers, on the other hand, sell a less significant share of ENERGY STAR appliances. This disparity could be interpreted as the result of several factors. Independent stores typically have a more experienced staff that is able to provide more information regarding product efficiency. Independent retailers have unique marketing strategies and often demonstrate a greater willingness to make special orders. Instead of engaging in price competition with national chains, independent retailers tend to focus on customer service, a knowledgeable employee base, and the ability to address the needs of individual customers. Independent appliance retailers also serve a specific clientele, which may be more inclined to purchase high-end products.

In the past, the appliance selection found at national chains was limited in comparison to the selection found at independent appliance retailers. Over the past few years, national chains have augmented their ENERGY STAR product lines so that the market share of these items in California has increased.

2.5. Summary of 2007 Database Coverage

Table 2-4 summarizes the RMST coverage of units sold in 2007 by appliance type. The 2007 database includes sales data for an estimated 71% of the total number of clothes washers, 32% of dishwashers, 58% of refrigerators, and 26% of room air conditioners sold in California.

Table 2-4: 2007 Coverage of Units Sold, by Appliance Type

	Appliance Type			
	Clothes Washers	**Dishwashers**	**Refrigerators**	**Room AC**
Estimate of total unit sales	860,600	700,000	1,182,500	494,200
Unit sales in sample	611,073	222,345	686,347	130,721
Percent of unit sales in sample	71%	32%	58%	26%

a. See subsequent sections for comments on estimates of total unit sales for each measure type.

2.6. Analysis Approach

The RMST appliance study estimates the market share of ENERGY STAR qualified units and the average efficiency rating of all units sold. The results are presented by retailer type and utility service area. The average energy factor (EF) is calculated for dishwashers and refrigerators, while the average modified energy factor (MEF) is calculated for clothes washers. The results are reported on an annual and quarterly basis. A brief description of each approach is presented below; a more detailed description is provided in Appendix A.

ENERGY STAR Market Share Analysis

The share of ENERGY STAR qualified units sold is estimated by analyzing sales data obtained from national chains and independent retailers. An appliance is considered "ENERGY STAR qualified" if the energy efficiency rating of the product meets the minimum threshold for the ENERGY STAR program. However, products that meet the minimum efficiency criteria are not necessarily designated with the official ENERGY STAR label.

Increases in the ENERGY STAR minimum threshold have demonstrated a significant impact on market share during the period following the revision. For example, when the efficiency standard for ENERGY STAR refrigerators increased in 2001, the share of ENERGY STAR qualified refrigerators dropped from 35% to 1%.

Energy Factor Analysis

In addition to the ENERGY STAR market share analysis described above, the RMST study tracks the average energy efficiency ratings of appliances sold throughout California. The national chain sales data does not include the energy efficiency ratings or the model numbers of units sold. Because of these limitations, the EF analysis does not include national chain sales. However, the analysis does include appliances sold through independent retailers.

3

Clothes Washers

3.1. Overview

This chapter presents the results for residential clothes washers and includes the following: total estimated unit sales in California (3.2), energy efficiency standards (3.3), market share of ENERGY STAR qualified units sold in California (3.4), ENERGY STAR sales by retailer type (3.5), and efficiency analysis of units sold by independent retailers (3.6).

3.2. Total Unit Sales

Table 3-1 presents estimated annual unit sales of residential clothes washers in California from 1998 through 2007. Until a 14% decrease in 2007, clothes washer sales had increased every year since the RMST study began. The Association of Home Appliance Manufacturers (AHAM) provided the data.

Table 3-1: Estimate of Total Clothes Washer Unit Sales in California

Year	Units Sold
1998	702,000
1999	721,100
2000	731,500
2001	766,500
2002	819,500
2003	881,500
2004	937,100
2005	960,200
2006	999,000
2007	860,600

Source: AHAM

3.3. Clothes Washer Energy Efficiency Standards

Clothes washer efficiency ratings are based on estimated annual energy use (kWh) under "typical conditions" and an average of 392 loads, or cycles, per year. In general, the efficiency ratings for clothes washers are expressed in terms of ft^3/kWh/cycle.

On January 1, 2004, the federal, California, and ENERGY STAR standards changed the performance metric used to evaluate clothes washers, thus replacing energy factor (EF) with modified energy factor (MEF).[8] MEF accounts for the amount of dryer energy used to remove the remaining moisture content in washed items.

The MEF is computed as the capacity in cubic feet (C) divided by the sum of the machine electrical energy for the mechanical action of a cycle (M) and the water heating energy required for a cycle (E) and the energy required for removal of the remaining moisture in the wash load (D).

$$MEF = \frac{C}{M + E + D}$$

where:

C = clothes washer capacity in cubic feet
M = machine electrical energy consumption
E = hot water energy consumption
D = energy required for removal of the remaining moisture in the wash load
(M + E + D) = the total clothes washer energy use in kWh per cycle

Federal Energy Use Standard. Effective January 1, 2007, the federal standard requires top-loading clothes washers to have a minimum MEF of 1.26. This revision reflects an increase from the former federal standard of 1.04 MEF.

ENERGY STAR Standard. The ENERGY STAR criteria for clothes washers changed on January 1, 2007. The new ENERGY STAR criteria require qualifying products to have an MEF of 1.72 or greater as well as a water factor (WF)[9] of 8.0 or lower. The ENERGY STAR program recently announced two future revisions to the qualifying efficiency level. The first revision, which increases minimum qualifying to 1.8 and reduces the qualifying water factor to 7.5, becomes effective on July 1, 2009. The second revision, which becomes effective on January 1, 2011, states that clothes washers must have an MEF of at least 2.0 and a water

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[8]   http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers
[9]   WF = gallons per cycle per cubic foot

factor no greater than 6.0. Table 3-2 summarizes the federal, state, and ENERGY STAR standards for clothes washers.

Table 3-2: Summary of Clothes Washer Energy Standards

	January 1, 2001	**January 1, 2004**	**January 1, 2007**	**July 1, 2009**	**January 1, 2011**
California Standard	1.18 EF	1.04 MEF	1.26 MEF	1.26 MEF	1.26 MEF
Federal Standard	1.18 EF	1.04 MEF	1.26 MEF	1.26 MEF	1.26 MEF
ENERGY STAR Criteria	1.26 MEF	1.42 MEF	1.72 MEF	1.8 MEF	2.0 MEF

California IOU Incentive Programs. In order to qualify for a rebate in California, clothes washers are required to meet EF and WF criteria. Most rebates are only available for side-loading high efficiency washers, which consume less water and remove more moisture from clothes during the spin cycle, thus shortening the drying cycle and using less energy. The San Diego County Water Authority provides financial incentives to customers who purchase a high efficiency washer with a maximum WF of 5.0. The program is co-funded by SDG&E and offers a rebate of up to $185. PG&E offers a $35 rebate for select clothes washers with a minimum MEF of 2.0 and a maximum WF of 6.0. The utility also offers a rebate of $75 for clothes washers with a minimum MEF of 2.2 and maximum WF of 4.5. SCE does not offer rebates for high-efficiency clothes washers.

3.4. Market Share of ENERGY STAR Qualified Clothes Washers

Figure 3-1 and Table 3-3 present the share of ENERGY STAR qualified clothes washers sold in California from 1998 to 2007, although it appears that there are inconsistencies in the 2007 data. The share of ENERGY STAR appliances typically declines when new criteria are introduced. However, in the first and third quarters of 2007, an uncharacteristic gain in ENERGY STAR market share occurred. According to the ENERGY STAR website, "it is expected that the incorrect coding of previously qualified units for these two quarters resulted in a higher than actual market share projection."[10] Itron does not have access to the sales data submitted by national chain retailers and is therefore not able to adjust these figures. However, it is possible that the ENERGY STAR share for the first and third quarters may be similar to the share of the second and fourth quarters, 37% and 30%, respectively.

Figure 3-1: Clothes Washer Sales, Percent ENERGY STAR Qualified Units
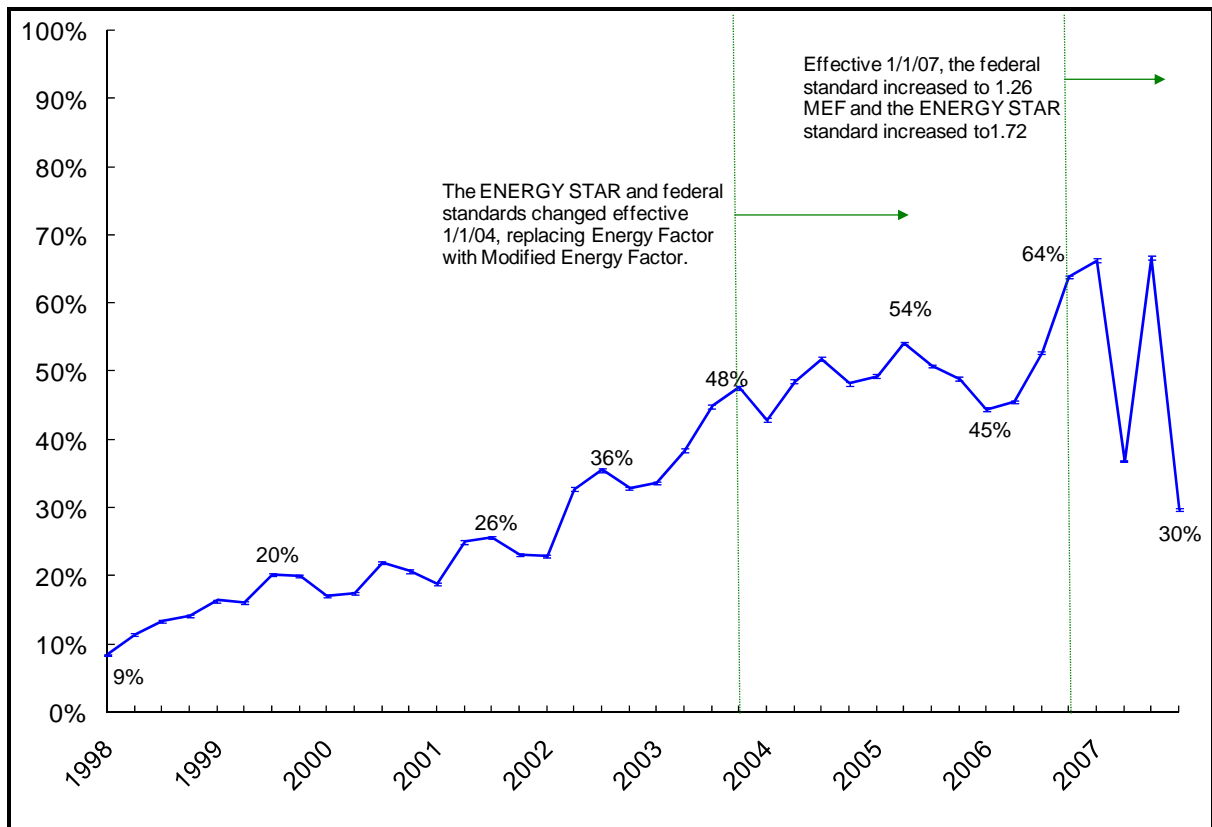
Error bands for the 90% confidence interval.

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[10] http://www.energystar.gov/ia/partners/manuf_res/2007FinalSalesData.xls

Table 3-3: Clothes Washer Sales Statewide, Percent ENERGY STAR Units

Year	Percent ENERGY STAR Qualified Clothes Washers				
	Annual	**Q1**	**Q2**	**Q3**	**Q4**
1998	**12.0%** (-) n = 180,983	**8.5%** (-) n = 44,233	**11.5%** (-) n = 43,366	**13.4%** (-) n = 44,746	**14.2%** (-) n = 48,638
1999	**18.2%** (0.0006) n = 425,528	**16.5%** (0.0011) n = 115,621	**16.2%** (0.0011) n = 107,984	**20.2%** (0.0013) n = 101,691	**20.1%** (0.0013) n = 100,232
2000	**19.3%** (.0006) n 414,505	**17.2%** (.0013) n = 113,966	**17.5%** (.0011) n = 114,385	**22.0%** (.0011) n = 88,754	**20.8%** (.0014) n = 97,400
2001	**23.2%** (0.0006) n = 427,489	**18.9%** (0.0012) n = 109,184	**25.1%** (0.0013) n = 103,324	**25.8%** (0.0014) n = 103,185	**23.2%** (0.0013) n = 111,796
2002	**30.6%** (0.0007) n = 462,069	**23.0%** (0.0011) n = 150,430	**32.8%** (0.0014) n = 108,486	**35.6%** (0.0015) n = 102,046	**32.9%** (0.0015) n = 101,107
2003	**41.5%** (0.0008) n = 345,297	**33.8%** (0.0014) n = 108,379	**38.5%** (0.0018) n = 76,204	**45.0%** (0.0018) n = 76,179	**47.7%** (0.0017) n = 84,535
2004	**47.9%** (0.0008) n = 387,664	**42.9%** (0.0016) n = 96,350	**48.6%** (0.0016) n = 94,907	**51.9%** (0.0016) n = 96,908	**48.3%** (0.0016) n = 99,499
2005	**51.0%** (0.0007) n = 489,388	**49.4%** (0.0014) n = 126,122	**54.2%** (0.0014) n = 123,204	**50.9%** (0.0015) n = 117,267	**49.0%** (0.0014) n = 122,795
2006	**51.5%** (0.0007) n = 520,567	**44.5%** (0.0013) n = 142,957	**45.7%** (0.0014) n = 132,351	**52.9%** (0.0014) n = 123,650	**64.0%** (0.0014) n = 121,609
2007	**45.5%** (0.0006) n = 611,073	**66.4%** (0.0014) n = 111,927	**36.9%** (0.0011) n = 196,932	**66.7%** (0.0015) n = 99,937	**29.8%** (0.0010) n = 202,277

Standard errors in parentheses.

Table 3-4 reports the share of ENERGY STAR qualified clothes washers sold in each utility service area on an annual and quarterly basis. With a 48% market share, the PG&E service territory exhibited the highest average annual percentage of ENERGY STAR clothes washer sales in 2007. Retailers in the SDG&E service area sold a 45 % share of ENERGY STAR clothes washers. ENERGY STAR sales in the SCE service territory and "Other" regions constituted approximately 44% of total clothes washer sales in each territory.

Table 3-4: Clothes Washer Sales by Utility, Percent ENERGY STAR Units

Utility	Year	Percent ENERGY STAR Qualified Clothes Washers				
		Annual	Q1	Q2	Q3	Q4
PG&E	1998	12.7% (-) n = 83,563	80.6% (-) n = 19,916	13.7% (-) n = 20,751	15.3% (-) n = 20,520	12.9% (-) n = 22,376
	1999	14.7% (0.0008) n = 165,144	12.9% (0.0015) n = 47,436	13.7% (0.0017) n = 42,090	15.6% (0.0019) n = 37,916	17.2% (0.0019) n = 37,702
	2000	24.3% (.0011) n = 165,405	20.4% (.0019) n = 43,959	24.0% (.0020) n = 45,042	28.1% (.0023) n = 37,038	25.0% (.0022) n = 39,366
	2001	29.5% (0.0011) n = 170,360	23.5% (0.0020) n = 43,035	31.1% (0.0023) n = 40,366	32.7% (0.0023) n = 41,868	30.7% (0.0022) n = 45,091
	2002	36.7% (0.0012) n = 170,593	30.3% (0.0020) n = 53,861	39.8% (0.0025) n = 39,911	41.3% (0.0025) n = 38,456	37.6% (0.0025) n = 38,365
	2003	45.5% (0.0014) n = 128,897	39.8% (0.0024) n = 41,517	43.3% (0.0030) n = 28,070	46.4% (0.0030) n = 28,465	54.7% (0.0028) n = 30,845
	2004	47.8% (0.0013) n = 148,696	39.7% (0.0025) n = 37,258	48.2% (0.0026) n = 36,535	51.8% (0.0026) n = 36,965	51.4% (0.0026) n = 37,938
	2005	54.6% (0.0012) n = 171,534	53.5% (0.0024) n = 43,806	55.9% (0.0024) n = 42,676	53.7% (0.0024) n = 41,723	55.4% (0.0024) n = 43,329
	2006	58.9% (0.0012) n = 175,987	51.8% (0.0023) n = 49,051	52.7% (0.0024) n = 43,696	60.3% (0.0024) n = 41,930	71.5% (0.0022) n = 41,310
	2007	47.6% (0.0011) n = 222,390	68.7% (0.0023) n = 40,049	38.5% (0.0018) n = 71,238	71.2% (0.0024) n = 35,398	31.7% (0.0017) n = 75,705
SCE	1998	8.7% (-) n = 47,708	7.6% (-) n = 12,287	7.2% (-) n = 11,357	7.9% (-) n = 11,693	12.2% (-) n = 12,371
	1999	17.4% (0.0010) n = 140,863	15.6% (0.0018) n = 36,820	15.4% (0.0019) n = 35,609	19.7% (0.0021) n = 34,829	19.0% (0.0021) n = 33,605
	2000	15.0% (.0009) n = 136,046	14.1% (.0018) n = 38,696	12.2% (.0017) n = 38,212	16.8% (.0022) n = 27,790	17.3% (.0021) n = 31,348
	2001	19.0% (0.0010) n = 144,802	15.9% (0.0019) n = 37,341	21.1% (0.0022) n = 35,457	21.7% (0.0022) n = 34,187	17.6% (0.0019) n = 37,817
	2002	28.5% (0.0011) n = 157,803	20.5% (0.0018) n = 51,295	30.1% (0.0024) n = 37,933	32.9% (0.0025) n = 34,570	31.9% (0.0025) n = 34,005
	2003	39.2% (0.0014) n = 117,280	24.8% (0.0023) n = 36,021	35.7% (0.0029) n = 26,493	44.3% (0.0031) n = 25,888	43.9% (0.0029) n = 28,878
	2004	42.2% (0.0014) n = 124,558	43.5% (0.0029) n = 29,630	44.3% (0.0028) n = 30,740	43.2% (0.0028) n = 31,646	37.5% (0.0027) n = 32,542
	2005	48.4% (0.0012) n = 173,465	46.4% (0.0024) n = 45,025	51.1% (0.0024) n = 44,148	49.7% (0.0025) n = 41,049	46.5% (0.0024) n = 43,243
	2006	47.4% (0.0011) n = 194,080	40.9% (0.0021) n = 52,716	42.0% (0.0022) n = 50,137	48.0% (0.0023) n = 46,381	60.3% (0.0023) n = 44,846
	2007	44.4% (0.0011) n = 218,104	63.7% (0.0024) n = 40,787	37.0% (0.0018) n = 70,606	62.8% (0.0025) n = 36,222	28.5% (0.0017) n = 70,489

Standard errors in parentheses.

Table 3-4 (cont'd.): Clothes Washer Sales by Utility, Percent ENERGY STAR

Utility	Year	Percent ENERGY STAR Qualified Clothes Washers				
		Annual	**Q1**	**Q2**	**Q3**	**Q4**
SDG&E	1998	11.7% (-) n = 14,582	10.6% (-) n = 3,491	11.7% (-) n = 3,359	14.2% (-) n = 3,413	10.7% (-) n = 4,319
	1999	18.0% (0.0020) n = 38,302	18.7% (0.0039) n = 9,915	14.7% (0.0035) n = 9,943	18.7% (0.0041) n = 9,229	20.2% (0.0042) n = 9,215
	2000	21.3% (.0022) n = 35,560	19.9% (.0040) n = 9,890	16.3% (.0037) n=9,816	24.4% (.0050) n = 7,492	24.7% (.0047) n = 8,362
	2001	18.2% (0.0020) n = 39,016	14.2% (0.0035) n = 9,835	18.7% (0.0040) n = 9,592	18.7% (0.0040) n = 9,621	21.1% (0.0041) n = 9,968
	2002	25.5% (0.0023) n = 37,314	16.8% (0.0036) n = 12,438	27.3% (0.0048) n = 8,668	31.3% (0.0050) n = 8,513	31.3% (0.0053) n = 7,695
	2003	39.7% (0.0031) n = 24,164	33.7% (0.0052) n = 8,223	34.2% (0.0067) n = 5,046	47.4% (0.0069) n = 5,181	46.3% (0.0066) n = 5,714
	2004	41.7% (0.0030) n = 26,475	35.1% (0.0059) n = 6,485	44.1% (0.0062) n = 6,436	45.9% (0.0061) n = 6,756	41.5% (0.0060) n = 6,798
	2005	42.6% (0.0025) n = 39,504	42.0% (0.0049) n = 10,169	42.3% (0.0049) n = 10,137	44.7% (0.0051) n = 9,592	41.5% (0.0050) n = 9,606
	2006	44.3% (0.0024) n = 41,720	37.7% (0.0046) n = 11,057	37.7% (0.0047) n = 10,748	46.0% (0.0050) n = 10,084	57.3% (0.0050) n = 9,831
	2007	45.4% (0.0024) n = 44,125	68.4% (0.0052) n = 7,976	35.9% (0.0040) n = 14,344	68.0% (0.0054) n = 7,582	30.0% (0.0038) n = 14,233
Other	1998	13.4% (-) n = 35,130	7.8% (-) n = 8,539	10.4% (-) n = 7,899	14.4% (-) n = 9,120	19.8% (-) n = 9,572
	1999	15.7% (0.0013) n = 81,219	14.7% (0.0024) n = 21,450	14.9% (0.0025) n = 20,342	17.7% (0.0027) n = 19,717	15.7% (0.0026) n = 19,710
	2000	16.2% (.0013) n = 77,494	16.0% (.0025) n = 21,421	15.1% (.0025) n = 21,315	17.5% (.0030) n = 16,434	16.4% (.0027) n = 18,324
	2001	22.0% (0.0015) n = 73,311	18.5% (0.0028) n = 18,973	25.0% (0.0032) n = 17,909	23.2% (0.0032) n = 17,509	21.6% (0.0030) n = 18,920
	2002	21.4% (0.0013) n = 96,359	14.0% (0.0019) n = 32,836	23.3% (0.0028) n = 21,974	27.8% (0.0031) n = 20,507	24.9% (0.0030) n = 21,042
	2003	35.8% (0.0018) n = 74,956	27.6% (0.0030) n = 22,618	32.1% (0.0036) n = 16,595	42.8% (0.0038) n = 16,645	42.8% (0.0036) n = 19,098
	2004	55.5% (0.0017) n = 87,935	47.8% (0.0033) n = 22,977	55.0% (0.0034) n = 21,196	62.5% (0.0033) n = 21,541	56.8% (0.0033) n = 22,221
	2005	51.4% (0.0015) n = 104,885	50.5% (0.0030) n = 27,122	59.2% (0.0030) n = 26,243	49.6% (0.0032) n = 24,903	42.6% (0.0030) n = 26,617
	2006	47.4% (0.0015) n = 108,780	40.2% (0.0028) n = 30,133	42.5% (0.0030) n = 27,770	49.4% (0.0031) n = 25,255	58.9% (0.0031) n = 25,622
	2007	43.5% (0.0014) n = 126,454	66.7% (0.0031) n = 23,115	34.3% (0.0024) n = 40,754	65.2% (0.0033) n = 20,735	28.4% (0.0022) n = 41,850

Standard errors in parentheses.
"Other" includes municipal utilities, including LADWP, SMUD, and others.

3.5. Analysis by Retailer Type

In Figure 3-2 and Table 3-5, the share of ENERGY STAR qualified clothes washers sold through national chains is compared with the share sold by independent retailers. In general, independent retailers sell a large percentage of ENERGY STAR qualified clothes washers while national chains sell a smaller percentage. It is not clear why this difference exists. In 2007, the share of ENERGY STAR clothes washers sold by independent retailers decreased slightly as a result of increased criteria. For national chains, only the second and fourth quarters of 2007 can be regarded with a degree of certainty due to inaccuracies in the data submitted by national retailers.

Figure 3-2: Clothes Washer Sales, Percent ENERGY STAR by Retailer Type
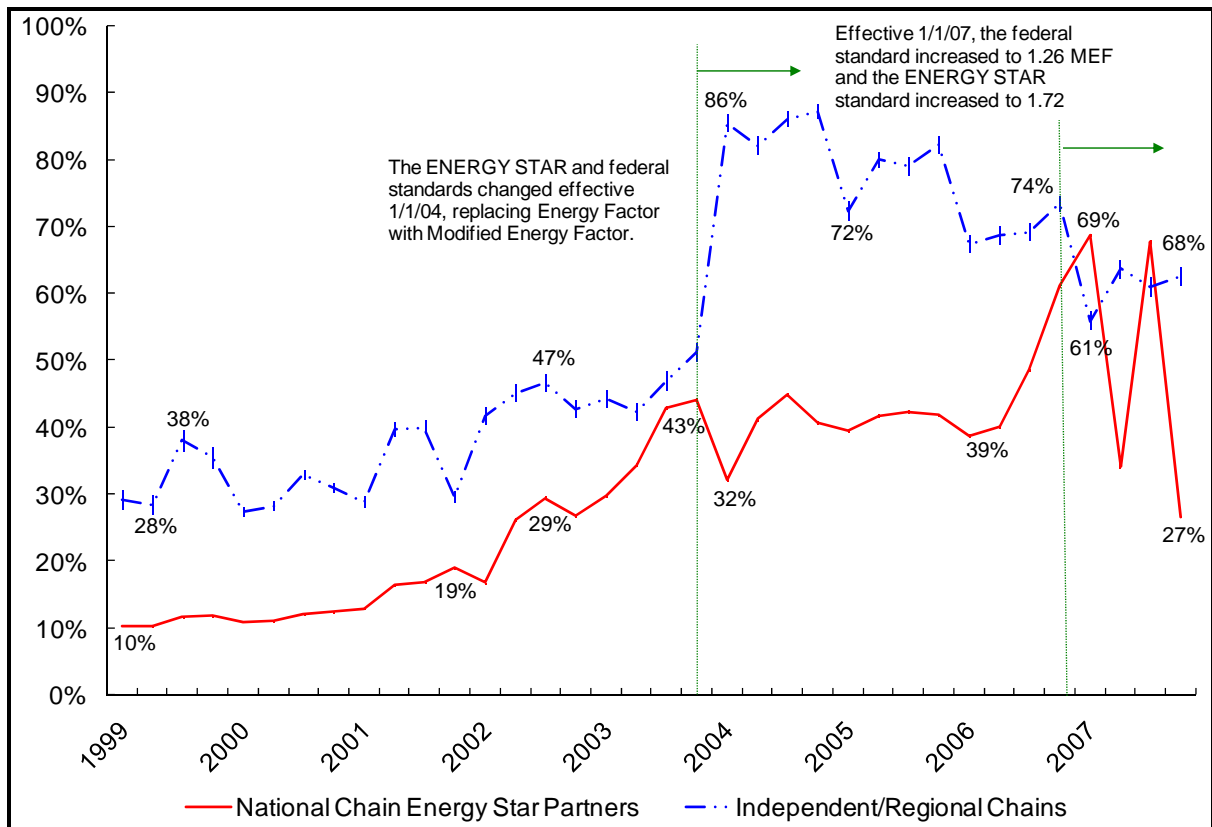
Error bands for the 90% confidence interval.

Table 3-5: Clothes Washer Sales, Percent ENERGY STAR by Retailer Type

Year	Retailer Type	Q1	Q2	Q3	Q4
1999	National Chain	**10.4%** (0.0009) n =113,050	**10.3%** (0.0009) n =105,551	**11.6%** (0.0010) n =99,385	**11.9%** (0.0010) n =97,766
	Independent/Regional Chain	**29.3%** (0.0090) n =2,571	**28.5%** (0.0091) n =2,433	**38.1%** (0.0101) n =2,306	**35.6%** (0.0096) n =2,466
2000	National Chain	**11.0%** (0.0010) n =102,845	**11.1%** (0.0010) n =103,399	**12.1%** (0.0012) n =76,422	**12.5%** (0.0011) n =85,304
	Independent/Regional Chain	**27.4%** (0.0042) n =11,121	**28.3%** (0.0043) n =10,986	**33.1%** (0.0042) n =12,332	**31.0%** (0.0042) n =12,096
2001	National Chain	**13.0%** (0.0011) n = 102,255	**16.4%** (0.0012) n = 96,959	**16.8%** (0.0012) n = 96,088	**19.1%** (0.0012) n = 104,159
	Independent/Regional Chain	**28.9%** (0.0054) n = 6,929	**39.8%** (0.0061) n = 6,365	**40.1%** (0.0058) n = 7,097	**29.7%** (0.0052) n = 7,637
2002	National Chain	**16.8%** (0.0010) n = 146,565	**26.3%** (0.0014) n = 104,567	**29.5%** (0.0015) n = 97,998	**26.9%** (0.0014) n = 96,899
	Independent/Regional Chain	**41.8%** (0.0079) n = 3,865	**45.2%** (0.0080) n = 3,919	**46.8%** (0.0078) n = 4,048	**42.8%** (0.0076) n = 4,208
2003	National Chain	**29.7%** (0.0014) n = 104,513	**34.4%** (0.0018) n = 72,203	**43.0%** (0.0018) n = 73,121	**44.2%** (0.0015) n = 94,403
	Independent/Regional Chain	**44.4%** (0.0080) n = 3,866	**42.4%** (0.0078) n = 4,001	**47.0%** (0.0090) n = 3,058	**51.3%** (0.0088) n = 3,204
2004	National Chain	**32.2%** (0.0015) n = 94,403	**41.2%** (0.0016) n = 92,813	**45.0%** (0.0016) n = 94,840	**40.8%** (0.0016) n = 96,842
	Independent/Regional Chain	**85.5%** (0.0080) n = 1,947	**82.2%** (0.0084) n = 2,094	**86.2%** (0.0076) n = 2,068	**87.3%** (0.0065) n = 2,657
2005	National Chain	**39.5%** (0.0014) n = 123,921	**41.8%** (0.0014) n = 120,502	**42.4%** (0.0015) n = 114,801	**41.9%** (0.0014) n = 120,557
	Independent/Regional Chain	**72.4%** (0.0095) n = 2,201	**80.1%** (0.0077) n = 2,702	**79.1%** (0.0082) n = 2,466	**82.4%** (0.0080) n = 2,238
2006	National Chain	**38.8%** (0.0013) n = 139,861	**40.2%** (0.0014) n = 129,360	**48.7%** (0.0014) n = 120,374	**61.2%** (0.0014) n = 118,256
	Independent/Regional Chain	**67.4%** (0.0084) n = 3,096	**68.7%** (0.0085) n = 2,991	**69.2%** (0.0081) n = 3,276	**73.5%** (0.0076) n = 3,353
2007	National Chain	**68.8%** (0.0014) n = 108,642	**34.1%** (0.0011) n = 194,027	**67.8%** (0.0015) n = 97,227	**26.7%** (0.0010) n = 199,326
	Independent/Regional Chain	**56.0%** (0.0087) n = 3,285	**63.8%** (0.0089) n = 2,905	**61.1%** (0.0094) n = 2,710	**62.6%** (0.0089) n = 2,951

Standard errors in parentheses.

3.6. Energy Factor Analysis

Figure 3-3 illustrates the average efficiency trends of ENERGY STAR and non-ENERGY STAR clothes washers sold through independent retailers in California. The sales data provided by national retailers are not detailed enough to be included in this analysis. Because MEF has only been the official efficiency metric since 2004, the results are also presented in terms of EF. In 2007, the federal efficiency standard increased from 1.04 MEF to 1.26 MEF, and the ENERGY STAR criteria increased from 1.42 MEF to 1.72 MEF. Due to these increased standards, the average efficiency of qualified and non-qualified clothes washers increased in 2007. In the fourth quarter of 2007, the average efficiency of ENERGY STAR qualified clothes washers reached a record high of 2.3 MEF. The average efficiency of non-qualified clothes washers also reached a record high of 3.1 EF in 2007.

Figure 3-3: Average Efficiency of Clothes Washers Sold By Independent Retailers
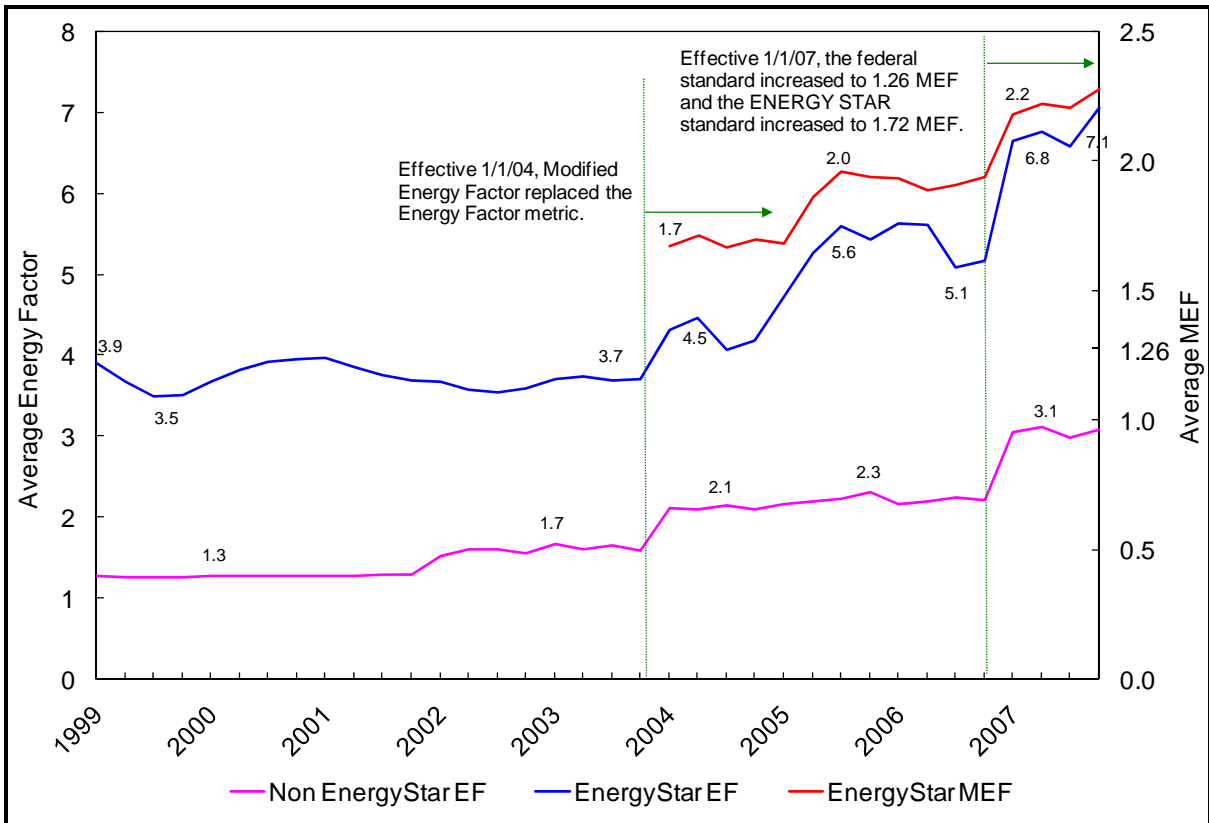
Figure 3-4 presents the tier distribution of ENERGY STAR qualified clothes washers sold by independent retailers in California. The Consortium for Energy Efficiency (CEE) introduced revised minimum requirements for each tier on January 1, 2007. [11] The tiers are currently defined as:

- CEE Tier 1: 1.80 MEF and 7.5 WF
- CEE Tier 2: 2.00 MEF and 6.0 WF
- CEE Tier 3: 2.20 MEF and 4.5 WF

The percentages in the figure represent the portion of total ENERGY STAR qualified clothes washers by CEE tier. In 2007, CEE Tier 1 clothes washers accounted for 14% of total ENERGY STAR units sold by independent retailers, while CEE Tier 2 clothes washers accounted for 21%. The majority (63%) of ENERGY STAR clothes washers sold by independent retailers met the requirements for CEE Tier 3. Only 1% of ENERGY STAR clothes washers did not meet the CEE Tier requirements. Clothes washers that are not ENERGY STAR qualified are not represented in the figure below.

Figure 3-4: Distribution of ENERGY STAR Clothes Washers by CEE Tier

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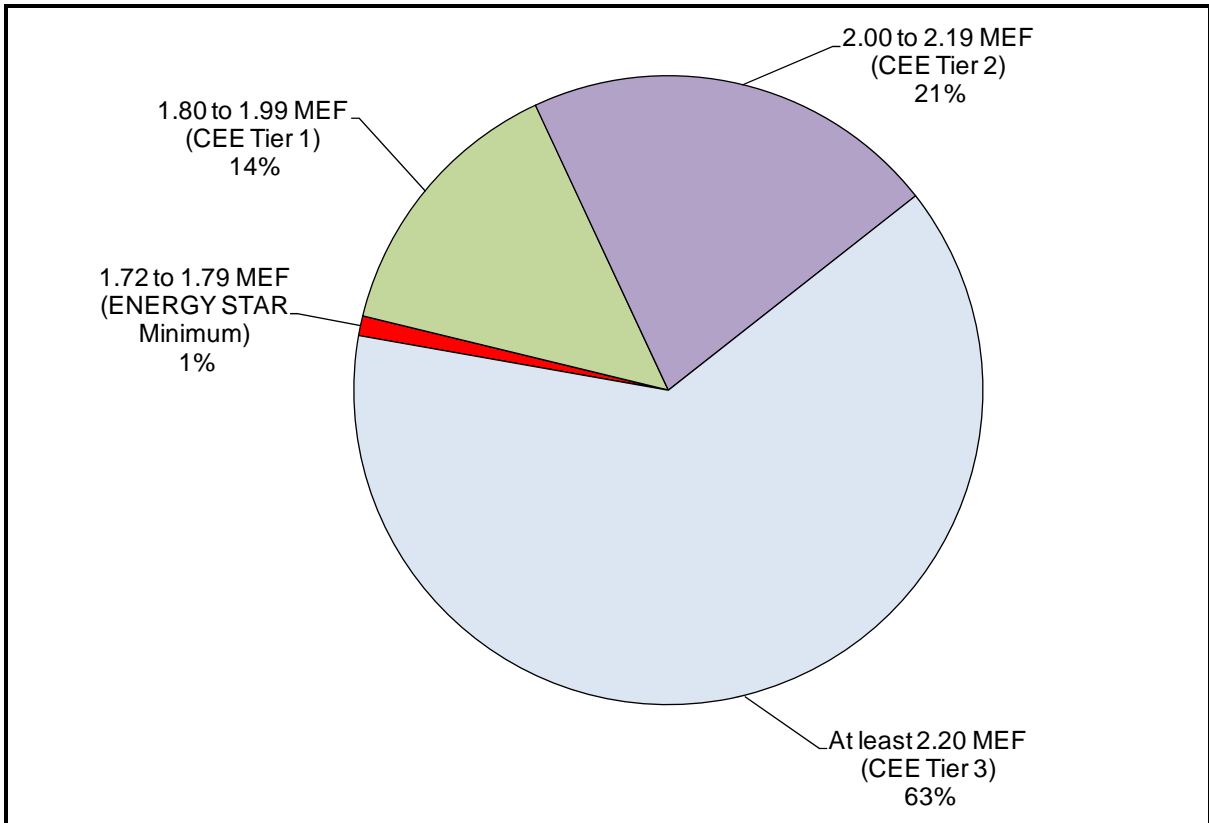
[11] http://www.cee1.org/resid/seha/rwsh/reswash_specs.pdf

4

Dishwashers

4.1. Overview

This section presents the results of the dishwasher sales analysis and includes the following: total estimated dishwasher unit sales (4.2), energy efficiency standards (4.3), market share of ENERGY STAR qualified units (4.4), ENERGY STAR sales by retailer type (4.5), and energy efficiency analysis (4.6).

4.2. Total Unit Sales

Table 4-1 presents the estimated annual unit sales of dishwashers. These figures are essential to the calculation of market share. In the past, total dishwasher sales typically experienced annual increases. However, after decreasing for the first time in recent years in 2006, total sales declined 10% in 2007.

Table 4-1: Estimate of Total Dishwasher Unit Sales in California

Year	Units Sold
1998	509,000
1999	566,800
2000	579,100
2001	595,800
2002	660,300
2003	716,200
2004	790,800
2005	818,400
2006	774,500
2007	700,000

Source: AHAM

4.3. Dishwasher Energy Efficiency Standards

Energy Factor (EF) is the dishwasher energy performance metric. EF is expressed in cycles per kWh and is the reciprocal of the sum of the machine electrical energy per cycle, *M*, plus the water heating energy consumption per cycle, *W*.

$$EF = \frac{1}{M + W}$$

The greater the EF, the more efficient the dishwasher is. Dishwasher efficiency ratings are based on estimated annual energy use under "typical conditions" and an average of 215 loads, or cycles, per year.

Federal Energy Use Standard. The current federal efficiency standard for dishwashers went into effect in 1994 and established a minimum EF of 0.46. On February 24, 2004, the U.S. Department of Energy (DOE) reduced the number of *average cycles per year* used in the dishwasher EF calculation from 264 cycles to 215 cycles. Due to the downward revision of *average cycles per year*, the average EF of dishwashers decreased even though actual efficiency remained the same. In order to maintain the same efficiency relative to the federal energy standard, dishwashers were required to become more efficient.

The Energy Independence and Security Act of 2007 (EISA) establishes new federal standards for dishwashers. [12] The energy efficiency metric will shift from EF to kWh/year in order to account for the consumption of power for standby purposes. All standard dishwashers manufactured on or after January 1, 2010 shall not exceed 355 kWh/year and 6.5 gallons per cycle. The 355 kWh/year is the equivalent of an EF of 0.62 (347 kWh/year) plus the 8 kWh/year that a 1 watt dishwasher consumes in standby mode. This allows for standby power, but regulates the maximum standby power that a machine with minimum active power efficiency can use. The inclusion of water consumption in the federal standard also marks the first time that water efficiency has been included in a DOE dishwasher standard.

ENERGY STAR Standard. The current minimum ENERGY STAR criteria of 0.65 EF became effective January 1, 2007.[13] These criteria replaced the previous minimum qualifying EF of 0.58. A current proposal suggests that there will be additional revisions to the ENERGY STAR standard in the future. Effective August 11, 2009, ENERGY STAR requirements will consist of a maximum energy use of 324 kWh/year and 5.8 gallons per cycle. A subsequent revision takes place on July 1, 2011 when the ENERGY STAR criteria are tightened to 307 kWh/year and 5.0 gallons per cycle.

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[12] http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/home_appl_nopr_fr.pdf

[13] In this report, compact dishwashers were not included in ENERGY STAR sales. However, the new 2007 ENERGY STAR standard allows compact dishwashers with a 0.88 EF to qualify. Compact dishwashers are defined as having a capacity of less than eight place settings and six serving pieces.

Table 4-2 presents the timeline of energy efficiency standards and the ENERGY STAR criteria for dishwashers.

Table 4-2: Comparison of Dishwasher Energy Efficiency Standards

	Jan. 1, 2001	Jan. 1, 2007	Aug. 11, 2009	Jan. 1, 2010	Jul. 1, 2011
Federal Standard	EF ≥ 0.46 (since 1994)			≤ 355 kWh/year ≤ 6.58 gallons per cycle	
ENERGY STAR Criteria	EF ≥ 0.58	EF ≥ 0.65	≤ 324 kWh/year ≤ 5.8 gallons per cycle		≤ 307 kWh/year ≤ 5 gallons per cycle

California IOU Incentive Programs. In 2007, PG&E offered a $30 rebate for dishwashers with a minimum EF of 0.65 and a $50 rebate for dishwashers with a minimum EF of 0.68. SDG&E offered a $30 rebate for select dishwashers with an EF of at least 0.65. SCE did not offer residential customers a rebate for the purchase of a new ENERGY STAR dishwasher.

4.4. Market Share of ENERGY STAR Qualified Dishwashers

Figure 4-1 and Table 4-3 present the market share of ENERGY STAR qualified dishwashers sold in California from 1998 to 2007. Until 2007, the market share of ENERGY STAR qualified dishwashers had grown steadily, reaching a peak of 96% at the end of 2006. When the ENERGY STAR criteria became more stringent in 2007, the market share of qualified dishwashers dropped to 41%, the lowest share in six years. As retailers adjusted their product lines to reflect the new ENERGY STAR criteria, market share rebounded and by the end of 2007 attained 58%.

Figure 4-1: Dishwasher Sales, Percent of ENERGY STAR Qualified Units
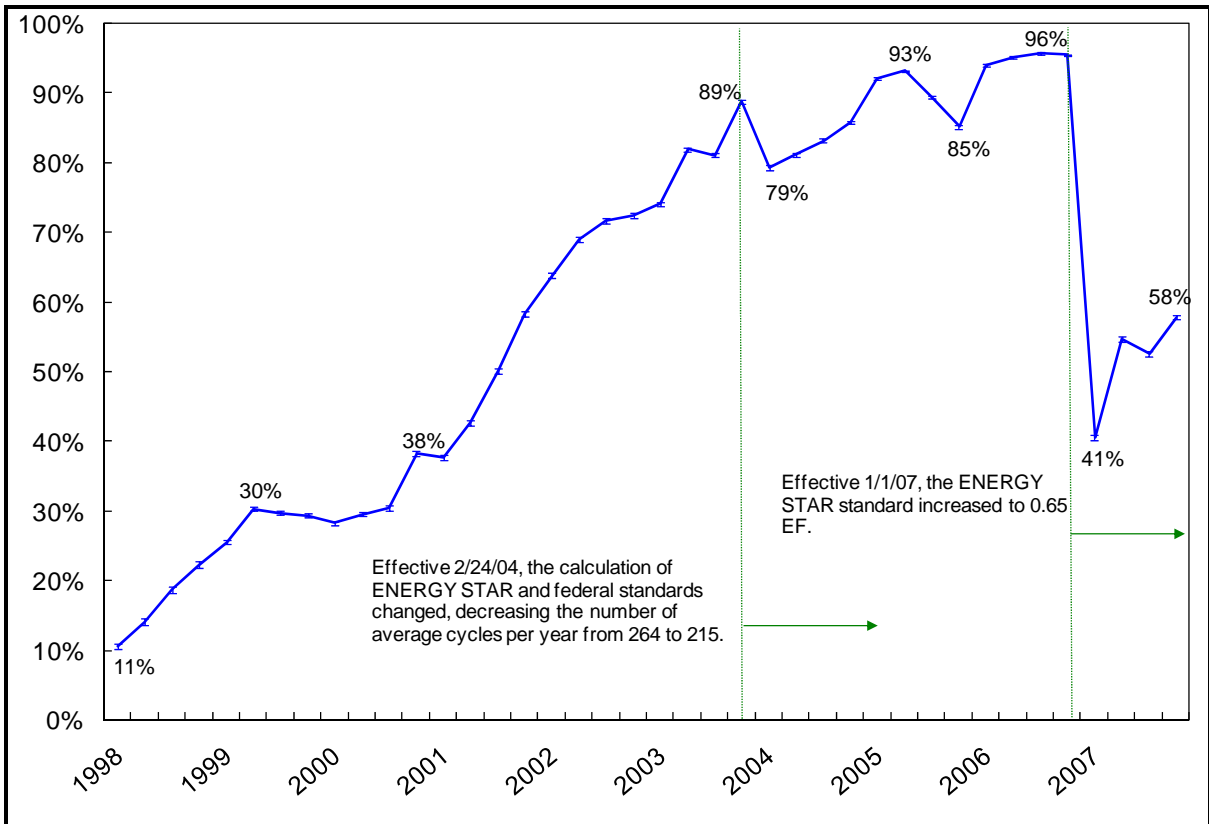
Error bands for the 90% confidence interval.

Table 4-3: Statewide Dishwasher Sales, Percent ENERGY STAR Units

Year	Percent of ENERGY STAR Qualified Dishwashers				
	Annual	**Q1**	**Q2**	**Q3**	**Q4**
1998	**16.9%** (-) n = 66,161	**10.7%** (-) n = 15,478	**14.2%** (-) n = 15,012	**18.9%** (-) n = 16,775	**22.4%** (-) n = 18,896
1999	**28.8%** (0.001) n = 194,979	**25.6%** (0.0019) n = 47,633	**30.3%** (0.0021) n = 47,098	**29.7%** (0.0021) n = 46,689	**29.4%** (0.002) n = 53,559
2000	**31.6%** (.0010) n = 214,069	**28.3%** (.0018) n = 60,727	**29.5%** (.0019) n = 56,656	**30.5%** (.0022) n = 44,899	**38.3%** (.0021) n = 51,787
2001	**47.7%** (0.0012) n = 184,187	**37.7%** (0.0023) n = 44,730	**42.7%** (0.0024) n = 42,940	**50.2%** (0.0024) n = 44,784	**58.4%** (0.0022) n = 51,733
2002	**69.2%** (0.0011) n = 192,032	**63.9%** (0.0022) n = 47,405	**69.0%** (0.0021) n = 47,971	**71.7%** (0.0021) n = 45,298	**72.4%** (0.0020) n = 51,358
2003	**82.1%** (0.0009) n = 197,813	**74.1%** (0.0020) n = 48,553	**82.0%** (0.0017) n = 49,761	**81.1%** (0.0018) n = 46,281	**88.8%** (0.0014) n = 53,218
2004	**82.3%** (0.0009) n = 196,134	**79.3%** (0.0019) n = 44,782	**81.2%** (0.0018) n = 47,601	**83.2%** (0.0017) n = 49,378	**85.8%** (0.0015) n = 54,373
2005	**90.2%** (0.0006) n = 259,752	**92.1%** (0.0011) n = 63,921	**93.2%** (0.0010) n = 65,389	**89.4%** (0.0012) n = 63,882	**85.2%** (0.0014) n = 66,560
2006	**95.1%** (0.0004) n = 238,674	**94.1%** (0.0009) n = 65,013	**95.1%** (0.0009) n = 59,082	**95.7%** (0.0008) n = 56,793	**95.5%** (0.0009) n = 57,786
2007	**51.3%** (0.0011) n = 222,345	**40.5%** (0.0021) n = 52,261	**54.7%** (0.0021) n = 56,810	**52.6%** (0.0021) n = 57,776	**57.8%** (0.0021) n = 55,498

Standard errors in parentheses.
1998 data were adjusted and do not include standard error due to the lack of independent data for that year.

Table 4-4 reports the percentage of ENERGY STAR qualified dishwashers sold quarterly in each utility service area from 1998 to 2007. Due to stricter ENERGY STAR criteria in 2007, market share declined in all utility service areas. With a share of 78%, retailers in the SDG&E service territory exhibited the smallest decrease in the percent of qualified products sold. Retailers in the PG&E service area sold a 56% market share of ENERGY STAR qualified products, while retailers in SCE and the "Other" service areas sold a share of 48% and 44%, respectively.

Table 4-4: Dishwasher Sales by Utility, Percent ENERGY STAR Units

Utility	Year	Percent ENERGY STAR Qualified Dishwashers				
		Annual	**Q1**	**Q2**	**Q3**	**Q4**
PG&E	1998	12.0% (-) n = 24,900	7.6% (-) n = 5,671	10.8% (-) n = 5,626	13.5% (-) n = 6,522	15.1% (-) n = 7,081
	1999	16.2% (0.0014) n = 69,128	11.6% (0.0024) n = 17,005	13.3% (0.0026) n = 16,425	18.1% (0.003) n = 16,172	21.1% (0.0029) n = 19,526
	2000	30.7% (0.0015) n = 94,925	28.3% (0.0028) n = 25,748	28.9% (0.0029) n = 24,730	31.6% (0.0032) n = 20,976	34.4% (0.0031) n = 23,471
	2001	53.1% (0.0017) n = 91,396	43.0% (0.0033) n = 22,532	50.8% (0.0034) n = 21,389	57.8% (0.0033) n = 22,475	60.2% (0.0031) n = 25,000
	2002	73.7% (0.0015) n = 85,869	67.9% (0.0032) n = 21,314	73.8% (0.0030) n = 21,844	76.9% (0.0029) n = 20,540	75.6% (0.0029) n = 22,171
	2003	86.1% (0.0012) n = 82,079	85.1% (0.0024) n = 21,318	86.0% (0.0024) n = 21,398	82.7% (0.0028) n = 18,310	90.9% (0.0020) n = 21,053
	2004	85.2% (0.0013) n = 77,772	81.4% (0.0029) n = 18,159	83.0% (0.0027) n = 18,818	86.2% (0.0025) n = 19,336	89.5% (0.0021) n = 21,459
	2005	91.4% (0.0009) n = 93,617	94.2% (0.0015) n = 22,815	94.5% (0.0015) n = 23,497	92.1% (0.0018) n = 23,101	85.3% (0.0023) n = 24,204
	2006	97.3% (0.0006) n = 85,176	97.0% (0.0011) n = 23,296	97.4% (0.0011) n = 20,813	97.1% (0.0012) n = 20,338	97.8% (0.0010) n = 20,729
	2007	56.0% (0.0018) n = 80,272	44.1% (0.0036) n = 18,928	58.5% (0.0035) n = 19,898	60.4% (0.0034) n = 21,081	59.9% (0.0034) n = 20,365
SCE	1998	20.4% (-) n = 20,197	12.0% (-) n = 4,893	15.4% (-) n = 4,596	22.1% (-) n = 4,940	30.2% (-) n = 5,768
	1999	29.6% (0.0017) n = 68,633	26.2% (0.0034) n = 16,560	32.5% (0.0036) n = 17,027	30.8% (0.0036) n = 16,882	28.9% (0.0034) n = 18,164
	2000	32.2% (0.0018) n = 65,649	28.5% (0.0032) n = 19,451	30.4% (0.0035) n = 17,358	30.0% (0.0040) n = 13,271	39.9% (0.0039) n = 15,669
	2001	47.5% (0.0022) n = 51,430	34.6% (0.0043) n = 12,227	37.3% (0.0044) n = 11,849	49.1% (0.0045) n = 12,273	63.2% (0.0039) n = 15,081
	2002	72.6% (0.0018) n = 60,392	67.1% (0.0038) n = 14,981	71.5% (0.0037) n = 14,823	74.1% (0.0037) n = 13,954	78.6% (0.0032) n = 16,634
	2003	83.4% (0.0014) n = 66,365	47.8% (0.0040) n = 15,417	83.6% (0.0029) n = 16,371	84.9% (0.0028) n = 16,233	89.8% (0.0022) n = 18,344
	2004	82.1% (0.0015) n = 67,530	82.1% (0.0032) n = 14,600	80.2% (0.0031) n = 16,650	78.9% (0.0031) n = 17,204	87.4% (0.0024) n = 19,076
	2005	87.8% (0.0011) n = 91,953	88.5% (0.0021) n = 22,761	91.7% (0.0018) n = 23,387	85.8% (0.0023) n = 22,746	84.1% (0.0024) n = 23,059
	2006	92.3% (0.0009) n = 84,959	88.8% (0.0021) n = 22,765	92.5% (0.0018) n = 21,420	94.2% (0.0016) n = 20,225	93.1% (0.0018) n = 20,549
	2007	48.3% (0.0018) n = 77,716	40.7% (0.0036) n = 18,191	53.6% (0.0035) n = 20,344	44.5% (0.0035) n = 19,941	55.4% (0.0036) n = 19,240

Standard errors in parentheses.

Table 4-4 (cont'd.): Dishwasher Sales (Utility), Percent ENERGY STAR Units

Utility	Year	Percent ENERGY STAR Qualified Dishwashers				
		Annual	**Q1**	**Q2**	**Q3**	**Q4**
SDG&E	1998	15.4% (-) n = 6,510	12.0% (-) n = 1,466	14.3% (-) n = 1,487	17.6% (-) n = 1,724	17.3% (-) n = 1,833
	1999	30.0% (0.0032) n = 20,564	29.3% (0.0064) n = 4,995	31.2% (0.0066) n = 4,868	29.2% (0.0065) n = 4,872	30.6% (0.006) n = 5,829
	2000	36.3% (0.0035) n = 18,996	30.7% (0.0061) n = 5,674	32.5% (0.0066) n = 5,070	33.4% (0.0076) n = 3,831	47.8% (0.0075) n = 4,421
	2001	25.6% (0.0036) n = 14,803	20.7% (0.0068) n = 3,596	24.3% (0.0073) n = 3,485	25.1% (0.0073) n = 3,493	31.0% (0.0071) n = 4,229
	2002	31.1% (0.0040) n = 13,357	27.4% (0.0077) n = 3,318	31.7% (0.0081) n = 3,330	34.9% (0.0084) n = 3,185	30.7% (0.0078) n = 3,524
	2003	58.0% (0.0043) n = 13,358	43.8% (0.0085) n = 3,396	51.2% (0.0089) n = 3,148	52.9% (0.0089) n = 3,115	81.2% (0.0064) n = 3,699
	2004	90.4% (0.0026) n = 12,934	82.6% (0.0070) n = 2,902	88.3% (0.0057) n = 3,130	90.9% (0.0049) n = 3,390	98.0% (0.0024) n = 3,512
	2005	81.1% (0.0027) n = 21,121	81.7% (0.0054) n = 5,145	81.7% (0.0053) n = 5,387	82.8% (0.0052) n = 5,235	78.2% (0.0056) n = 5,354
	2006	90.4% (0.0021) n = 19,009	90.0% (0.0042) n = 5,130	90.1% (0.0043) n = 4,745	91.2% (0.0042) n = 4,630	90.4% (0.0044) n = 4,504
	2007	78.5% (0.0031) n = 17,467	62.6% (0.0077) n = 3,959	81.0% (0.0059) n = 4,458	83.8% (0.0054) n = 4,699	84.4% (0.0055) n = 4,351
Other	1998	12.9% (-) n = 14,554	8.2% (-) n = 3,448	11.8% (-) n = 3,303	14.8% (-) n = 3,589	16.2% (-) n = 4,214
	1999	27.7% (0.0023) n = 36,654	24.1% (0.0045) n = 9,073	27.9% (0.0048) n = 8,778	28.3% (0.0048) n = 8,763	29.4% (0.0045) n = 10,040
	2000	29.7% (0.0025) n = 34,399	26.5% (0.0044) n = 9,854	27.4% (0.0046) n = 9,898	27.2% (0.0054) n = 6,821	37.8% (0.0053) n = 8,226
	2001	39.2% (0.0030) n = 26,558	34.5% (0.0060) n = 6,375	38.9% (0.0062) n = 6,217	38.1% (0.0060) n = 6,543	45.0% (0.0058) n = 7,423
	2002	33.1% (0.0026) n = 32,414	29.5% (0.0052) n = 7,792	34.0% (0.0053) n = 7,974	35.6% (0.0055) n = 7,619	33.2% (0.0050) n = 9,029
	2003	60.0% (0.0026) n = 36,011	51.0% (0.0054) n = 8,422	52.8% (0.0053) n = 8,844	57.3% (0.0053) n = 8,623	76.1% (0.0042) n = 10,122
	2004	77.8% (0.0021) n = 37,898	72.4% (0.0047) n = 9,121	79.3% (0.0043) n = 9,003	83.2% (0.0038) n = 9,448	77.2% (0.0041) n = 10,326
	2005	93.8% (0.0010) n = 53,061	95.5% (0.0018) n = 13,200	95.2% (0.0019) n = 13,118	92.5% (0.0023) n = 12,800	88.8% (0.0027) n = 13,943
	2006	96.9% (0.0008) n = 49,530	97.2% (0.0014) n = 13,822	96.8% (0.0016) n = 12,104	96.8% (0.0016) n = 11,600	96.7% (0.0016) n = 12,004
	2007	43.6% (0.0023) n = 46,890	31.0% (0.0044) n = 11,183	45.1% (0.0045) n = 12,110	47.6% (0.0045) n = 12,055	53.0% (0.0046) n = 11,542

Standard errors in parentheses.
"Other" includes areas served by municipal utilities such as LADWP, LMUD, PP&L, SMUD, and others.

4.5. Analysis by Retailer Type

In Figure 4-2 and Table 4-5, the share of ENERGY STAR qualified dishwashers sold by national chains is compared with the share sold by independent retailers. Until 2007, independent retailers had sold a greater percentage of qualifying appliances in almost every quarter since 1998. However, the share of qualified dishwashers sold by independent retailers declined significantly after the ENERGY STAR criteria were increased to 0.65 EF. In early 2007, the percent of ENERGY STAR qualified dishwashers sold by independent retailers fell to 29%, the retailers' lowest share in the history of the RMST study. Had the ENERGY STAR criteria not been revised for 2007, 96% of units sold independent retailers would have qualified. The share of qualified dishwashers sold by national chains fell to 60% in the first quarter of 2007, but rebounded to 86% by the end of the year.

It is not clear whether the disparity between retailer shares is the result of market changes or due to differences in reporting methods. This evaluation designates units sold by independent retailers as ENERGY STAR qualified based upon EF calculations. The units sold by national chains are labeled as "qualified" or "non-qualified" by the retailers themselves. It is possible that national retailers reported unqualified dishwashers sold in 2007 as qualified units according to the 2006 ENERGY STAR criteria.

Figure 4-2: Percent of ENERGY STAR Qualified Dishwashers by Retailer Type
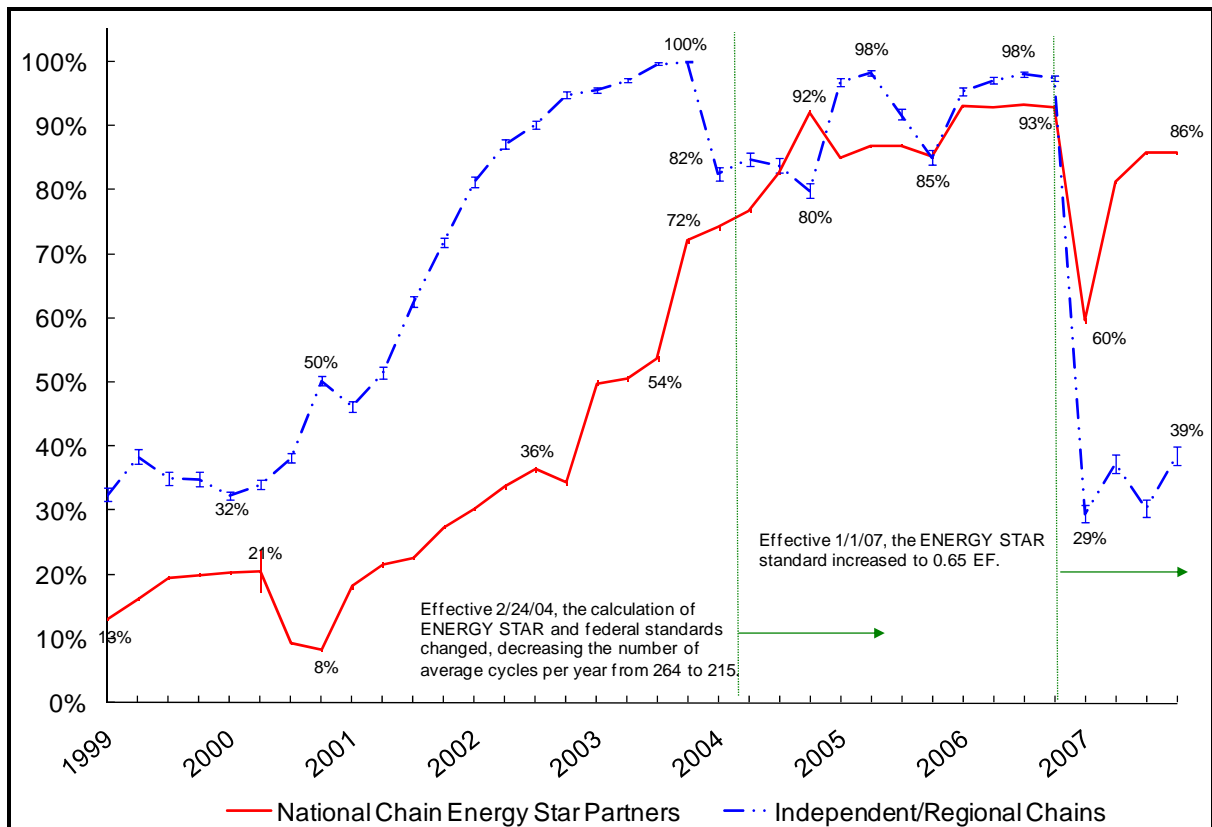
Table 4-5: Dishwasher Sales by Retailer Type, Percent ENERGY STAR Units

Year	Retailer Type	Q1	Q2	Q3	Q4
1999	National Chain	13.1% (0.0014) n = 69,128	16.2% (0.0018) n = 42,227	19.5% (0.0019) n = 41,425	19.9% (0.0018) n = 48,184
	Independent/Regional Chain	32.5% (0.0066) n = 5,067	38.4% (0.0069) n = 4,871	35.1% (0.0066) n = 5,264	34.9% (0.0065) n = 5,375
2000	National Chain	20.5% (0.0019) n = 45,309	20.5% (0.0020) n = 41,854	9.3% (0.0017) n = 30,180	8.3% (0.0015) n = 35,928
	Independent/Regional Chain	32.3% (0.0038) n = 15,418	34.1% (0.0039) n = 14,802	38.2% (0.0040) n = 14,719	50.2% (0.0040) n = 15,859
2001	National Chain	18.2% (0.0021) n = 35,045	24.5% (0.0022) n = 33,560	22.7% (0.0022) n = 35,237	27.4% (0.0022) n = 41,079
	Independent/Regional Chain	46.2% (0.0051) n = 9,685	51.5% (0.0052) n = 9,380	62.5% (0.0050) n = 9,547	71.9% (0.0044) n = 10,654
2002	National Chain	30.4% (0.0027) n = 41,160	33.7% (0.0023) n = 40,640	36.5% (0.0025) n = 38,225	34.4% (0.0023) n = 44,304
	Independent/Regional Chain	81.2% (0.0049) n = 6,245	87.1% (0.0039) n = 7,331	90.1% (0.0036) n = 7,073	94.7% (0.0027) n = 7,054
2003	National Chain	49.9% (0.0024) n = 42,754	50.6% (0.0024) n = 43,700	53.6% (0.0024) n = 43,605	72.1% (0.0020) n = 50,186
	Independent/Regional Chain	95.5% (0.0027) n = 5,799	97.1% (0.0022) n = 6,061	99.6% (0.0013) n = 2,676	99.9% (0.0006) n = 3,032
2004	National Chain	74.2% (0.0021) n = 41,468	76.8% (0.0020) n = 44,415	82.6% (0.0018) n = 46,251	92.1% (0.0012) n = 50,772
	Independent/Regional Chain	82.4% (0.0066) n = 3,314	84.8% (0.0064) n = 3,186	83.8% (0.0066) n = 3,127	79.8% (0.0067) n = 3,601
2005	National Chain	85.0% (0.0014) n = 61,450	86.9% (0.0013) n = 62,793	86.9% (0.0014) n = 61,064	85.2% (0.0014) n = 63,695
	Independent/Regional Chain	96.7% (0.0036) n = 2,471	98.2% (0.0026) n = 2,596	91.7% (0.0052) n = 2,818	85.1% (0.0067) n = 2,865
2006	National Chain	93.0% (0.0010) n = 61,953	92.9% (0.0011) n = 56,088	93.3% (0.0011) n = 53,907	93.0% (0.0011) n = 54,578
	Independent/Regional Chain	95.2% (0.0039) n = 3,060	97.1% (0.0031) n = 2,994	98.0% (0.0026) n = 2,886	97.3% (0.0028) n = 3,208
2007	National Chain	59.6% (0.0022) n = 49,339	81.3% (0.0017) n = 53,794	85.7% (0.0015) n = 54,847	85.8% (0.0015) n = 52,465
	Independent/Regional Chain	29.5% (0.0084) n = 2,922	37.4% (0.0088) n = 3,016	30.4% (0.0085) n = 2,929	38.6% (0.0088) n = 3,033

Standard errors in parentheses.

4.6. Energy Efficiency Analysis

Figure 4-3 illustrates the distribution of ENERGY STAR qualified dishwashers sold by independent retailers in California according to efficiency level. National chains are not included in the analysis because sales data from these retailers do not provide the information necessary for the grouping of dishwasher sales by efficiency level. The ENERGY STAR minimum efficiency level was 26% above the federal standard until 2007 when it was increased to 41%. The figure below shows that most products fall in the range of 26% to 40% more efficient than the federal standard.

Figure 4-3: Distribution of Dishwasher Sales through Independent Retailers by Efficiency Level
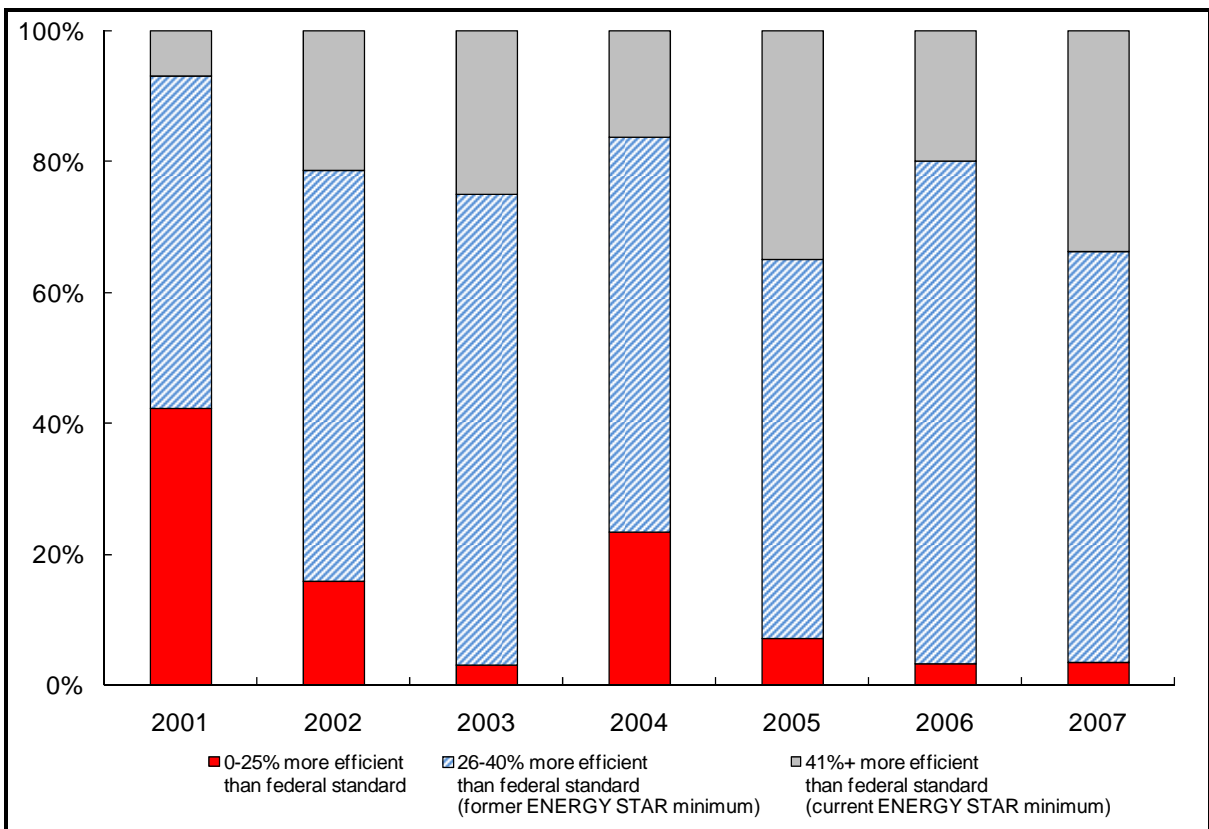

Figure 4-4 illustrates the average EF of dishwashers sold by independent appliance retailers throughout California from 1999 through 2007. During 2007, the average EF increased gradually to 0.66 in the fourth quarter, a record high. The increase in the average EF of dishwashers sold by independent appliance retailers in California reflects stricter ENERGY STAR criteria.

The average EF decreased in early 2004 when the average number of cycles used to calculate EF was decreased to 215. As a result, the EF metric underestimates the gains in dishwasher

efficiency over the past several years. To accurately display efficiency improvements, the graph includes "Adjusted EF," which represents the EF as calculated with 322 average annual cycles for all years.

Figure 4-4: Average Energy Factor of Dishwashers Sold by Independent Appliance Retailers
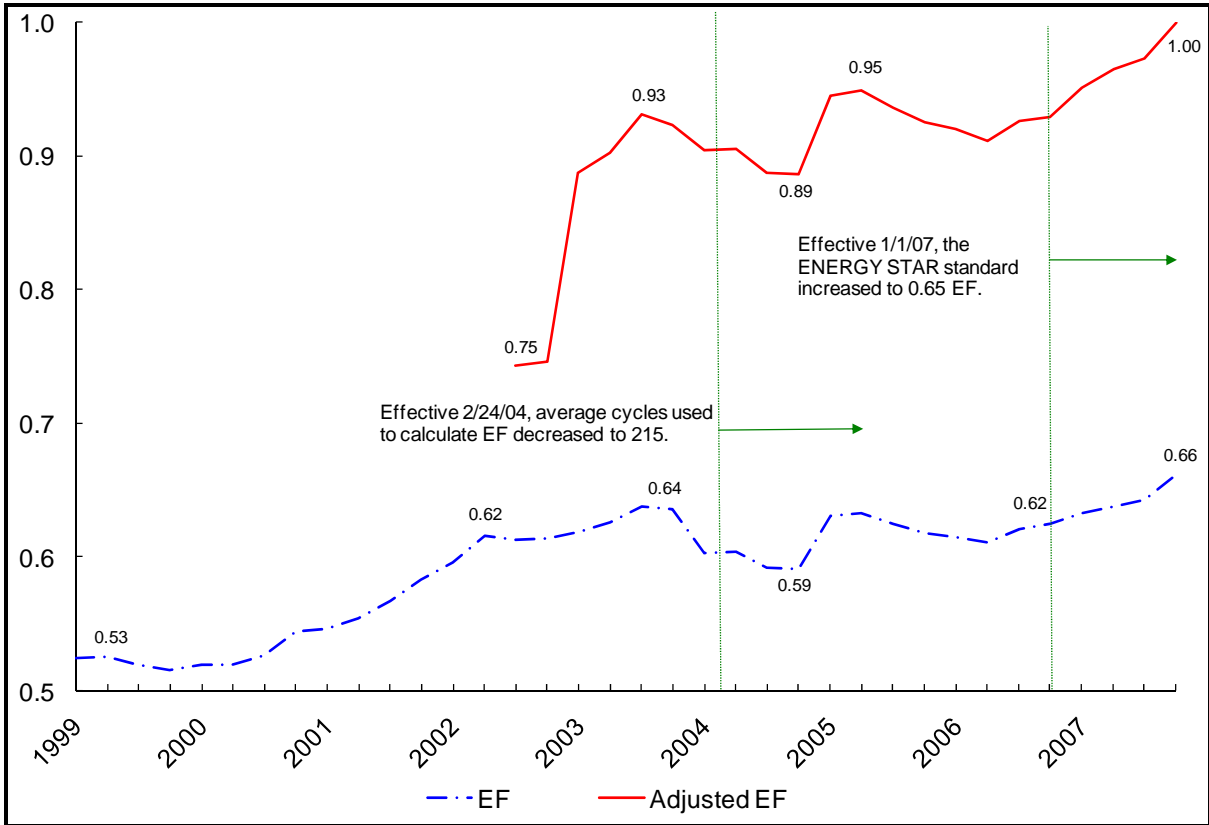
5

Refrigerators

5.1. Overview

This section presents the results of the refrigerator analysis and includes total refrigerator unit sales (5.2), efficiency standards (5.3), market share of ENERGY STAR qualified units (5.4), ENERGY STAR sales by retailer type (5.5), and average efficiency of refrigerators sold by independent retailers (5.6).

5.2. Total Unit Sales

Table 5-1 presents the estimated unit sales of refrigerators over the past several years. These figures are essential in the development of ENERGY STAR market share. Until 2007, total refrigerator sales in California had increased every year since the RMST study began in 1998. In 2007, total refrigerator sales in California decreased 12%.

Table 5-1: Estimate of Total Refrigerator Units Sales in California

Year	Units Sold
1998	949,400
1999	975,700
2000	1,025,300
2001	1,150,600
2002	1,199,100
2003	1,234,600
2004	1,332,800
2005	1,333,100
2006	1,341,800
2007	1,182,500

Source: AHAM

5.3. Refrigerator Energy Efficiency Standards

Refrigerator energy use ratings are expressed in terms of expected annual energy use (kWh) under "typical conditions." Federal energy use standards vary by refrigerator configuration and are a function of the unit's adjusted volume (AV). The *adjusted volume* is the sum of the fresh food compartment volume in cubic feet, and the product of an adjustment factor and the net freezer compartment volume.[14] The EF for refrigerators is calculated as:

$$EF = \frac{Adjusted\ Volume}{Annual\ Energy\ Usage\left(kWh\right)/\ 365}$$

Federal Energy Use Standard. Federal energy use standards for refrigerators changed on July 1, 2001.[15] The reduction of energy use reductions ranged from 27% to 32%, depending on configuration. On December 19, 2007, the President signed the Energy Independence and Security Act of 2007 (EISA 2007), which directs DOE to undertake new rulemakings for appliance energy-efficiency standards. The law requires that DOE publish a final rule no later than December 31, 2010, to determine whether to amend the standards in effect for refrigerators, refrigerator-freezers, and freezers manufactured on or after January 1, 2014.

ENERGY STAR Standard. In 2003, the ENERGY STAR criteria for refrigerators were expanded to include all sizes and configurations of refrigerators and freezers. Several products, which were previously ineligible, became ENERGY STAR qualified, including:

- Manual defrost refrigerators,
- Partial automatic defrost refrigerators,
- Single-door refrigerators,
- Compact refrigerators and freezers, and
- Chest and upright freezers.[16]

The expansion of refrigerators eligible for ENERGY STAR did not impact this study. The current analysis method evaluates products that *could* qualify for the ENERGY STAR label rather than products that actually bear the ENERGY STAR label. These products have been tracked on an ongoing basis and have been analyzed under the qualifying criteria used for standard full-size automatic-defrost refrigerator-freezers.

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[14] Adjusted volume takes into account the differing temperatures between the refrigerator and freezer compartments with the following calculation: *adjusted volume = fresh volume +* (1.63 x *freezer volume*).

[15] The 2001 federal standard for refrigerators can be found in the following: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers. *Federal Register.* Vol. 62, No. 81. April 28, 1997.

[16] These product categories are outside of the scope of work of the study and are not addressed in this report.

A revised ENERGY STAR standard became effective January 1, 2004. It required full-sized refrigerators to consume 15% less energy than the minimum federal government standard in order to qualify for the ENERGY STAR label. Compact refrigerators and full-sized freezers were required to use 20% and 10%, respectively, less energy than the federal minimum. Neither of these refrigerator types, however, is treated in this analysis.

On April 28, 2008, the ENERGY STAR criteria changed for all full-sized refrigerators. All refrigerators greater than 7.75 cubic feet must be at least 20% more efficient than the federal standard in order to qualify for ENERGY STAR. This criteria change does not affect this analysis, which concludes with 2007 data.

California IOU Incentive Programs. Each California IOU program has a unique rebate structure. In 2007, SDG&E offered a $25 rebate and SCE offered a $50 for the purchase an ENERGY STAR qualified refrigerator. PG&E did not offer a financial incentive for the purchase of an ENERGY STAR refrigerator.

Table 5-2 summarizes the federal, state, and ENERGY STAR standards for refrigerators through 2005.

Table 5-2: Refrigerator Energy Use Standards

	Federal Standard	ENERGY STAR Criteria			
	July 1, 2001	January 1, 2001	January 1, 2003	January 1, 2004	April 28, 2008
Refrigerators and refrigerator-freezers, manual defrost	8.82*AV+248.4	N/A	10% less energy than federal standard	15% less energy than federal standard	20% less energy than federal standard
Refrigerator-freezers, partial automatic defrost	8.82*AV+248.4				
Refrigerator-freezers, automatic defrost, top mount without TTD	9.80*AV+276.0	10% less energy than federal standard			
Refrigerator-freezers, automatic defrost, side mount without TTD	4.91*AV+507.5				
Refrigerator-freezers, automatic defrost, bottom mount without TTD	4.60*AV+459.0				
Refrigerator-freezers, automatic defrost, top mount with TTD	10.20*AV+356.0				
Refrigerator-freezers, automatic defrost, side mount with TTD	10.10*AV+406.0				
Upright freezers, manual defrost	7.55*AV+258.3	N/A		10% less energy than federal standard	
Upright freezers, automatic defrost	12.43*AV+326.1				
Chest freezers and all other freezers except compact freezers	9.88*AV+143.7				
Compact refrigerators and refrigerator-freezers, manual defrost	10.70*AV+299.0			20% less energy than federal standard	
Compact refrigerator-freezers, partial automatic defrost	7.00*AV+398.0				
Compact refrigerator-freezers, automatic defrost with top-mounted freezer and compact all-refrigerators, automatic defrost	12.70*AV+355.0				
Compact refrigerator-freezers, automatic defrost with side-mounted freezer	7.60*AV+501.0				
Compact refrigerator-freezers, automatic defrost with bottom-mounted freezer	13.10*AV+367.0				
Compact upright freezers, manual defrost	9.78*AV+250.8				
Compact upright freezers, automatic defrost	11.40*AV+391.0				
Compact chest freezers	10.45*AV+152.0				
CALIFORNIA STANDARDS	Identical to the federal standard				

TTD = through-the-door ice dispenser.
For refrigerators, AV = Adjusted Volume = Fresh Volume + (1.63*Freezer Volume).
Compact refrigerators, refrigerator-freezers, and freezers are products with a total volume of less than 7.75 ft^3 and 36 inches or less in height.

5.4. Market Share of ENERGY STAR Qualified Refrigerators

Figure 5-1 and Table 5-3 present the percentage of ENERGY STAR qualified refrigerators sold in California from 1998 through 2007. During the first three quarters of 2007, 49% of the refrigerators sold in California met the ENERGY STAR criteria. In the fourth quarter, sales data suggest that the share of ENERGY STAR qualified refrigerators unexpectedly fell to 35%. However, these fourth quarter figures are not entirely accurate. According to the ENERGY STAR website, one particular national retailer submitted flawed data that understate the percentage of ENERGY STAR refrigerators sold. Itron does not have direct access to the sales data submitted by national chain retailers and relies on the data released by the ENERGY STAR program. Therefore, Itron is not able to make corrections to the available data.

Revisions to the ENERGY STAR criteria became effective in January of 2001 and 2004, thus increasing the minimum EF necessary to qualify for the ENERGY STAR label. As a result, the share of ENERGY STAR qualified refrigerators declined sharply in the first quarters of 2001 and 2004.

Figure 5-1: Refrigerator Sales, Percent of ENERGY STAR Qualified Units
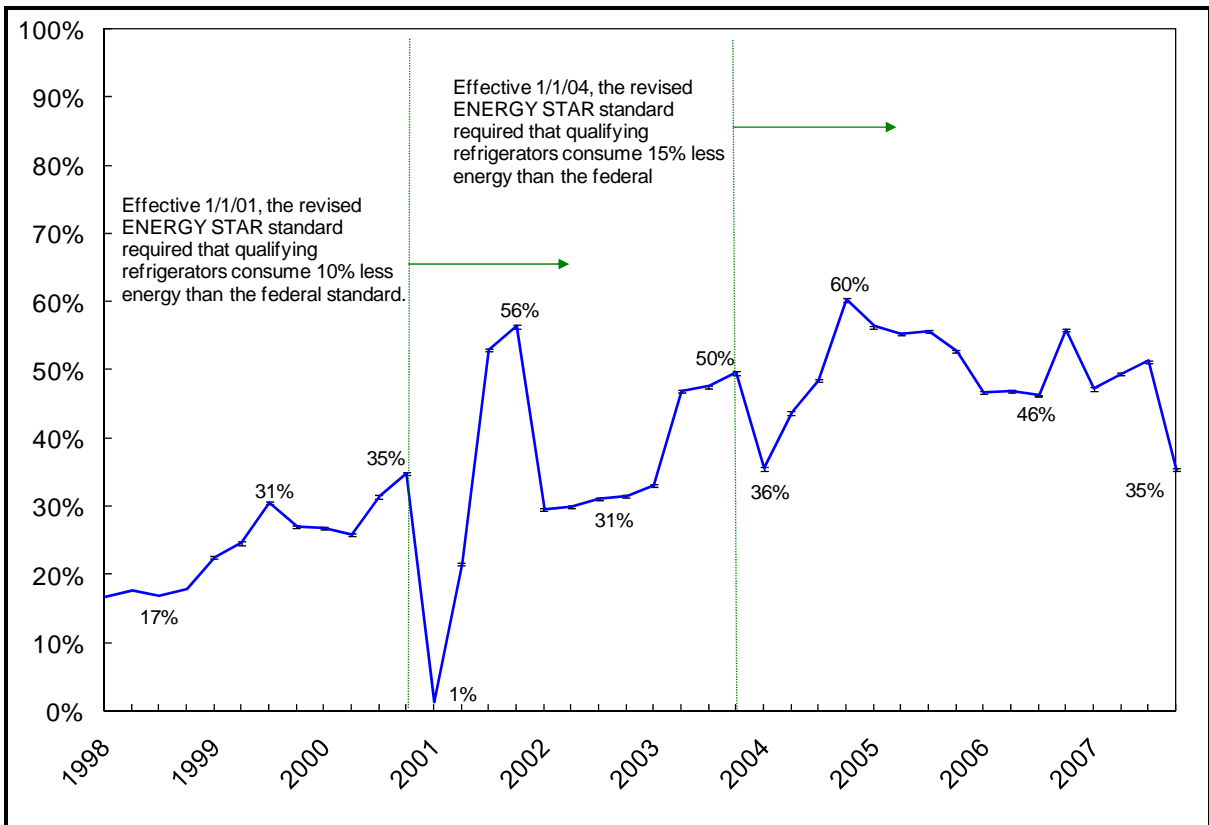
Error bands for the 90% confidence interval.

Table 5-3: Refrigerator Sales Statewide, Percent ENERGY STAR Units

Year	Percent ENERGY STAR Qualified Refrigerators				
	Annual	**Q1**	**Q2**	**Q3**	**Q4**
1998	**17.4%** (-) n = 230,171	**16.8%** (-) n = 46,004	**17.8%** (-) n = 55,309	**17.0%** (-) n = 76,525	**17.9%** (-) n = 52,333
1999	**26.5%** (0.0006) n = 473,882	**22.7%** (0.0013) n = 110,181	**24.7%** (0.0012) n = 121,250	**30.6%** (0.0013) n = 130,514	**27.1%** (0.0013) n = 111,937
2000	**29.8%** (0.0007) n = 490,296	**26.8%** (0.0013) n = 115,865	**25.9%** (0.0012) n = 145,173	**31.5%** (0.0013) n = 122,865	**34.9%** (0.0015) n = 106,393
2001	**35.4%** (0.0007) n = 522,010	**1.4%** (0.0004) n = 104,765	**21.7%** (0.0010) n = 146,412	**53.0%** (0.0013) n = 148,463	**56.4%** (0.0014) n = 122,370
2002	**30.6%** (0.0006) n = 694,594	**29.6%** (0.0012) n = 155,115	**30.0.%** (0.0011) n = 181,401	**31.2%** (0.0010) n = 198,236	**31.6%** (0.0012) n = 159,842
2003	**44.4%** (0.0007) n = 581,712	**33.2%** (0.011) n = 170,947	**46.9%** (0.0014) n = 128,821	**47.6%** (0.0013) n = 157,519	**49.6%** (0.0014) n = 124,425
2004	**47.1%** (0.0008) n = 436,826	**35.6%** (0.0016) n = 91,394	**43.7%** (0.0015) n = 114,903	**48.5%** (0.0014) n = 131,115	**60.4%** (0.0016) n = 99,414
2005	**51.8%** (0.0006) n = 683,768	**52.2%** (0.0013) n = 149,259	**52.9%** (0.0012) n = 180,323	**52.3%** (0.0011) n = 192,646	**49.3%** (0.0012) n = 161,540
2006	**48.5%** (0.0006) n = 685,310	**46.8%** (0.0012) n = 159,436	**47.0%** (0.0011) n = 190,558	**46.3%** (0.0011) n = 206,522	**55.9%** (0.0014) n = 128,794
2007	**45.3%** (0.0006) n = 686,347	**47.3%** (0.0013) n = 139,981	**49.5%** (0.0013) n = 150,861	**51.3%** (0.0012) n = 173,945	**35.4%** (0.0010) n = 221,560

Standard errors in parentheses.

Table 5-4 presents the percentage of refrigerators that qualified for the ENERGY STAR label by utility service area. In the PG&E service territory, 52% of the refrigerators sold qualified for the ENERGY STAR label. In the SCE territory, 42% of the refrigerators sold by retailers were ENERGY STAR qualified. ENERGY STAR qualified refrigerators accounted for 41% of total sales in the "Other" service territories, and 39% of total sales in the SDG&E service territory.

Table 5-4: Refrigerator Sales by Utility, Percent ENERGY STAR Units

| Utility | Year | Percent ENERGY STAR Qualified Refrigerators | | | | |
		Annual	Q1	Q2	Q3	Q4
PG&E	1998	17.4% (-) n = 90,493	17.9% (-) n = 19,547	19.1% (-) n = 21,576	16.3% (-) n = 28,722	16.5% (-) n = 20,648
	1999	28.4% (0.0011) n = 157,639	23.4% (0.0021) n = 38,313	24.6% (0.0021) n = 40,307	31.5% (0.0023) n = 41,424	34.4% (0.0025) n = 37,595
	2000	35.0% (0.0011) n = 179,113	34.3% (0.0023) n = 42,475	31.1% (0.0020) n = 52,914	34.6% (0.0023) n = 43,030	40.6% (0.0024) n = 40,694
	2001	35.5% (0.0011) n = 206,711	1.6% (0.0006) n = 43,728	26.8% (0.0018) n = 58,424	54.6% (0.0021) n = 57,738	53.9% (0.0023) n = 46,821
	2002	37.3% (0.0010) n = 252,536	35.9% (0.0020) n = 57,267	37.8% (0.0019) n = 66,242	38.5% (0.0018) n = 70,350	36.7% (0.0020) n = 58,677
	2003	46.0% (0.0011) n = 211,498	37.7% (0.0019) n = 63,250	49.0% (0.0023) n = 48,387	49.9% (0.0021) n = 54,846	49.3% (0.0024) n = 45,015
	2004	54.4% (0.0013) n = 155,935	42.1% (0.0027) n = 33,323	51.5% (0.0025) n = 40,786	53.9% (0.0023) n = 45,775	68.0% (0.0025) n = 36,051
	2005	61.2% (0.0011) n = 204,995	57.3% (0.0024) n = 44,207	61.2% (0.0021) n = 54,083	63.3% (0.0020) n = 58,300	61.9% (0.0022) n = 48,405
	2006	59.8% (0.0011) n = 198,896	58.2% (0.0023) n = 47,771	58.1% (0.0021) n = 54,480	58.3% (0.0020) n = 58,316	66.0% (0.0024) n = 38,329
	2007	51.7% (0.0011) n = 219,172	54.9% (0.0024) n = 43,327	55.4% (0.0023) n = 46,654	56.4% (0.0021) n = 53,680	42.9% (0.0018) n = 75,511
SCE	1998	16.2% (-) n = 69,987	14.2% (-) n = 13,179	15.8% (-) n = 17,023	16.3% (-) n = 24,049	18.1% (-) n = 15,736
	1999	25.4% (0.0011) n = 168,527	21.5% (0.0021) n = 37,392	23.7% (0.0020) n = 43,460	30.4% (0.0021) n = 48,231	24.6% (0.0022) n = 39,444
	2000	24.6% (0.0011) n = 165,926	20.0% (0.0020) n = 39,486	20.4% (0.0018) n = 49,416	28.0% (0.0022) n = 42,985	29.1% (0.0024) n = 34,039
	2001	42.8% (0.0012) n = 174,894	1.2% (0.0006) n = 32,063	20.4% (0.0018) n = 49,836	63.7% (0.0021) n = 50,445	68.1% (0.0023) n = 42,550
	2002	26.4% (0.0009) n = 231,730	25.9% (0.0019) n = 51,988	24.3% (0.0017) n = 60,352	26.6% (0.0017) n = 67,547	29.2% (0.0020) n = 51,843
	2003	45.0% (0.0011) n = 195,784	28.7% (0.0019) n = 56,672	45.5% (0.0024) n = 42,524	47.1% (0.0021) n = 54,812	51.5% (0.0024) n = 41,776
	2004	36.1% (0.0013) n = 147,609	27.3% (0.0026) n = 29,646	35.1% (0.0024) n = 39,156	38.2% (0.0023) n = 45,130	46.5% (0.0027) n = 33,677
	2005	42.8% (0.0010) n = 267,188	42.8% (0.0020) n = 58,622	44.8% (0.0019) n = 70,205	44.1% (0.0018) n = 75,099	38.5% (0.0019) n = 63,262
	2006	40.6% (0.0009) n = 279,948	38.3% (0.0019) n = 63,815	39.6% (0.0017) n = 78,386	38.7% (0.0017) n = 85,828	48.1% (0.0022) n = 51,919
	2007	41.8% (0.0010) n = 262,862	43.0% (0.0021) n = 55,294	45.9% (0.0020) n = 59,205	48.2% (0.0019) n = 68,471	31.0% (0.0016) n = 79,892

Standard errors in parentheses.

## Table 5-4 (cont'd.): Refrigerator Sales by Utility, Percent ENERGY STAR

Utility	Year	Percent ENERGY STAR Qualified Refrigerators				
		Annual	**Q1**	**Q2**	**Q3**	**Q4**
SDG&E	1998	**23.1%** (-) n = 17,969	**25.4%** (-) n = 2,980	**21.1%** (-) n = 4,484	**22.8%** (-) n = 6,434	**24.0%** (-) n = 4,071
	1999	**29.8%** (0.0023) n = 39,695	**28.5%** (0.0046) n = 9,483	**29.0%** (0.0045) n = 10,237	**32.2%** (0.0046) n = 10,417	**29.0%** (0.0046) n = 9,558
	2000	**37.4%** (0.0024) n = 39,102	**29.5%** (0.0048) n = 9,036	**30.0%** (0.0044) n = 10,749	**42.0%** (0.0047) n = 10,671	**44.7%** (0.0053) n = 8,646
	2001	**29.0%** (0.0022) n = 43,135	**0.9%** (0.0010) n = 9,221	**23.3%** (0.0039) n = 11,829	**40.2%** (0.0045) n = 12,045	48.1% (0.0050) n = 10,040
	2002	**29.1%** (0.0020) n = 53,498	**27.4%** (0.0077) n = 3,318	**31.7%** (0.0080) n = 3,330	**34.9%** (0.0084) n = 3,185	**30.7%** (0.0078) n = 3,524
	2003	**40.2%** (0.0025) n = 38,187	**31.2%** (0.0041) n = 12,718	**46.8%** (0.0058) n = 7,360	**43.8%** (0.0050) n = 9,994	**43.9%** (0.0055) n = 8,115
	2004	**53.2%** (0.0031) n = 26,079	**53.9%** (0.0068) n = 5,368	**53.8%** (0.0061) n = 6,717	**43.9%** (0.0056) n = 7,930	**63.7%** (0.0062) n = 6,064
	2005	**44.3%** (0.0022) n = 52,984	**42.6%** (0.0045) n = 11,996	**47.3%** (0.0042) n = 14,021	**46.1**% (0.0041) n = 14,477	**40.5%** (0.0044) n = 12,490
	2006	**39.8%** (0.0021) n = 52,214	**40.4%** (0.0045) n = 11,875	**37.8%** (0.0040) n = 14,436	**37.3%** (0.0038) n = 15,983	**46.0%** (0.0050) n = 9,920
	2007	**39.0%** (0.0022) n = 47,700	**40.7%** (0.0050) n = 9,513	**44.0%** (0.0049) n = 10,256	**47.4%** (0.0045) n = 12,333	**28.1%** (0.0036) n = 15,598
Other	1998	**13.9%** (-) n = 51,722	**13.0%** (-) n = 10,298	**13.9%** (-) n = 12,226	**13.9%** (-) n = 17,320	**14.7%** (-) n = 11,878
	1999	**21.7%** (0.0013) n = 108,021	**18.6%** (0.0025) n = 24,993	**20.1%** (0.0024) n = 27,246	**22.8%** (0.0024) n = 30,442	**24.7%** (0.0027) n = 25,340
	2000	**25.0%** (0.0013) n = 106,155	**22.7%** (0.0026) n = 24,868	**23.2%** (0.0024) n = 32,094	**26.6%** (0.0027) n = 26,179	**27.9%** (0.0029) n = 23,014
	2001	**19.0%** (0.0013) n = 97,270	**1.1%** (0.0008) n = 19,753	**12.0%** (0.0020) n = 26,323	**26.2%** (0.0026) n = 28,235	**33.4%** (0.0031) n = 22,959
	2002	**24.9%** (0.0011) n = 156,830	**23.3%** (0.0023) n = 33,661	**23.8%** (0.0021) n = 41,022	**26.2%** (0.0021) n = 44,999	**25.8%** (0.0023) n = 37,148
	2003	**40.2%** (0.0013) n = 136,243	**28.0%** (0.0023) n = 38,307	**44.5%** (0.0028) n = 30,550	**45.1%** (0.0026) n = 37,867	**45.4%** (0.0029) n = 29,519
	2004	**50.5%** (0.0015) n = 107,203	**38.3%** (0.0032) n = 23,057	**43.7%** (0.0030) n = 28,244	**53.3%** (0.0028) n = 32,280	**64.4%** (0.0031) n = 23,622
	2005	**52.6%** (0.0013) n = 158,601	**61.0%** (0.0026) n = 34,434	**54.7%** (0.0024) n = 42,014	**48.1%** (0.0024) n = 44,770	**45.4%** (0.0026) n = 37,383
	2006	**44.4%** (0.0013) n = 154,252	**42.4%** (0.0026) n = 35,975	**43.3%** (0.0024) n = 43,256	**41.7%** (0.0023) n = 46,395	**52.6%** (0.0030) n = 28,626
	2007	**41.2%** (0.0012) n = 156,613	**43.8%** (0.0028) n = 31,847	**46.2%** (0.0027) n = 34,746	**48.3%** (0.0025) n = 39,461	**30.0%** (0.0020) n = 50,559

"Other" includes areas served by municipal utilities such as LADWP, LMUD, PP&L, SMUD, and others.

5.5. Analysis by Retailer Type

Figure 5-2 and Table 5-5 compare the share of ENERGY STAR qualified refrigerators sold by national chains and the share sold by independent retailers. The share sold by the national chains in California is typically less than the share sold by the independent appliance retailers. In 2007, 67% of the refrigerators sold by independent retailers met the ENERGY STAR criteria. During the first three quarters of 2007, 42% of refrigerators sold by national chains in California qualified for the ENERGY STAR label. The significant decline in the share sold by national chains in the fourth quarter is due to inconsistencies in the data provided by the ENERGY STAR program.

Figure 5-2: Refrigerator Sales by Retailer Type, Percent ENERGY STAR Units
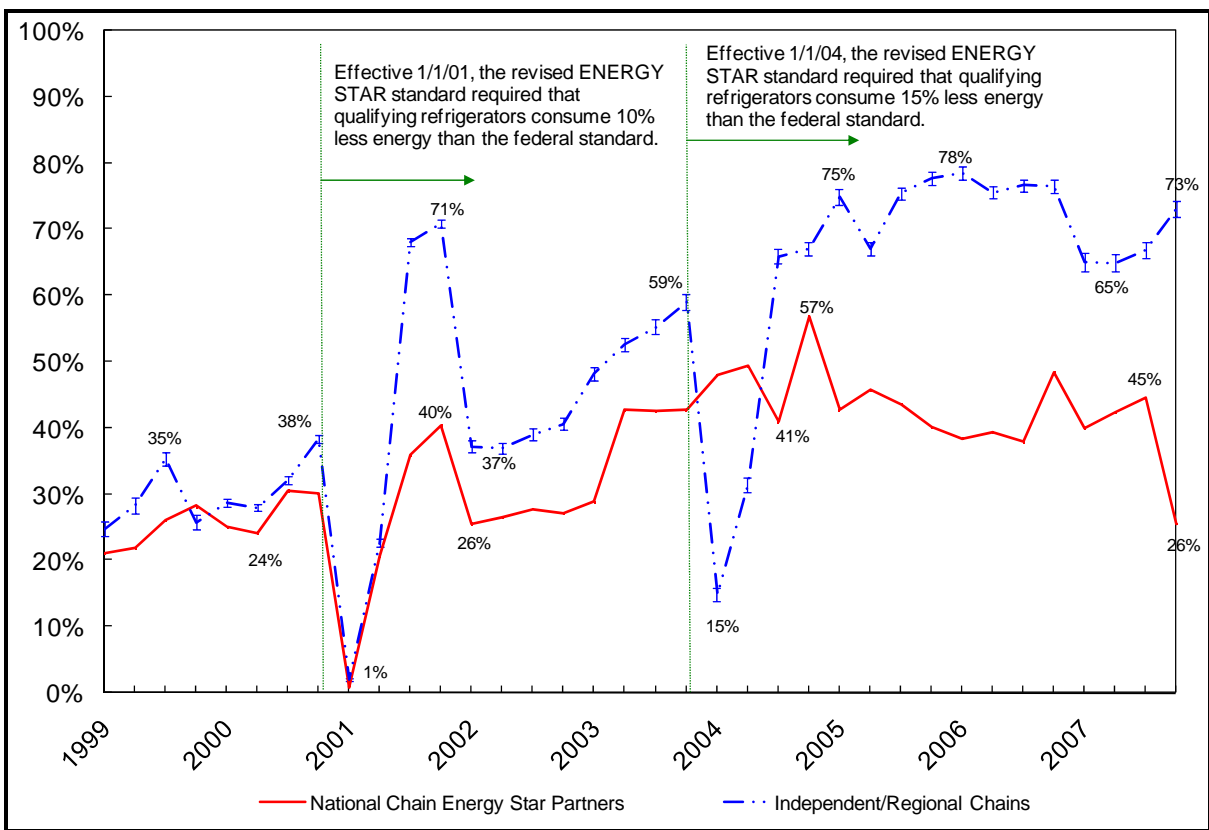
Error bands for the 90% confidence interval.

Table 5-5: Refrigerator Sales by Retailer Type, Percent ENERGY STAR

| Year	Retailer Type	Q1	Q2	Q3	Q4
1999	National Chain	21.1% (0.0012) n = 106,212	21.8% (0.0012) n = 116,872	26.2% (0.0012) n = 124,803	28.2% (0.0014) n = 107,273
	Independent/Regional Chain	24.8% (0.0069) n = 3,969	28.3% (0.0068) n = 4,378	35.31 (0.0063) n = 5,711	25.8% (0.0064) n = 4,664
2000	National Chain	25.0% (0.0014) n = 100,864	24.1% (0.0012) n = 127,557	30.6% (0.0014) n = 101,910	30.1% (0.0015) n = 87,641
	Independent/Regional Chain	28.8% (0.0037) n = 15,001	28.0% (0.0034) n = 17,616	32.1% (0.0032) n = 20,955	38.4% (0.0036) n = 18,752
2001	National Chain	0.8% (0.0003) n = 93,368	20.7% (0.0011) n = 128,000	36.0% (0.0013) n = 129,037	40.43% (0.0015) n = 106,864
	Independent/Regional Chain	2.1% (0.0013) n = 11,397	22.7% (0.0031) n = 18,412	68.1% (0.0033) n = 19,426	70.9% (0.0036) n = 15,506
2002	National Chain	25.6% (0.0011) n = 147,043	26.5% (0.0011) n = 172,062	27.8% (0.0010) n = 189,973	27.1% (0.0011) n = 152,300
	Independent/Regional Chain	37.3% (0.0054) n = 8,072	36.9% (0.0050) n = 9,339	39.1% (0.0054) n = 8,263	40.7% (0.0057) n = 7,542
2003	National Chain	28.9% (0.0011) n = 164,613	42.8% (0.0014) n = 121,735	42.5% (0.0013) n = 151,690	42.8% (0.0014) n = 120,044
	Independent/Regional Chain	48.1% (0.0063) n = 6,334	52.7% (0.0098) n = 7,086	55.3% (0.0065) n = 5,829	59.1% (0.0122) n = 4,381
2004	National Chain	48.0% (0.0017) n = 88,026	49.4% (0.0015) n = 110,220	41.0% (0.0014) n = 125,258	56.9% (0.0016) n = 93,970
	Independent/Regional Chain	14.9% (0.0061) n = 3,368	31.5% (0.0068) n = 4,683	66.0% (0.0062) n = 5,857	67.1% (0.0064) n = 5,444
2005	National Chain	42.7% (0.0013) n = 145,499	45.8% (0.0012) n = 175,189	43.6% (0.0011) n = 186,636	40.2% (0.0012) n = 156,316
	Independent/Regional Chain	75.6% (0.0070) n = 3,760	69.0% (0.0065) n = 5,134	76.7% (0.0055) n = 6,010	78.9% (0.0057) n = 5,224
2006	National Chain	38.5% (0.0012) n = 154,959	39.4% (0.0011) n = 185,262	37.9% (0.0011) n = 200,624	48.4% (0.0014) n = 123,861
	Independent/Regional Chain	78.5% (0.0061) n = 4,477	75.6% (0.0059) n = 5,296	76.7% (0.0055) n = 5,898	76.5% (0.0060) n = 4,933
2007	National Chain	39.9% (0.0013) n = 136,805	42.3% (0.0013) n = 146,755	44.6% (0.0012) n = 169,380	25.6% (0.0009) n = 217,506
	Independent/Regional Chain	65.1% (0.0085) n = 3,176	64.9% (0.0074) n = 4,106	66.9% (0.0070) n = 4,565	73.1% (0.0070) n = 4,054

Standard errors in parentheses.

5.6. Energy Factor Analysis

The data used in this analysis is limited to the point-of-sale data obtained by a panel of independent appliance retailers. The EF analysis is a more accurate measure of efficiency trends than the market share of ENERGY STAR qualified units because ENERGY STAR specifications change periodically, making it more difficult to compare results over time.

Figure 5-3 illustrates the distribution of refrigerator sales by independent appliance retailers according to efficiency level. The graph categorizes refrigerators sold into one of three efficiency brackets, which are calculated using the 2001 federal standard. Since 2005, independent retailers have sold more refrigerators in the bracket of 15%-19% more efficient than federal standard than any other efficiency bracket.

Figure 5-3: Percent of Independent Refrigerator Sales by Efficiency Level
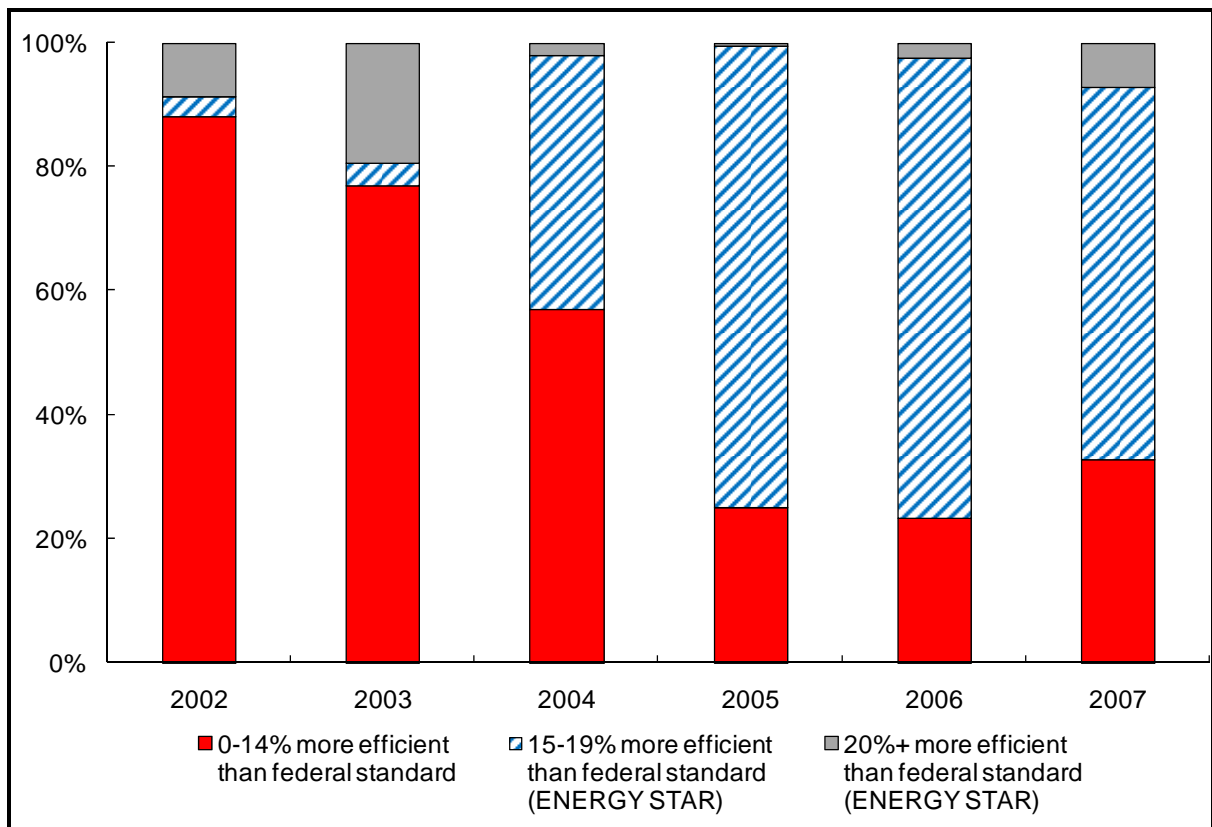
6

Room Air Conditioners

6.1. Overview

This section presents the results of the refrigerator analysis and includes total room air conditioner unit sales (6.2), efficiency standards (6.3), market share of ENERGY STAR qualified units by retailer type (6.4).

6.2. Total Unit Sales

Table 6-1 presents estimated unit sales of room air conditioners in California. Most room air conditioning units are typically sold during the second and third quarter of the year when weather conditions drive sales. Due to the seasonal nature of room air conditioners, sales statistics vary dramatically from one quarter to the next quarter. The results in this report are presented annually in order to present a more meaningful analysis. In 2007, room air conditioner sales reached a five-year low.

Table 6-1: Estimate of Room Air Conditioner Unit Sales in California

Year	Units Sold
1998	231,100
1999	278,600
2000	279,600
2001	409,200
2002	316,200
2003	515,900
2004	664,100
2005	538,600
2006	502,000
2007	494,200

Source: AHAM

6.3. Room Air Conditioner Energy Efficiency Standards

The energy efficiency of room air conditioners is expressed by the Energy Efficiency Rating (EER), which is the ratio of the cooling effect measured in BTU per hour divided by the electrical energy input measured in Watts.

Federal Energy Use Standard. Federal energy efficiency standards for room air conditioners were updated on October 1, 2000. The former standards had been in effect since January 1, 1990.

ENERGY STAR Standard. To qualify for the ENERGY STAR label, room air conditioners must exceed the federal standard by at least 10%. On October 1, 2003, the ENERGY STAR criteria for room air conditioners were expanded to include units without louvered sides, commonly referred to as "built in" or "through-the-wall" units and the casement product classes. October 1, 2005, the ENERGY STAR criterion expanded to include reverse-cycle room air conditioners (or heat pump RACs). Packaged terminal air conditioners are not currently eligible for participation in the ENERGY STAR program.

California Standard. In January 2002, the CEC amended its appliance efficiency regulations to reflect and equal the increase in the 2000 federal energy use standards.

California IOU Incentive Programs. In 2007, PG&E, SDG&E, and SCE offered a $50 rebate towards the purchase of an ENERGY STAR qualified room air conditioner.

Table 6-2 summarizes the federal, state, and ENERGY STAR standards for room air conditioners by room air conditioner configuration and size.

Table 6-2: Energy Efficiency Standards for Room Air Conditioners

| Btuh | Configuration | Federal Standard | | ENERGY STAR | California Standards |
		January 1, 1990	October 1, 2000	October 1, 2003	January 1, 2002
< 6,000	Without reverse cycle and with louvered sides	8.0	9.7	10.7	9.7
	Without reverse cycle and without louvered sides	8.0	9.0	9.9	9.0
6,000 – 7,999	Without reverse cycle and with louvered sides	8.5	9.7	10.7	9.7
	Without reverse cycle and without louvered sides	8.5	9.0	9.9	9.0
8,000 - 13,999	Without reverse cycle and with louvered sides	9.0	9.8	10.8	9.8
	Without reverse cycle and without louvered sides	8.5	8.5	9.4	8.5
14,000 - 19,000	Without reverse cycle and with louvered sides	8.8	9.7	10.7	9.7
	Without reverse cycle and without louvered sides	8.5	8.5	9.4	8.5
> 20,000	Without reverse cycle and with louvered sides	8.2	8.5	9.4	8.5
	Without reverse cycle and without louvered sides	8.2	8.5	9.4	8.5
< 14,000	With reverse cycle and without louvered sides	8.0	8.5	9.4	8.5
≥ 14,000	With reverse cycle and without louvered sides	8.0	8.0	8.8	8.0
< 20,000	With reverse cycle and with louvered sides	8.5	9.0	9.9	9.0
≥ 20,000	With reverse cycle and with louvered sides	8.5	8.5	9.4	8.5
	Casement only	*	8.7	9.6	8.7
	Casement slider	*	9.5	10.5	9.5

6.4. Analysis by Retailer Type

Figure 6-1 and Table 6-3 present the market share of ENERGY STAR room air conditioners sold through independent retailers and for national chains. As shown, a large percentage of the inventory sold by independent retailers meets the criteria for the ENERGY STAR label. The sales of national chains reflect a smaller percentage of ENERGY STAR qualified room air conditioners. In 2007, 79% of the room air conditioners sold by independent retailers in California were ENERGY STAR qualified, whereas 52% of the units sold by national chains met the criteria. However, both retailer types sold fewer ENERGY STAR qualified units in 2007 than they did in 2006.

Figure 6-1: Room Air Conditioner Sales, Annual Percent of ENERGY STAR Qualified Units, by Retailer Type
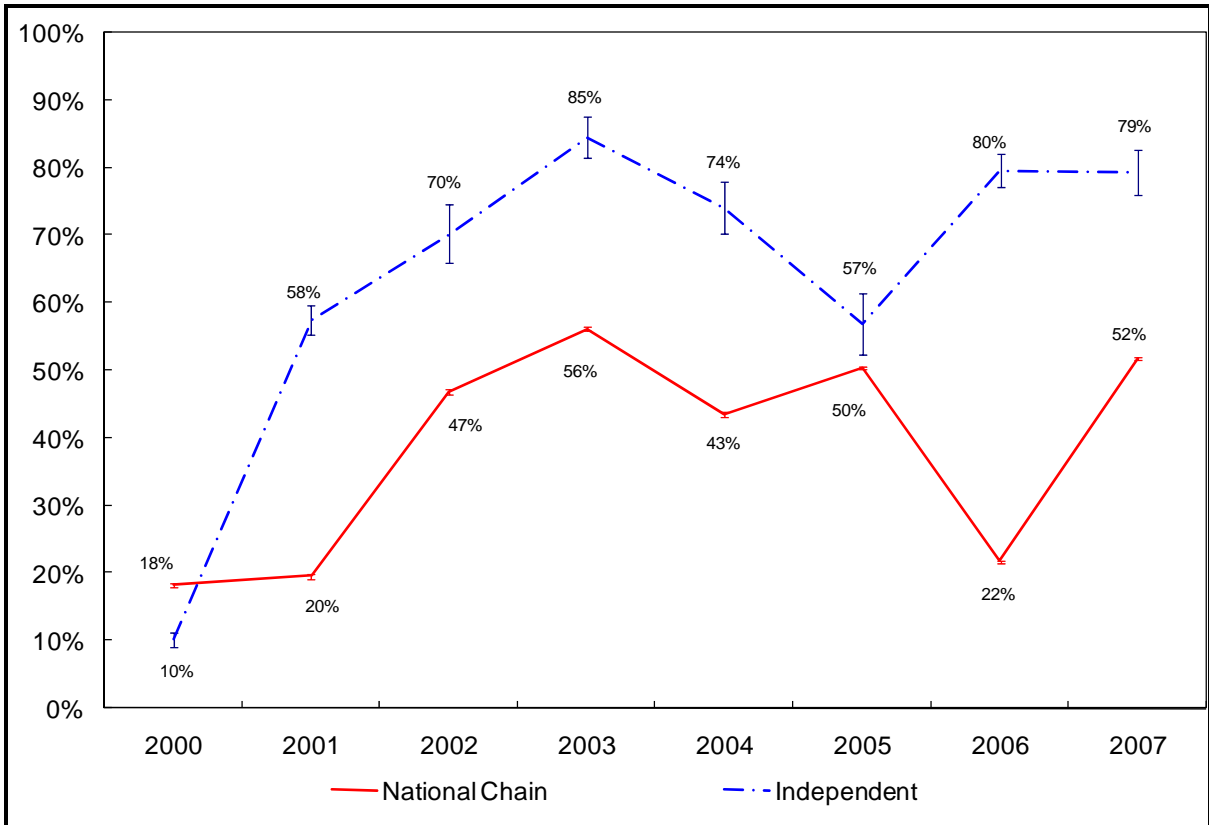
Error bands for the 90% confidence interval.

Table 6-3: Room Air Conditioner ENERGY STAR Sales, by Retailer Type

Year/Quarter	Retailer Type	
	National Chains	**Independent and Regional Chains**
2000	11.6% (0.0005) n = 41,138	10.1% (0.0063) n = 2,314
2001	16.3% (0.0006) n = 33,669	30.1% (0.0122) n = 1,408
2002	46.8% (0.0025) n = 39,202	70.2% (0.0263) n = 302
2003	56.2% (0.0020) n = 62,215	84.5% (0.018) n = 388
2004	43.5% (0.0020) n = 58,738	74.0% (0.0233) n = 353
2005	50.4% (0.0014) n = 128,755	56.9% (0.0275) n = 325
2006	21.7% (0.0010) n = 165,827	79.6% (0.0150) n = 722
2007	51.8% (0.0014) n = 130,721	79.4% (0.0204) n = 393

Standard errors in parentheses.

Table 6-4 presents the share of ENERGY STAR room air conditioners sold by national chains in California. Units sold through independent retailers were not included due to insufficient data. The results are presented by utility service territory. Approximately half of the units sold by national chains in the PG&E, SCE, and SDG&E service territories qualified for the ENERGY STAR label. National chains in the "Other" service areas sold a less significant share (27%) of ENERGY STAR qualified room air conditioners.

Table 6-4: Room Air Conditioner Sales by National Chains in California, Percent ENERGY STAR Qualified Units by Utility Service Area

Year	PG&E	SCE	SDG&E	Other
1998	6.4% (0.0033) n = 5,641	5.9% (0.0030) n = 6,119	4.5% (0.0077) n = 728	8.0% (0.0033) n = 6,613
1999	6.0% (0.0042) n = 3,209	6.5% (0.0041) n = 3,580	6.3% (0.0152) n = 254	6.7% (0.0039) n = 4,134
2000	18.9% (0.0032) n = 15,074	18.3% (0.0036) n = 11,636	15.8% (0.0083) n = 1,927	17.7% (0.0035) n = 11,611
2001	24.5% (0.0041) n = 10,906	17.1% (0.0037) n = 10,346	18.9% (0.0105) n = 1,402	16.9% (0.0036) n = 10,950
2002	48.6% (0.0046) n = 11,811	44.8% (0.0045) n = 12,028	43.6% (0.0126) n = 1,558	47.5% (0.0042) n = 13,818
2003	50.4% (0.0040) n = 16,008	58.1% (0.0034) n = 21,630	52.2% (0.0093) n = 2,915	58.9% (0.0033) n = 21,738
2004	41.4% (0.0043) n = 12,826	43.2% (0.0033) n = 23,133	39.3% (0.0078) n = 3,966	46.1% (0.0036) n = 18,813
2005	47.6% (0.0030) n = 28,480	52.3% (0.0021) n = 54,463	44.6% (0.0056) n = 7,827	50.9% (0.0026) n = 37,985
2006	21.1% (0.0022) n = 34,905	20.3% (0.0015) n = 71,065	17.1% (0.0031) n = 14,757	26.0% (0.0021) n = 45,100
2007	55.0% (0.0052) n = 9,252	51.1% (0.0023) n = 46,734	53.1% (0.0019) n = 71,154	27.4% (0.0075) n = 3,581

Standard errors in parentheses.
"Other" includes areas served by municipal utilities such as LADWP, SMUD, and others.

Appendix A

Appliance Sales Data Analysis

Itron analyzes sales data for each tracked appliance in order to estimate the statewide market share for each of these appliances. This was done by estimating the percent of units sold for each appliance that met ENERGY STAR qualifications from the first quarter of 1999 through 2007 based upon sales data provided by national chain appliance retailers and independent appliance retailers throughout California.[1]

A.1 Data Processing

A considerable amount of effort is needed to transform the raw data collected from the various sources into a common format that will support this analysis. This process is discussed below for national retail chain data and for independent and regional chain data.

National Retail Chain Data. The national chain sales data provided by D&R were converted into the same format as the independent data. Itron added a variable to indicate if an appliance was ENERGY STAR qualified. Since ENERGY STAR specifications vary by appliance type, this variable functioned as the mechanism by which ENERGY STAR sales were distinguished from non-ENERGY STAR sales.

Independent and Regional Chain Data. The data received from independent and regional chains were first converted to a common electronic format. For example, hard copy data were coded into an electronic database. The required efficiency parameters were then electronically merged to the sales data by the manufacturer model numbers provided in the sales data. Itron obtained efficiency parameters for ENERGY STAR qualified appliances from the CEC's Appliance Efficiency Database, the ENERGY STAR website, and directly from manufacturer websites. For refrigerators and room air conditioners, Itron utilized AHAM's Directory of Certified Refrigerators and Freezers to supplement the efficiency data.[2] In addition to energy factor, a variable indicating *percent above federal standard* was created to decribe model efficiency relative to the federal standard.

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[1]   The 1998 analysis was based on national chain sales data only since independent appliance retailer data were not available for that period.

[2]   Association of Home Appliance Manufacturers. *AHAM Directory of Certified Refrigerators and Freezer.*

A.2 Appliance Sales Analysis

The analysis of appliance sales data involved estimation of the share of units sold that met the ENERGY STAR criteria. Itron estimated the percentage of ENERGY STAR compliant units sold on a statewide basis and by utility service areas. The results are presented on an annual and quarterly basis from the first quarter of 1998 through the fourth quarter of 2007.

Expansion Weights. Itron developed weights to expand the sample to the total sales of each appliance in California and each utility service area. This required 1) total appliance sales in California and each utility service area, and 2) estimation of total appliance sales through each market channel.

To estimate the total appliance sales in each utility area, Itron developed the ratio of the total number of households in each utility service area to the total number of households in California. This ratio was used to estimate the proportion of total sales of each appliance type in each utility service area for each year, based on total appliance shipments to California as published by AHAM.

$$N_{ua} = \frac{P_u}{P_{CA}} \times S_{CAau}$$

where:

N_{ua} is an estimate of total sales of appliance *a* for utility *u*.

P_u is the total number of households in each utility's *u* service area.

P_{CA} is the total number of households in California.

S_{CAa} is the total shipments of appliance type *a* to California.

To estimate total sales for each market channel, Itron estimated the total sales of each appliance type by expanding the D&R data to represent sales by all ENERGY STAR partner national chains. Because total unit sales by individual chains are not known, Itron expanded sales by a revenue-multiplier as a proxy for total unit sales:[3]

$$N_{ua}^{nc} = n_{ua}^{nc}\left(\frac{R_{=}^{nc}}{r^{nc}}\right)$$

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[3]   D&R International provided revenue data to Itron for creation of revenue multipliers in 1999. Itron conducted market research to obtain revenue data for other years.

where:

N_{ua}^{nc} is the total estimated sales of appliance *a* in utility area *u* by all national chain *(nc)* stores.

n_{ua}^{nc} is the reported sales by national chain *(nc)* ENERGY STAR partners of appliance *a* for utility *u*.

R^{nc} is the total revenues from appliance sales by all national chain *(nc)* ENERGY STAR partners in 1999.[4]

r^{nc} is the total revenues from appliance sales by the national chain *(nc)* retailers in the analysis sample in various years where available.

Total sales by the independent retail channel is assumed to be the remainder of market, or

$$N_{ua}^{in} = N_{ua} - N_{ua}^{nc}$$

where:

N_{ua}^{in} is the total sales of appliance *a* for utility *u* by all independent retailers *(in)*.

The expansion weights for each appliance *a* sold in each utility area *u* for sales by the national chain ENERGY STAR partners and independent retailers are computed as the ratio of total units sold to the units sold represented in the analysis sample:

$$w_{ua}^{nc} = \frac{N_{ua}^{nc}}{n_{ua}^{nc}}$$

$$w_{ua}^{in} = \frac{N_{ua}^{in}}{n_{ua}^{in}}$$

where:

w_{ua}^{nc} is the expansion weight applied to all sales by the national chain ENERGY STAR partners in the sample, and

w_{ua}^{in} is the expansion weight applied to all sales by independently owned retailers in the sample.

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[4]   Due to the unavailability of data, the 1999 proxy was used for 2000-2003. Market research was conducted to develop 2004-2007 weights.

Shares of ENERGY STAR qualifying appliances during each quarter were estimated by expanding the sales in the database by the appropriate expansion factor and computing the percent of the expanded sales that qualify for the ENERGY STAR label.