

California Residential Efficiency Market Share Tracking

Appliances 2005

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Appendix A Appliance Sales Data Analysis

1

Introduction

1.1. Overview

The California Appliance Report 2005 summarizes the analysis and results of the appliance component of the California Residential Market Share Tracking project (RMST).¹ The RMST project has monitored the market penetration of energy efficient measures in California since 1999 and supports California's investor-owned utilities (IOUs) in their program planning and efforts to measure statewide and IOU-specific 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 estimates the average efficiency rating and market penetration of high efficiency residential gas furnaces, central air conditioners, and heat pumps and examines the market penetration of compact fluorescent and other medium screw-based lamps.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 percent of ENERGY STAR[®] qualified clothes washers, refrigerators, dishwashers, and room air conditioners sold in the state from 1998 through 2005. Results are presented by IOU service area, statewide, and by retailer type (national chain versus independent retailer), if the data can support such segmentation. This report also contains a review of data collection and analysis methodologies, general market information, and summaries of applicable efficiency standards for each appliance type, including federal energy use standards, national ENERGY STAR program standards, and California's appliance efficiency standards.

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

¹ An eight-page companion report titled California Appliance Trends 2005 summarizes the findings in this report.

² This project is managed by Southern California Edison.

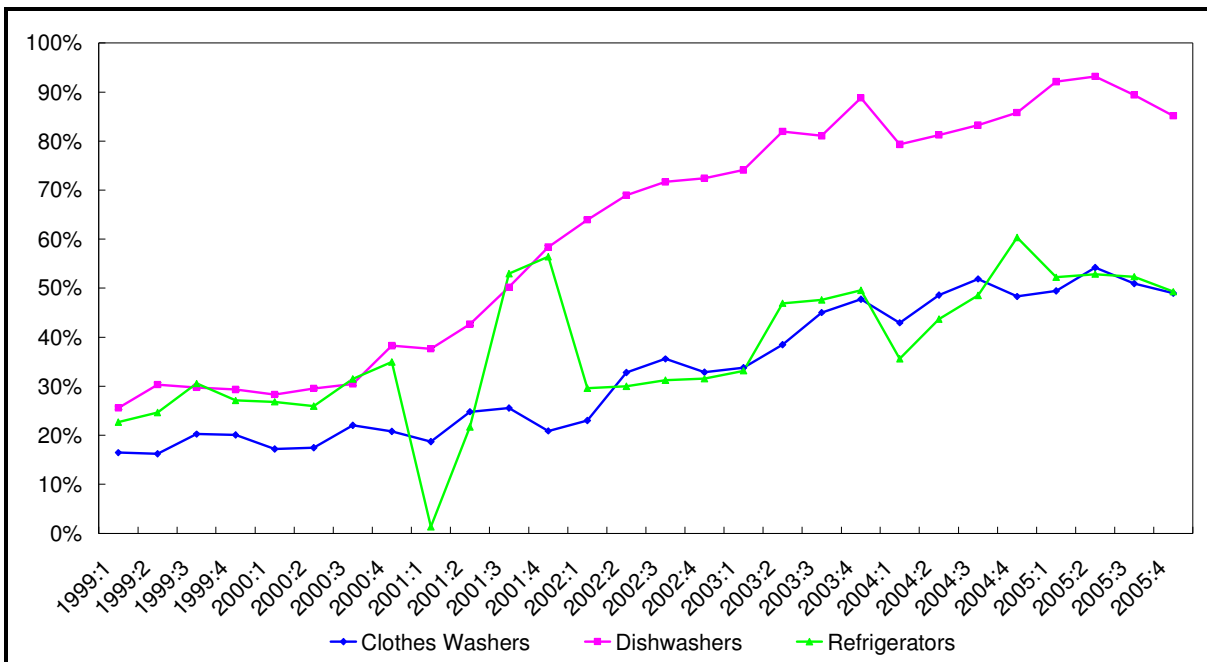
³ Annual RMST reports detailing CFL sales, residential appliance sales, and HVAC sales in California since 2000 can be downloaded from <http://www.calmac.org/>.

has partnered with the federal ENERGY STAR program for marketing and outreach. The share of ENERGY STAR qualifying appliances sold in the state can be a valuable indicator of program success and is used to support the evaluation of the statewide program.

1.2. Highlights

The trends in the market penetration of ENERGY STAR qualified appliances and the average energy efficiency ratings since 1999 reveal some rather notable trends. First, the data reveal distinct reaction of market penetration when the ENERGY STAR standards change. Figure 1-1 shows that each appliance type exhibited an initial dip in ENERGY STAR market share as a result of the ENERGY STAR standards change in the beginning of 2004. As anticipated, shares rebounded quickly (within a few quarters) to levels prior to the change. Second, the data reveal distinct differences in the shares of ENERGY STAR qualified units sold through national chains compared to independent retailers. In general, the independent retailers have sold higher shares of ENERGY STAR qualified units than the national chains in the California market.

Figure 1-1: Market Shares of Energy Star Qualified Appliances — 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 conditioning.

2

Data Collection and Analysis

2.1. Overview

The appliance component of the RMST project estimates the share of ENERGY STAR qualified units sold and average efficiency ratings from retailer point-of-sale (POS) data. In general, the appliance retail market is comprised of two retailer types: national chain stores and independently owned retailers (including regional appliance chains and single storefronts). To accurately reflect appliance market trends, it is important that POS data be 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. Data from national appliance retailers are provided by D&R International (D&R),⁴ a firm under contract with the U.S. Department of Energy (DOE) to administer the federal ENERGY STAR appliance program.

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

2.2. 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 estimates of the population of appliance retailers and number of storefronts in California in 2003; the table distinguishes between national chain retailers and independent retailers. As shown, all national chain storefronts are currently ENERGY STAR partners. Though trends vary across appliance types and over time, national chains sell about half of all appliances sold in California.

⁴ www.drintl.com

Table 2-1: California Appliance Retailers – 2003

	National Chains	Independent Regional Chains	Independent Individual Stores	All Retailers
Companies	6	32	300	338
ENERGY STAR Partners ^a	6	1	0	7
Retail Storefronts ^b	520	115	300	935

- a. All national chain storefronts participate in the ENERGY STAR program once the corporate home office has agreed to participate in the program. Individual storefronts do not make the decision regarding participation.
- b. Costco and Sam’s Club Membership Warehouses are included since these retailers have entered the home appliance market. The total number of California retail storefronts was confirmed through Internet research of national chain websites or through discussions with investor relations offices of national chains in California.

2.3. National Appliance Retailer Sales Data

D&R collects sales data from national chain retailers under a contract to support the ENERGY STAR appliance program and to track sales of ENERGY STAR labeled products on a national level. To support the RMST, D&R has provided Itron with aggregated sales data by ZIP code from national retail chains for each of the appliance types covered by the RMST project.⁵

D&R’s database of aggregated POS data includes, for each appliance type, the total number of all units sold and the total number of ENERGY STAR qualifying units sold by ZIP code. D&R is not able to provide more detailed information about specific efficiency characteristics of the units sold, which limits the analysis that can be conducted with these data.

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

To represent trends of appliance sales through independently owned storefronts and regional chains, Itron collects POS data from a panel of independent retailers throughout California. The sampling strategy, recruiting strategy, and characteristics of the 2005 retailer panel are described below.

Summary of 2005 Database Coverage

Table 2-2 summarizes the RMST coverage of units sold in 2005 by appliance type. As shown, the 2005 database includes sales data for an estimated 51% of the total number of

⁵ Appendix A presents further information on methodology used in weighting the national chain data.

clothes washers, 32% of dishwashers, 51% of refrigerators, and 22% of room air conditioners sold in California.

Table 2-2: 2005 Coverage of Units Sold, by Appliance Type

	Appliance Type			
	Clothes Washers	Dishwashers	Refrigerators	Room AC
Estimate of total unit sales ^a	960,200	818,400	1,333,100	538,600
Unit sales in sample	489,388	259,360	683,768	119,988
Percent of unit sales in sample	51%	32%	51%	22%

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

Independent Retailer Sample Frame and Sample Design

Table 2-3 summarizes the independent retailer sample frame used to recruit retailers for the RMST panel. The sample frame of independent retailers used for this study was mainly drawn from a list provided by the Electric and Gas Industries Association (EGIA). Independent research by the project team also supplemented the EGIA information.⁶

Note that Itron did not conduct additional recruiting for the 2005 RMST appliance panel because Itron is in the final year of the RMST contract. Therefore, Table 2-3 reflects the sample frame size from early 2004.

Table 2-3: Independent Appliance Retailer Sample Frame

	IOU				Total
	PG&E	SCE	SDG&E	Other ^a	
All Areas					
Storefronts	209	99	35	72	415
Percent of Total	50%	25%	8%	17%	100%
PG&E, SCE, and SDG&E Only					
Storefronts	209	99	35		343
Percent of Total	61%	29%	10%		100%

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

⁶ The sample obtained from the EGIA under-represented the SDG&E service area, according to EGIA staff. Augmenting the EGIA sample with Associated Volume Buyers (AVB) members helped alleviate this problem.

Table 2-4 provides the original sample targets for each utility service. Itron seeks to recruit approximately 15% of the independently owned storefronts statewide to provide sales data for the RMST project (i.e., the sample target is 65 of the 415 storefronts).

Table 2-4: Independent Appliance Retailer Sample Targets

	IOU			Total
	PG&E	SCE	SDG&E	
Storefronts	39	19	7	65
Percent of Total	60%	30%	10%	100%

Independent Retailer Panel

As noted above, Itron did not conduct additional recruiting for the 2005 RMST appliance panel. Therefore, only retailers of the 2004 appliance panel were contacted for 2005 data. Itron was able to retain seven distributors from the 2004 panel. These seven distributors represent 17 storefronts throughout the state.

The 2005 independent retailer panel included 17 individual storefronts, representing a panel of seven independent retailers. The retailers in the panel provided data in various formats, including electronic spreadsheets, hard-copy sales reports, and handwritten tallies of units sold. Most retailers provided monthly sales data that include the appliance type, manufacturer, manufacturer model number, quantity sold, and date of sale.

ENERGY STAR Sales by Independent Retailers

In California, independent retailers have secured a substantial market share in the overall appliance market. The results of this study continue to demonstrate that independent retailers generally sell a larger proportion of ENERGY STAR qualified appliances than national chain appliance retailers. This difference could be attributable to several factors, including lower employee turnover and therefore higher awareness, willingness to special order appliances, and overall different marketing strategies. Additionally, independent appliance retailers may cater to a different clientele that is more likely to purchase the higher end, and sometimes higher efficiency, product.

Moreover, independent stores do not try to compete with the price points that national chain stores offer on some models. Instead, they tend to focus on service, knowledge, and helping to find the best fit for the needs of a customer as their customers are often looking for planned appliance replacements. This stands in contrast to some customers who may seek out a national chain because they require an emergency appliance replacement purchase.

In the past, national chain stores' appliance selection was limited in comparison to independent appliance retailers, which typically offered a greater selection to consumers. However, national chains have improved their ENERGY STAR product lines, and the market share of these items has increased in California.

2.5. Analysis Approach

The analysis for the appliance component of the RMST includes the estimation of the share of ENERGY STAR qualified units sold and the estimation of the average efficiency rating of all units sold. For all appliances, the market share of ENERGY STAR qualified appliances is presented by retailer type and by utility service area. Average energy factors (EF) are calculated for dishwashers and refrigerators, while average modified energy factor (MEF) is calculated for clothes washers. Both results are reported on an annual and quarterly basis. A brief description of both approaches is presented below, and a more detailed description is provided in Appendix A.

ENERGY STAR Market Share Analysis

The share of ENERGY STAR qualified units sold is estimated with sales data from both national chains and independent retailers. This statistic is based on whether the energy efficiency rating of an appliance sold in California met the minimum threshold rating for the ENERGY STAR program. Periodic revisions (increases) in the federal ENERGY STAR specifications will impact the statistic in the periods immediately following the standard revision. For example, the impact of ENERGY STAR specification changes on market share was evident in 2001 when the efficiency standard for ENERGY STAR for refrigerators increased and the share of ENERGY STAR refrigerators sold dropped from 35% to just over 1%.

Energy Factor Analysis

In addition to the ENERGY STAR market share analysis described above, the RMST also tracks the average energy efficiency ratings of appliances sold throughout California. The sales data from national chains provided by D&R does not include the energy efficiency rating information nor the model numbers of units sold, which would enable national chain sales data to be included in this analysis. The results, therefore, are only available for the independent and regional chain retailer market channels and are presented for clothes washers, dishwashers, and refrigerators.

3

Clothes Washers

3.1. Overview

This section presents the results for residential clothes washers. Subsections 3.2 and 3.3 provide estimates of total clothes washer unit sales and summarize relevant energy efficiency standards, respectively. Subsection 3.4 provides estimates of the share of ENERGY STAR qualified clothes washers sold in California from 1998 through 2005. Subsection 3.5 presents a comparison of efficiency ratings of clothes washers sold through national chains and independent retailers. Subsection 3.6 presents efficiency results of clothes washers sold through independent retailers during the same period.

3.2. Total Unit Sales

Table 3-1 presents estimates of annual unit sales of residential clothes washers in California from 1998 through 2005. The Association of Home Appliance Manufacturers (AHAM) was the main source of information for these estimates.

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

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 ft³/kWh/cycle.

On January 1, 2004, the federal, California, and ENERGY STAR standards changed the performance metric used to evaluate clothes washers. The current standard reflects a switch to a modified energy factor (MEF) performance metric from the previous EF-based standard.⁷ The MEF considers the moisture content remaining in clothes after washing in order to correlate the effectiveness of the washer to the amount of dryer use required or, in other words, the dryer savings.

The new rating (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 in cubic feet

M = machine electrical energy consumption

E = the hot water energy consumption

D = the 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. Under the 2004 federal MEF standard, top-loading clothes washers with a tub capacity of 1.6 cubic feet or greater are required to have an MEF of at least 1.04. The requirements for front-loading units included an unheated rinse option.

The switch to use of the MEF was guided, in part, by the Super-Efficient Home Appliance Initiative (SEHA) standards created by the Consortium for Energy Efficiency (CEE). The changes to the federal energy use standards also mandate a second increase in the standard, to become effective January 1, 2007.

Table 3-2 summarizes the federal, state, and ENERGY STAR standards for clothes washers.

⁷ http://www.energystar.gov/index.cfm?c=clotheswash_pr_crit_clothes_washers

Table 3-2: Comparison of Federal and ENERGY STAR Clothes Washer Energy Standards

	1994 Standard	January 1, 2001 Standard	January 1, 2004 Standard	January 1, 2007 Standard
Federal Standard	1.18 EF	1.18 EF	1.04 MEF	1.26 MEF
Percent Improved	N/A	N/A	22% over 2001	35% over 2001 ⁸
ENERGY STAR Standard	2.50 EF	1.26 MEF (~ 2.50 EF)	1.42 MEF	1.72 MEF
California Standard	1.18 EF	1.18 EF	1.04 MEF	1.26 MEF

ENERGY STAR Standard. Effective January 1, 2004, the ENERGY STAR standard was revised to reflect the changes in the federal energy use standards. The current ENERGY STAR criteria require that all qualified products possess a MEF of 1.42 or greater. Another standards increase will occur January 1, 2007, requiring that all ENERGY STAR qualified clothes washers possess a MEF of 1.72 or greater and a maximum water factor of 8.0.

California IOU Incentive Programs. Each California IOU has a unique rebate structure based on the tiers established by the CEE. Currently, none of the utilities rebate CEE Tier 1 (1.42 to 1.59 MEF) clothes washers. SDG&E currently provides rebates for clothes washers ranging in MEF of 1.6 to 1.79 (CEE Tier 2), depending on building and decision type. PG&E provides a stepped rebate for clothes washers ranging in MEF of 1.6 to 1.8 (CEE Tier 2) and for clotheswashers with an MEF of greater than 1.8 (CEE Tier 3).

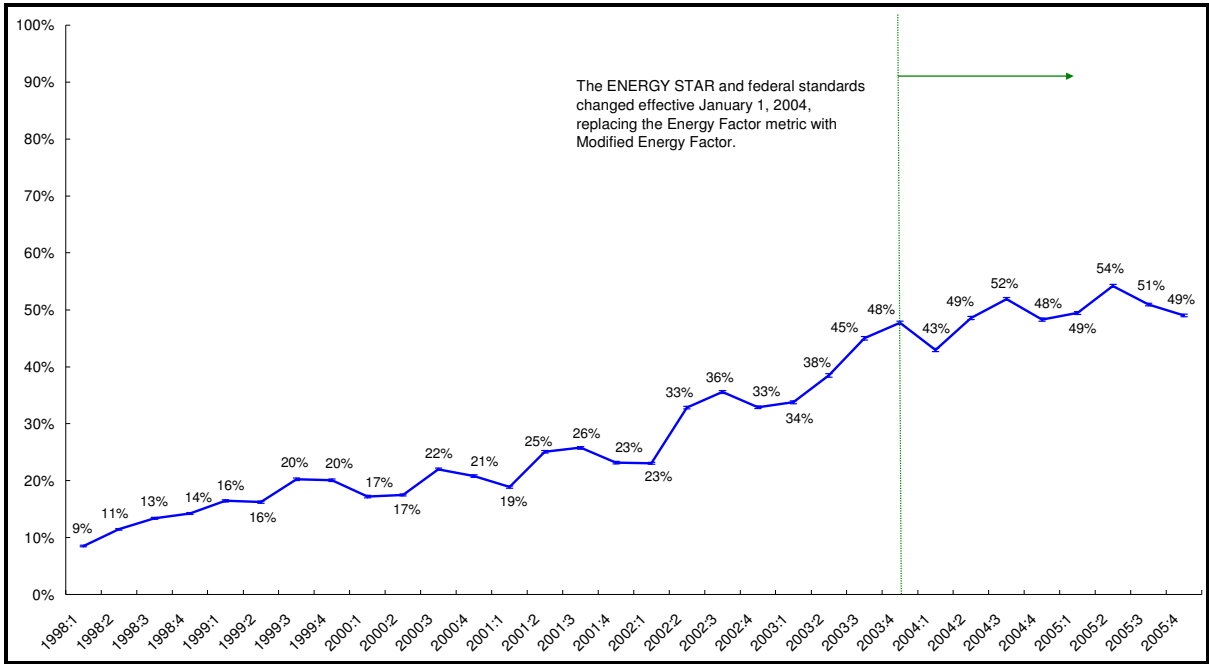
3.4. Market Share of ENERGY STAR Qualified Clothes Washers

Figure 3-1 and Table 3-3 present the percentage of ENERGY STAR qualified clothes washers sold in California from the first quarter of 1998 through the fourth quarter of 2005.⁹ As shown, the market share of ENERGY STAR qualified clothes washers has increased during the past six years—from a low of 9% in the first quarter of 1998, to a high of 54% in the second quarter of 2005, then down to 49% by the end of 2005.

⁸ Department of Energy. *Energy Conservation Program for Consumer Products: Clothes Washer Energy Conservation Standards; Final Rule*. 10 CFR Part 430. Federal Register, Volume 66, no. 9. Docket No. EE-RM-94-403. RIN 1904-AA67. Office of Energy Efficiency and Renewable Energy. Washington, DC. January 2001.

⁹ In Figure 3-1, Table 3-3, and Table 3-4, data from 1998 reflect national chain D&R data only. Because of this and the adjustments made to better estimate 1998 results, standard errors for 1998 are not listed.

Figure 3-1: Clothes Washer Sales, Percent of ENERGY STAR Qualified Units



Error bands for the 90% confidence interval.

Table 3-3: Clothes Washer Sales, Percent of ENERGY STAR Qualified Units (Statewide)

Year	Percent of 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

Standard errors in parentheses.

Table 3-4 reports the percentage of ENERGY STAR qualified clothes washers sold in each utility service area on an annual and quarterly basis. As shown, the PG&E service territory exhibited the highest average annual percentage of ENERGY STAR clothes washer sales in 2005, at 55%. Sales in the “Other” service area and SCE regions represented the next highest percentage of ENERGY STAR clothes washer sales in 2005, at 51% and 48%, respectively. The share of ENERGY STAR qualified units sold in SDG&E’s service territory was the lowest proportion of ENERGY STAR unit sales in 2005, at 43%.

Table 3-4: Clothes Washer Sales, Percent of ENERGY STAR Qualified Units by Utility Service Area

Utility	Year	Percent of 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
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

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

Utility	Year	Percent of 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
Other ^a	1998	13.4% (-) n = 35,130	7.8 (-) n = 8,539	10.4% (-) n = 7,899	14.4% (-) n = 9,120	19.8% (-) n = 9,57203
	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

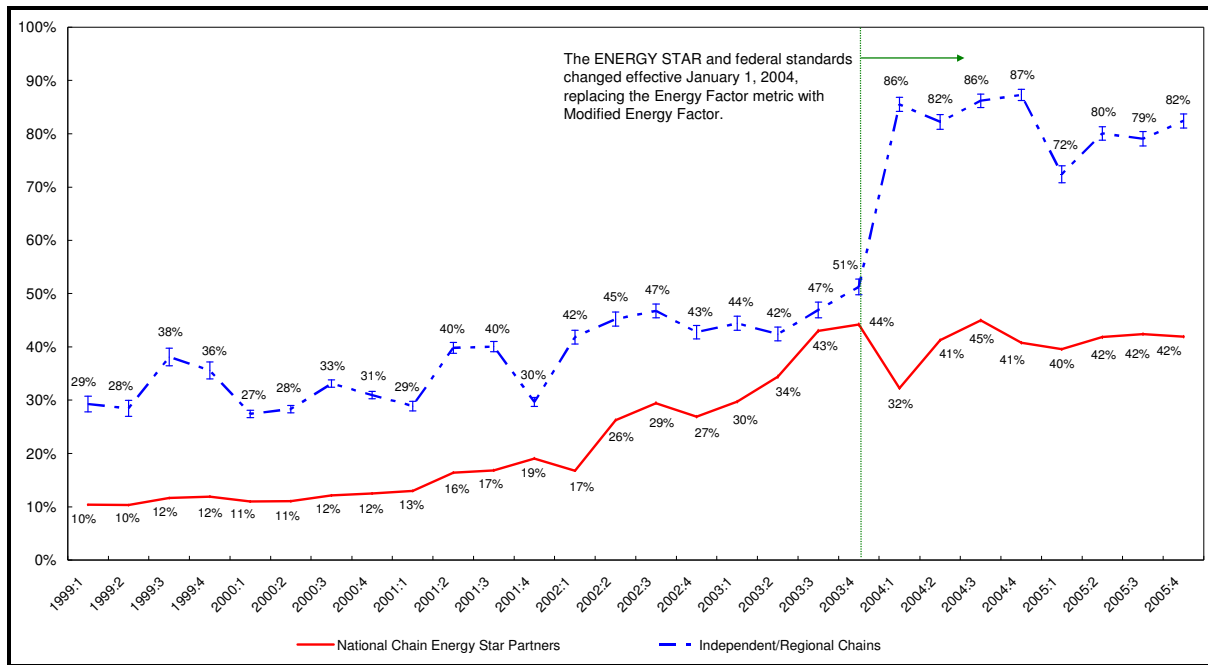
a "Other" includes municipal utilities, including LADWP, SMUD, and others.

3.5. Analysis by Retailer Type

Market Share of ENERGY STAR Qualified Clothes Washers

Figure 3-2 and Table 3-5 compare the shares of ENERGY STAR qualified clothes washers sold through national chains to sales by independently owned stores and regional chains. As shown, national chains have consistently sold a lower percentage of ENERGY STAR qualified clothes washers than independent retailers.

Figure 3-2: Clothes Washer Sales, Percent of ENERGY STAR-Qualified Units by Retailer Type



Error bands for the 90% confidence interval.

From 1999 through 2003, the share sold through national chains more than quadrupled, growing from 10% in the first quarter of 1999 to 44% by the last quarter of 2003. After dropping sharply in early 2004, the share rose again to 42% by the end of 2005. During the same period, the independent appliance retailers also experienced a growth in share, although their share fluctuated more noticeably, from 29% in early 1999 to 82% by the end of 2005.¹⁰

¹⁰ In the periods immediately following an increase in a qualifying energy use rating, one expects a drop in the share of qualifying units sold, as exhibited by the drop in the share of units sold through national chains. The reason for the noticeable difference in the share of qualified units between national chains and independent retailers is not known.

Table 3-5: Clothes Washer Sales, Percent of ENERGY STAR Qualified Units 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

Standard errors in parentheses.

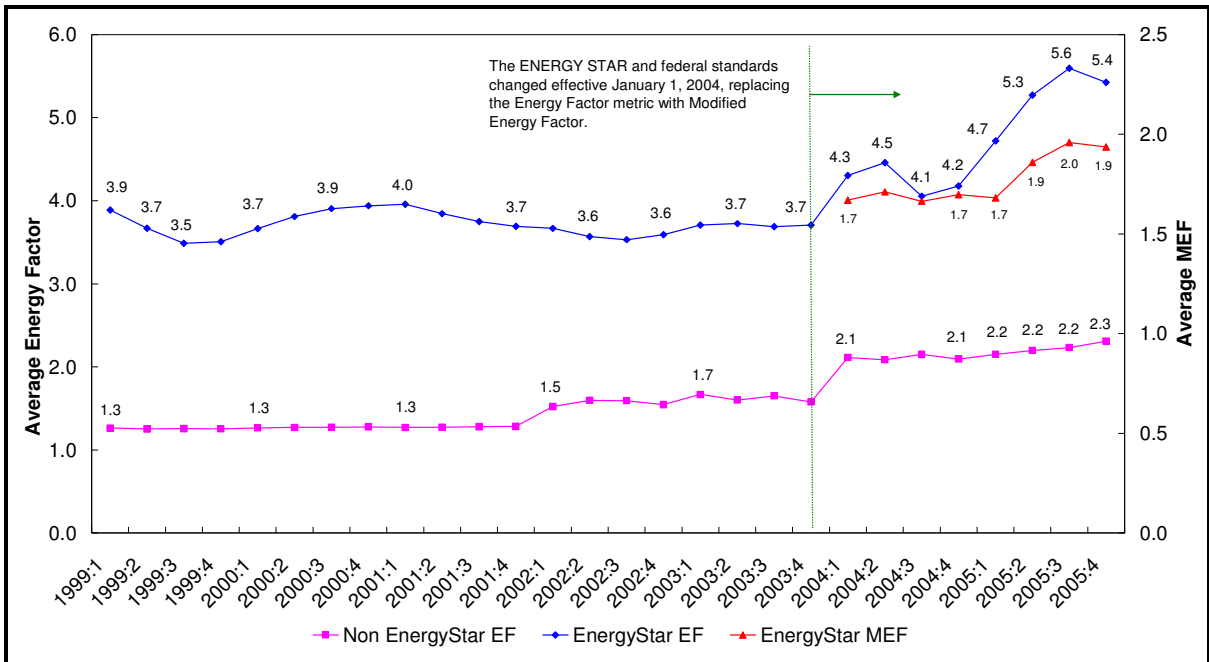
Energy Factor and Modified Energy Factor Analysis

In past reports, this section presented the average EF of clothes washers sold through independent retailers in California. As noted above, in January 2004 the minimum energy use standard for clothes washers became based upon a modified energy factor (MEF). Most data sources Itron depends upon to match efficiency characteristics (i.e., EF, MEF, kWh, tub capacity) to the model numbers in the sales database did not include the MEF for non-ENERGY STAR qualified clothes washers. (MEF was available for only a few models from

the California Energy Commission’s (CEC) Database of Energy Efficient Appliances.)¹¹ Thus, Itron’s analysis of energy efficiency ratings for clothes washers was limited to examining the trend of EFs of non-ENERGY STAR units sold.

Figure 3-3 illustrates the average EF trends of ENERGY STAR and non-ENERGY STAR clothes washers sold through independent retailers in California. As shown, the average EF of non-ENERGY STAR units was constant at 1.3 from 1999 through early 2002, after which the average rating increased to 2.3 by the end of 2005. Note that the minimum EF for the federal standard was 1.18 until January 2004, meaning that the average EF was not that much higher than standard until 2002. The minimum EF to qualify for the ENERGY STAR rating was 2.5 until January 2004. As shown in Figure 3-1, the average EF and MEF of ENERGY STAR qualified units have risen sharply since the 2004 standards change.

Figure 3-3: Average Energy Factor for Clothes Washers Sold By Independent Appliance Retailers

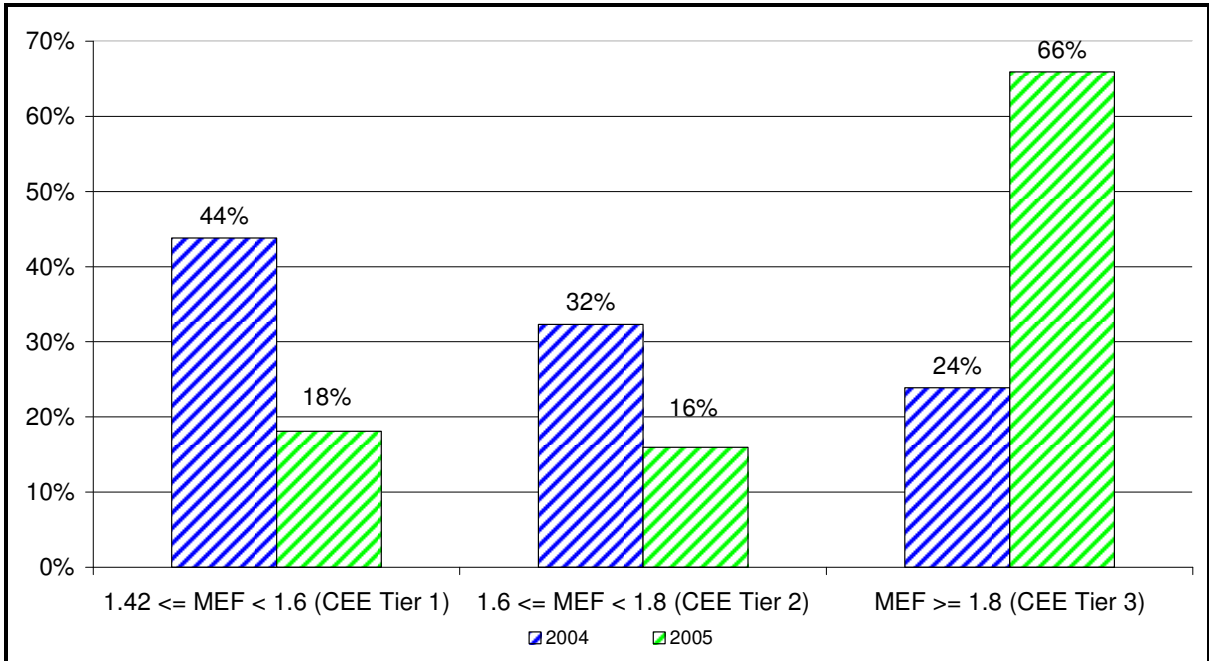


Average EFs and MEFs for Independent Retailer data only

¹¹ The CEE, which developed the standard, was not able to release the database because of confidentiality agreements with manufacturers to not divulge the MEF ratings for the non-ENERGY STAR qualified units.

Figure 3-4 presents the distribution of ENERGY STAR qualified clothes washer sales for independent retailers by tier, as designated by the CEE. About 18% of the qualified units sold fell into Tier 1, with a MEF of at least 1.42 but less than 1.6. Around 16% of the units sold fell into Tier 2 with a MEF of at least 1.6 but less than 1.8. About 66% of the units also fell into Tier 3 with a MEF of at least 1.8.

Figure 3-4: Distribution of ENERGY STAR Qualified Clothes Washer Sales by CEE Tier



None of the California IOUs currently rebate CEE Tier 1. The IOU's have differing incentive structures for CEE Tiers 2 and 3 based on building type and decision type.

4

Dishwashers

4.1. Overview

This section presents the results of the dishwasher sales analysis, including estimates of total dishwasher unit sales (subsection 4.2), efficiency standards (subsection 4.3), market shares of ENERGY STAR qualified units (subsection 4.4), and analysis of ENERGY STAR sales by retailer type (subsection 4.5).

4.2. Total Unit Sales

Table 4-1 presents estimates of annual unit sales of dishwashers used in the development of market shares in this report. AHAM was the main source of information for these estimates.

Table 4-1: Estimate of Total Dishwashers Units 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

Source: AHAM

4.3. Dishwasher Energy Efficiency Standards

Dishwasher efficiency ratings are based on estimated annual energy use (kWh) under “typical conditions” and an average of 215 loads, or cycles, per year. This EF for dishwashers is computed as follows:

$$EF = \frac{\text{Average Cycles per Year}}{\text{Annual Energy Usage (kWh)}}$$

Federal Energy Use Standard. The current federal efficiency standard for dishwashers went into effect in 1994 and establishes a minimum Energy Factor (EF) no less than 0.46. On June 17, 2002, the DOE decreased the number of cycles used to calculate a dishwasher's EF from 322 cycles to 264 cycles. Moreover, with another rulemaking on August 29, 2003, the number of cycles used for the dishwasher EF equation was further decreased to 215 cycles. The 215-cycle level took effect on February 24, 2004. As a result, without any alterations to the models available, the general EFs of dishwashers would fall due to the decrease in cycles, even though the energy efficiency standards have not changed. Therefore, in order to maintain the same efficiency relationship to the federal energy standard, dishwashers would be required to become increasingly efficient.

Finally, effective September 29, 2003, a new test procedure was passed for soil-sensing dishwashers, since manufacturers reported an inability to adequately test these models using existing test procedures.¹² The DOE announced that the EF for soil-sensing dishwashers must be calculated based on a weighted average of the results from three separate tests at three different soil levels (heavy, medium, and light). The results of each of the tests would be weighted according to the average frequency in which consumers wash heavy, medium, and light loads. The test procedure for non-soil-sensing dishwashers would continue to require only one test using a load of clean dishes. Dishwasher manufacturers were required to self-test their equipment according to the DOE test procedures described above by February 25, 2004.

Manufacturers or private labelers were also required to include the measurement of standby power consumption in the estimated annual operating cost and estimated annual energy use calculations for all dishwasher models. The EF rating, however, was not required to include standby power consumption amounts.

ENERGY STAR Standard. The ENERGY STAR qualification for dishwashers changed on January 1, 2001. The new qualification was based on the SEHA program from the CEE.¹³ As of January 1, 2001, ENERGY STAR qualified dishwashers must exceed the minimum EF of 0.58. Another standards increase will occur on January 1, 2007; the minimum EF of ENERGY STAR qualified dishwashers will increase to 0.65.

¹² http://www.eere.energy.gov/buildings/appliance_standards/residential/pdfs/dishwasher_test_procedure.pdf

¹³ Consortium for Energy Efficiency. Super Efficient Home Appliance Initiative: Dishwashers. www.ceeformt.org/resid/seha/dishw/dishw-main.php3

California Standard. In January 2002, the CEC amended its appliance efficiency regulations to reflect the increase in the federal energy use standards for several appliances. However, as with the federal standard, the actual dishwasher standard EF for California was not modified during those proceedings.

Table 4-2 presents the current energy efficiency standards and the ENERGY STAR specification for dishwashers. As shown, all standard-sized dishwashers must possess an EF of at least 0.46.¹⁴ There are no planned increases to the federal or California standards in the near future.

California IOU Incentive Programs. Currently, some California IOU's are rebating dishwashers that have an EF of 0.62 or higher. This standard falls between the 2004 ENERGY STAR standard of 0.58 EF and the 2007 ENERGY STAR standard of 0.65 EF shown in Table 4-2.

Table 4-2: Comparison of Dishwasher Energy Efficiency Standards

	2001 Standard	2007 Standard
Federal Standard	0.46	0.46
ENERGY STAR Standard	0.58	0.65
California Standard	0.46	0.46

4.4. Market Share of ENERGY STAR Qualified Dishwashers

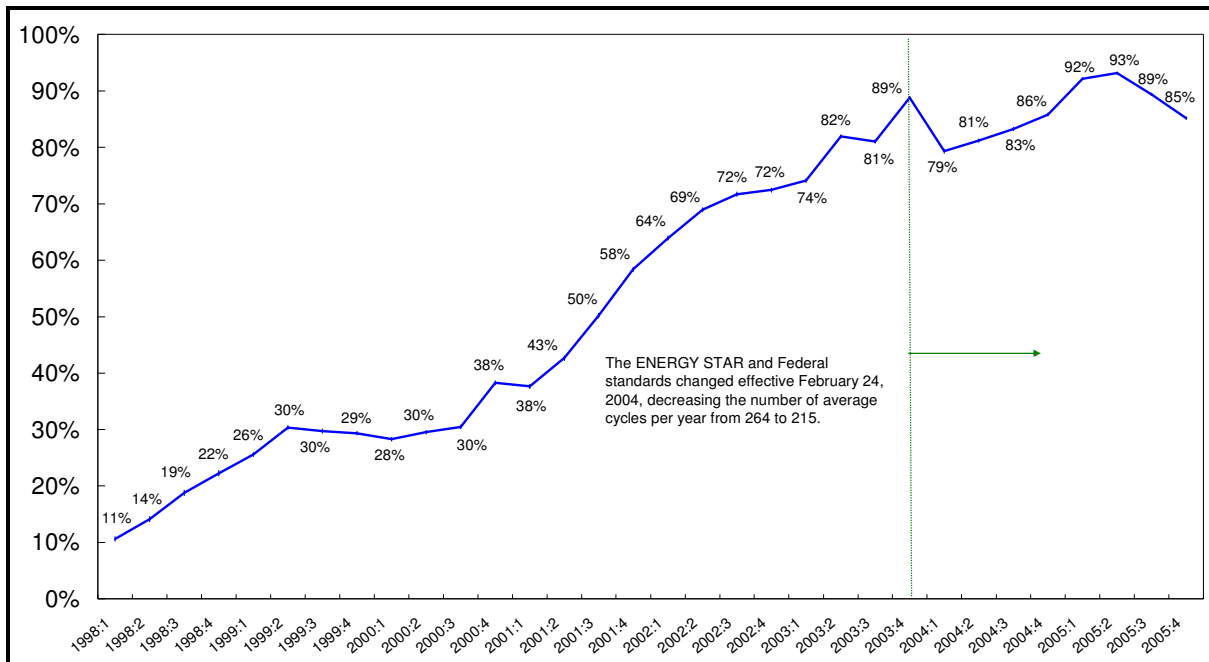
Figure 4-1 and Table 4-3 present the percentage of ENERGY STAR qualified dishwashers sold in California during the first quarter of 1998 through the fourth quarter of 2005.¹⁵ As shown, shares of ENERGY STAR dishwasher sales have increased significantly between 1998 and the fourth quarter of 2005. This increase was driven largely by the significant increase in models available that qualified for the ENERGY STAR label and the increasing shares of ENERGY STAR qualified dishwashers sold by independent appliance retailers in California. In 2005, shares of ENERGY STAR dishwasher sales peaked to 93% in the second quarter, but fell to 85% by the end of the fourth quarter of 2005.

¹⁴ Compact dishwashers are not currently eligible for an ENERGY STAR specification. However, with the new ENERGY STAR standard effective January 1, 2007, compact dishwashers with an EF greater than 0.88 qualify. Compact dishwashers are defined as those with a capacity less than eight place settings and six serving pieces.

¹⁵ In Figure 4-1, Table 4-3, and Table 4-4, data from 1998 reflect national chain D&R data only. Because of this and the adjustments made to better estimate 1998 results, standard errors are not listed.

It is interesting to note that while the EF calculation changed in mid-2002, the percentage of ENERGY STAR qualified units continued to increase throughout the year. One reason for this result is that dishwasher manufacturers adjusted their models available prior to the January 1, 2001 change to the ENERGY STAR specification.^{16, 17} These actions would most likely be attributable to the desire of manufacturers to prevent a drop in models available that met the specifications for the ENERGY STAR program, since ENERGY STAR usually forms the basis for incentive programs.

Figure 4-1: Dishwasher Sales, Percent of ENERGY STAR Qualified Units



Error bands for the 90% confidence interval.

¹⁶ This possibility is not reflected in the previous graphs in this section which used data from the CEC database, most likely because that database is not as comprehensive as the tracking data collected and developed for this study.

¹⁷ The adjustment required to improve dishwasher efficiency does not require radical modification of the unit in question. The CEC lists a few changes manufacturers can make in order to increase the efficiency of their dishwashers. <http://www.cee1.org/resid/seha/dishw/dishw-main.php3>

Table 4-3: Dishwasher Sales, Percent of ENERGY STAR Qualified Units (Statewide)

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

Standard errors in parentheses.

Table 4-4 reports the percentage of ENERGY STAR compliant dishwashers sold in each utility service area annually and by quarter. As shown in Table 4-4, the “Other” service territory exhibited the highest percentage of ENERGY STAR dishwasher sales in 2005 at 94%, followed closely by the PG&E service territory at 91%. The SCE and SDG&E service territories reported the lowest percentages, at 88% and 81%, respectively.

Table 4-4: Dishwasher Sales, Percent of ENERGY STAR Qualified Units by Utility Service Area

Utility	Year	Percent of 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
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

Table 4-5 (cont'd.): Dishwasher Sales, Percent of ENERGY STAR Qualified Units by Utility Service Area

Utility	Year	Percent of 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
	Other ^a	1998	12.9% (-) n = 14,554	8.2% (-) n = 3,448	11.8% (-) n = 3,303	14.8% (-) n = 3,589
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 = 8,821	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

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

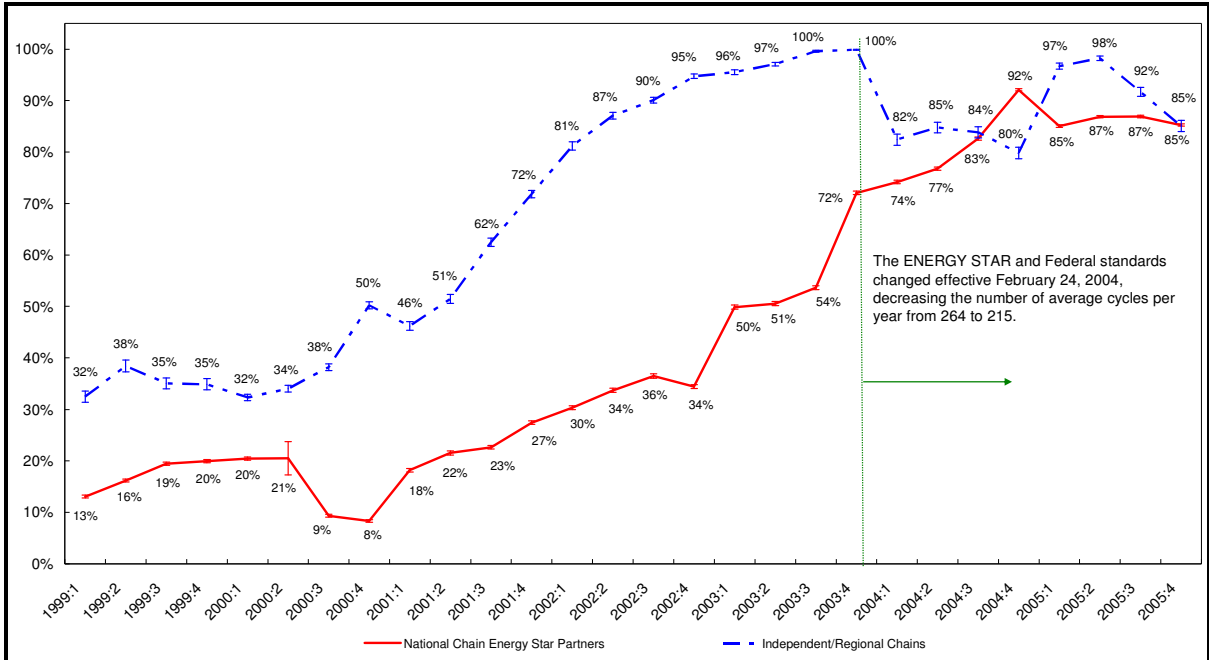
4.5. Analysis by Retailer Type

Market Share of ENERGY STAR Qualified Dishwashers

Figure 4-2 and Table 4-5 compare the shares of ENERGY STAR qualified dishwashers sold by national chains and independently owned stores and regional chains. As shown, except for the fourth quarter of 2004, the share sold by the national chains was consistently lower than the share sold by the independent appliance retailers. Recently however, national chains have seen a consistent increase in share, rising from 30% the first quarter of 2002 to 85% by the fourth quarter of 2005. Conversely, the ENERGY STAR share of independently owned stores has stayed relatively stable since 2002, fluctuating between 80% and 100%.

It is also worth noting the increase among independent appliance retailers from 32% at the beginning of 1999 to 99.9% in the last quarter of 2003. Almost all of the dishwashers sold by independent appliance retailers throughout California met the ENERGY STAR criteria in the third quarter of 2003. This growth most likely reflects a change in the mix of available models, with a larger proportion qualifying for ENERGY STAR, and not necessarily a change in consumer preferences. In particular, manufacturers have been producing a greater number of more efficient models to meet upcoming expected changes in the testing procedures (i.e., changing from 322 cycles to 264 cycles and subsequently to 215 cycles). For example, manufacturers planning to change model efficiency from 322 to 264 cycles to meet the new testing requirement would need to manufacture units that operate at an annual 125 kWh less than previously required by the federal standard. Similarly, manufacturers planning to change model efficiency from 322 to 215 cycles to meet the new testing requirement would need to manufacture units that operate at an annual 232 kWh less than previously required. As these more efficient models became available before they were actually required, their EF, calculated at the higher number of cycles, often met or exceeded the ENERGY STAR qualification. Thus, the proportion of available models that met ENERGY STAR qualifications grew significantly, nearly reaching 100% among independent retailers by the end of 2003. After the testing requirement changed to 215 cycles in 2004, the share fluctuated between 80% and 100% among independent retailers in 2004 and 2005.

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



Error bands for the 90% confidence interval.

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

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

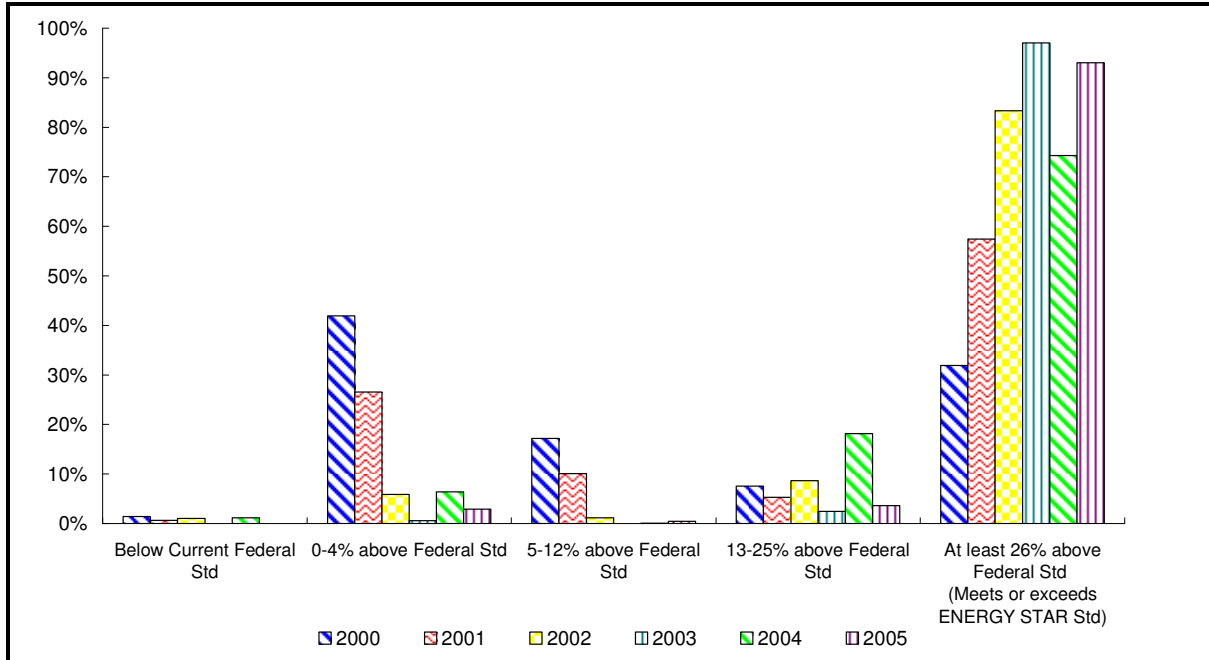
Standard errors in parentheses.

Energy Factor Analysis

Figure 4-3 illustrates the trend of steadily increasing ENERGY STAR market share within independent appliance retailers in California. For example, the sales in 2000 were split fairly evenly between ENERGY STAR (at least 13% above federal standard) and non ENERGY STAR. In 2001, when the ENERGY STAR specification changed, roughly 57% of units sold qualified for ENERGY STAR. In 2002, the number of cycles used to calculate the EF rating was reduced and the percentage of ENERGY STAR qualified units sold by independent retailers increased further. In 2003, the percentage of ENERGY STAR qualified units sold by independent retailers rose even higher, with nearly all units sold by independents meeting the ENERGY STAR specification. In 2004, the number of ENERGY STAR sales by independent retailers decreased slightly, but a high percentage of the units sold still met or exceeded the ENERGY STAR specification. In 2005, nearly all units sold by independents met or exceeded the ENERGY STAR specification.

The detailed data shared by independent retailers from 2000 through 2005 allowed the data to be analyzed in groupings of efficiency levels. Note that the ENERGY STAR threshold was 13% above the federal standard in 2000 and became 25% above the federal standard in 2001. In addition, when the DOE decreased the number of dishwasher cycles used in the calculation for EF for all units manufactured from July 1, 2002 onward, this change resulted in a lower EF rating of all dishwashers than previously calculated. This allowed the DOE to enforce higher efficiency levels without modifying the federal standard EF rating for dishwashers.

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



The number of cycles used for the dishwasher EF equation was decreased to 215 cycles in 2004.

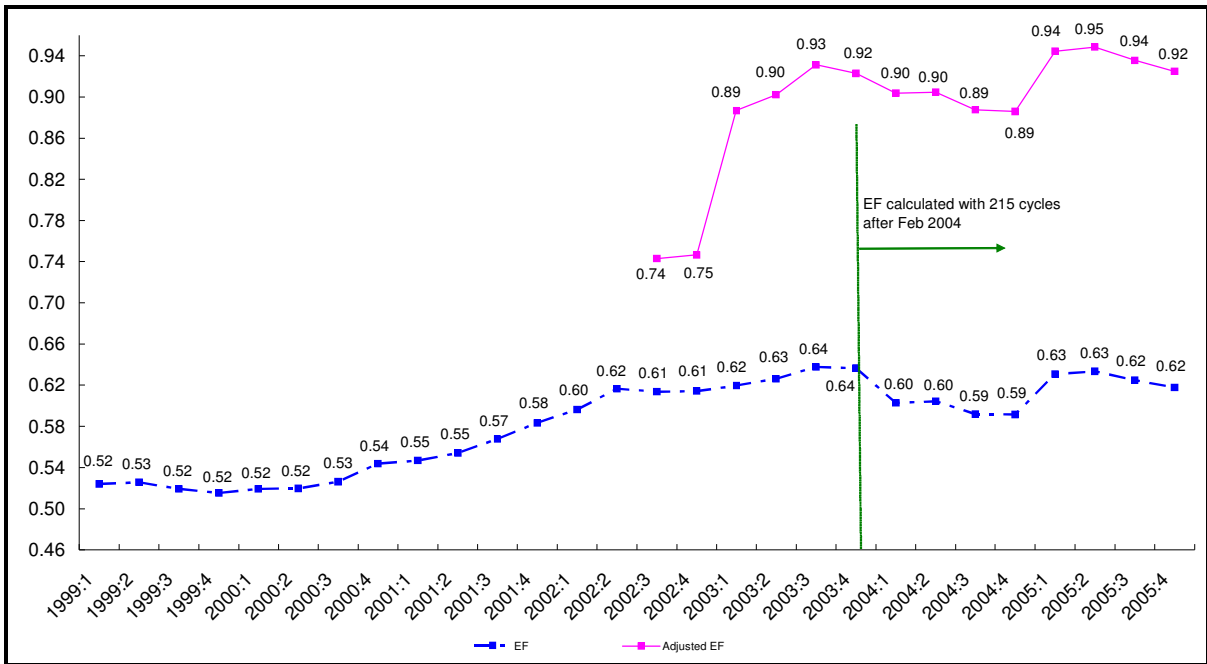
Figure 4-4 illustrates the average EF of dishwashers sold by independent appliance retailers throughout California from 1999 through 2005. As shown, after remaining relatively stable during 1999 and 2000, the average EF rose during the fourth quarter of 2000 and continued to rise through the fourth quarter of 2003, except for a slight drop in the third and fourth quarters of 2002. In 2005, the average EF rose slightly, reaching an average of 0.62 by the fourth quarter.

As explained previously, the steady and significant increase in the share of ENERGY STAR qualified dishwashers sold by independent appliance retailers in California is most likely due to dishwasher manufacturers modifying their products to adapt to upcoming changes in the number of cycles used to calculate EF. This may also explain the dramatic growth in average EF throughout 2001 and the first two quarters of 2002. The reduction in the number of cycles led manufacturers to create dishwashers with greater efficiency in order to continue to comply with the federal standard and/or to maintain ENERGY STAR qualification.

Note that the EF for all dishwashers sold after July 1, 2002, which were not directly matched to information from the ENERGY STAR program but where the project team calculated the EF, were calculated using the 264 cycles per year figure from the updated regulation by the DOE. For comparison, the second line in Figure 4-4, labeled “Adjusted EF,” represents the EF as calculated with 322 cycles per year.

As shown in Figure 4-4, the average EF of dishwashers sold would have risen sharply between the fourth quarter of 2002 and the first quarter of 2003 absent the change in the number of cycles used to compute dishwasher EF. However, with the cycle changes, the average EF of dishwashers sold by independents actually fell after the second half of 2002 before rebounding in mid-2003, but fell again after the fourth quarter of 2003. Regardless of the changes made to the number of cycles used to calculate EF, the majority of models offered to consumers by independent appliance retailers are now ENERGY STAR qualified, and the average EF of units sold in 2005 exceeded the ENERGY STAR qualification.

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



5

Refrigerators

5.1. Overview

This section discusses total refrigerator unit sales (subsection 5.2), efficiency standards (subsection 5.3), the market share of ENERGY STAR qualified units (subsection 5.4), and the analysis of ENERGY STAR sales by retailer type (subsection 5.5).

5.2. Total Unit Sales

Table 5-1 presents estimates of annual unit sales of refrigerators used in the development of market shares in this report. AHAM was the source of information for these estimates.

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

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).¹⁸

The EF for refrigerators is calculated as:

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

where the *Adjusted Volume* is the fresh volume of the unit plus 1.63 times the unit’s freezer volume.

Federal Energy Use Standard. Federal energy use standards for refrigerators changed on July 1, 2001.¹⁹ The required energy use reductions from the former standard to the 2001 standard varied by configuration, ranging between 27% and 32%. Six months prior to the standards change, AHAM’s Directory of Certified Refrigerators and Freezers contained 1,217 refrigerator/freezer models with automatic defrost, though only 25 of these already met the new standard. During the first half of 2001, manufacturers were preparing for the new energy use standards, which decreased refrigerators energy consumption an average of 25%.

ENERGY STAR Standard. Additionally, the ENERGY STAR standard, which took effect January 1, 2001, required refrigerators to consume 10% less energy than the July 1, 2001 federal standard. AHAM’s Directory of Certified Refrigerators and Freezers for July 2001 showed that 515 of the 1094 refrigerator/freezer models with automatic defrost complied with the new federal standard. The CEC’s appliance efficiency regulations were amended in January 2002 to reflect the increase in the federal energy use standards, though the CEC did not surpass the federal requirements for appliance efficiency standards.

In 2001, only full-size refrigerator-freezers were eligible for ENERGY STAR. Full-size automatic-defrost refrigerator-freezers were required to be 10% more efficient than the federal standard in order to qualify for ENERGY STAR.

¹⁸ Adjusted volume takes into account the differing temperatures between the refrigerator and freezer compartments with the following calculation: fresh volume plus (freezer volume times 1.63). The result is called the total adjusted volume and is used in the energy factor calculation.

¹⁹ 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.

However, on January 1, 2003, the ENERGY STAR criteria for refrigerators were expanded to include all sizes and configurations of refrigerators and freezers, qualifying previously ineligible products in the following categories:

- Manual defrost refrigerators,
- Partial automatic defrost refrigerators, and
- Single door refrigerators.²⁰

All refrigerators 7.75 ft³ or greater in volume were required to exceed the minimum federal standard by at least 10% to qualify for ENERGY STAR.

It should be noted, however, that expansion of the ENERGY STAR criteria on January 1, 2003 to include previously ineligible categories of refrigerators did not impact the analysis method. Since the current analysis addresses products that would have qualified for the ENERGY STAR label rather than products that actually bear the ENERGY STAR label or appear on ENERGY STAR lists, these products have been tracked on an ongoing basis and have been analyzed under the criterion used for standard full-size automatic-defrost refrigerator-freezers to qualify for ENERGY STAR (i.e., 10% above the federal standard).

Additionally, on January 1, 2004, the ENERGY STAR criteria for full-size refrigerators was modified to require all full-sized models to exceed the minimum federal standard by at least 15% to qualify for the ENERGY STAR label. The ENERGY STAR criteria for full-size freezers and compact refrigerators and freezers did not change at that time.

Upcoming Standard Increases

Currently, research is being conducted to determine when new federal standards should take effect for refrigerators and what those standards should be. A technology report that was released by the DOE in October of 2005 assumes that new standards will take effect in 2010, but please note that this was just an assumption made to calculate savings.

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

California IOU Incentive Programs. Currently, some California IOU's are rebating ENERGY STAR qualified refrigerators.

²⁰ On January 1, 2003, the ENERGY STAR criteria were also expanded to include freezers and compact refrigerators and freezers. However, these product categories are outside of the scope of work of the study; thus, these changes will not be addressed by this report.

Table 5-2: Refrigerator Energy Use Standards

	Federal Standard		ENERGY STAR Criteria			
	January 1, 1993	July 1, 2001	January 1, 1997	January 1, 2001	January 1, 2003	January 1, 2004
Refrigerators and refrigerator-freezers, manual defrost	13.5*AV+299.0	8.82*AV+248.4	N/A	N/A	10% less energy than the 2001 federal standard	15% less energy than the 2001 federal standard
Refrigerator-freezers, partial automatic defrost	10.4*AV+398.0	8.82*AV+248.4				
Refrigerator-freezers, automatic defrost, top mount without TTD	16.0*AV+355.0	9.80*AV+276.0	20% less energy than the 1993 federal standard	10% less energy than the 2001 federal standard		
Refrigerator-freezers, automatic defrost, side mount without TTD	11.8*AV+501.0	4.91*AV+507.5				
Refrigerator-freezers, automatic defrost, bottom mount without TTD	16.5*AV+367.0	4.60*AV+459.0				
Refrigerator-freezers, automatic defrost, top mount with TTD	17.6*AV+391.0	10.20*AV+356.0				
Refrigerator-freezers, automatic defrost, side mount with TTD	16.3*AV+527.0	10.10*AV+406.0	N/A	N/A	10% less energy than the 2001 federal standard	
Upright freezers, manual defrost	10.3*AV+264.0	7.55*AV+258.3				
Upright freezers, automatic defrost	14.9*AV+391.0	12.43*AV+326.1				
Chest freezers and all other freezers except compact freezers	11.0*AV+160.0	9.88*AV+143.7				
Compact refrigerators and refrigerator-freezers, manual defrost	13.5*AV+299.0	10.70*AV+299.0			20% less energy than the 2001 federal standard	20% less energy than the 2001 federal standard
Compact refrigerator-freezers, partial automatic defrost	10.4*AV+398.0	7.00*AV+398.0				
Compact refrigerator-freezers, automatic defrost with top-mounted freezer and compact all-refrigerators, automatic defrost	16.0*AV+355.0	12.70*AV+355.0				
Compact refrigerator-freezers, automatic defrost with side-mounted freezer	11.8*AV+501.0	7.60*AV+501.0				
Compact refrigerator-freezers, automatic defrost with bottom-mounted freezer	16.5*AV+367.0	13.10*AV+367.0				
Compact upright freezers, manual defrost	10.3*AV+264.0	9.78*AV+250.8				
Compact upright freezers, automatic defrost	14.9*AV+391.0	11.40*AV+391.0				
Compact chest freezers	11.0*AV+160.0	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 ft³ and 36 inches or less in height.

5.4. Market Share of ENERGY STAR Qualified Refrigerators

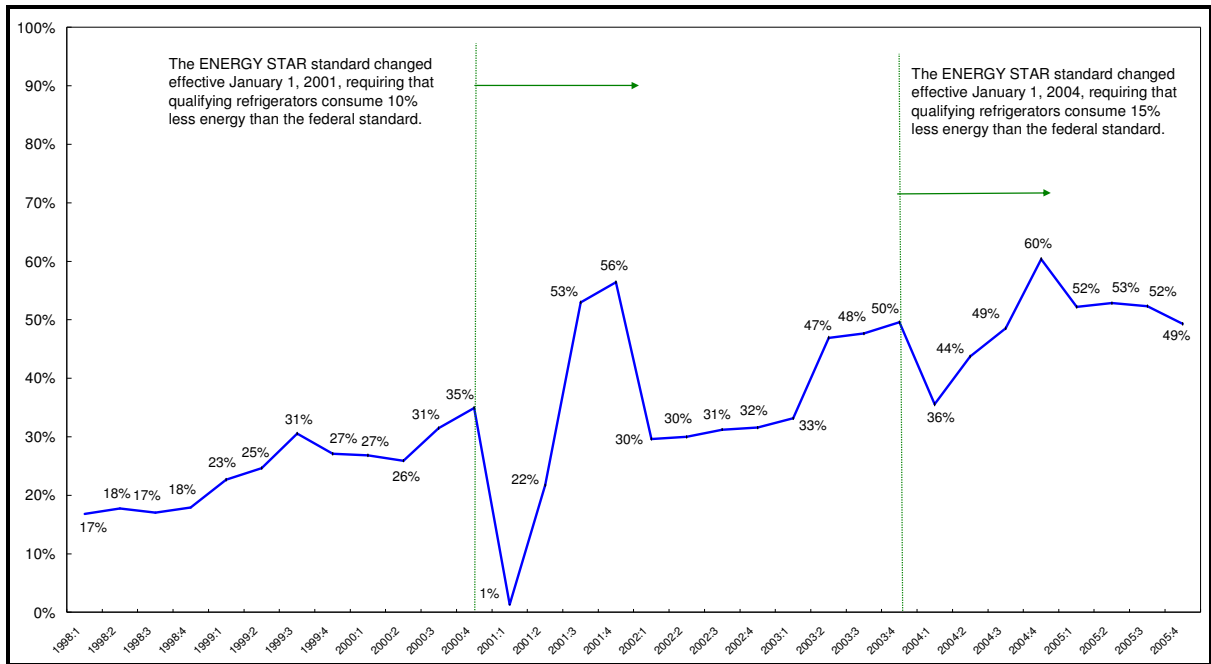
Figure 5-1 and Table 5-3 present the percentage of ENERGY STAR qualified refrigerators sold in California during the first quarter of 1998 through the fourth quarter of 2005.²¹ As shown, the percent of ENERGY STAR refrigerators remained relatively steady throughout 1999 and 2000. The abrupt decrease in market share to almost 0% during the first quarter of 2001 is due to the lack of refrigerators available for purchase that met the newly increased ENERGY STAR specification. The ENERGY STAR specification changed on January 1, 2001 and stated that qualified refrigerators had to use 10% less energy than allowed by the July 1, 2001 federal energy use standard. In turn, the growth in share between the first to the second quarter, and then again from the second to the third quarter of 2001, is attributable to manufacturers preparing for the federal standard change. As part of this preparation, ENERGY STAR qualified refrigerator units became available. As this occurred, these units began to regain market share.

In addition to the increasing availability of ENERGY STAR qualified refrigerators, that utility incentive programs might have affected market share shown in 2001. The peaks seen in the third and fourth quarter of 2001 seem to correlate with utility incentives that encouraged consumers to purchase ENERGY STAR qualified refrigerators. Recent research by the project team indicates that these incentives began July 1, 2001 and ended December 31, 2001. The subsequent decrease in ENERGY STAR share in 2002 would therefore be associated with the absence of utility incentives.

Throughout 2003, the share of ENERGY STAR qualified refrigerators increased, part of which could be attributable to efforts by manufacturers in 2003 to create more efficient models to meet upcoming changes in the ENERGY STAR standards for 2004. The sharp spike in ENERGY STAR share, however, that occurred between the first and second quarters of 2003 is predominantly explained by an increase in ENERGY STAR share among the national chain retailers. Since the project team does not maintain a direct relationship with the national chain retailers, the cause of the sharp spike in national chain retailer share is unknown. The drop in the ENERGY STAR qualified sales in the first quarter of 2004 is likely to be attributable to the increase in the ENERGY STAR qualifying threshold. As expected, shares rebounded rather quickly to 60% by the end of 2004. In 2005, the ENERGY STAR share of refrigerators decreased steadily to 49% by the fourth quarter.

²¹ In Figure 5-1, Table 5-3, and Table 5-4, data from 1998 represent national chain sales data only.

Figure 5-1: Refrigerator Sales, Percent of ENERGY STAR Qualified Units



Error bands for the 90% confidence interval.

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

Year	Percent of 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	0.0% (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

Standard errors in parentheses.

Table 5-4 presents the same information broken down by utility area. As shown, the PG&E service territory exhibited the highest proportion of ENERGY STAR qualified refrigerator sales in 2005, at 61%, followed closely by the “Other” service territory, at 53%. The SCE and SDG&E service territories reported the lowest proportion of ENERGY STAR qualified refrigerator sales, at 43% and 44%, respectively.

Table 5-4: Refrigerator Sales, Percent of ENERGY STAR Qualified Units by Utility Service Area

Utility	Year	Percent of 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	0.0% (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
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	0.0% (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

Table 5-4 (cont'd.): Refrigerator Sales, Percent of ENERGY STAR Qualified Units by Utility Service Area

Utility	Year	Percent of 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	0.0% (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
Other ^a	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	0.0% (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

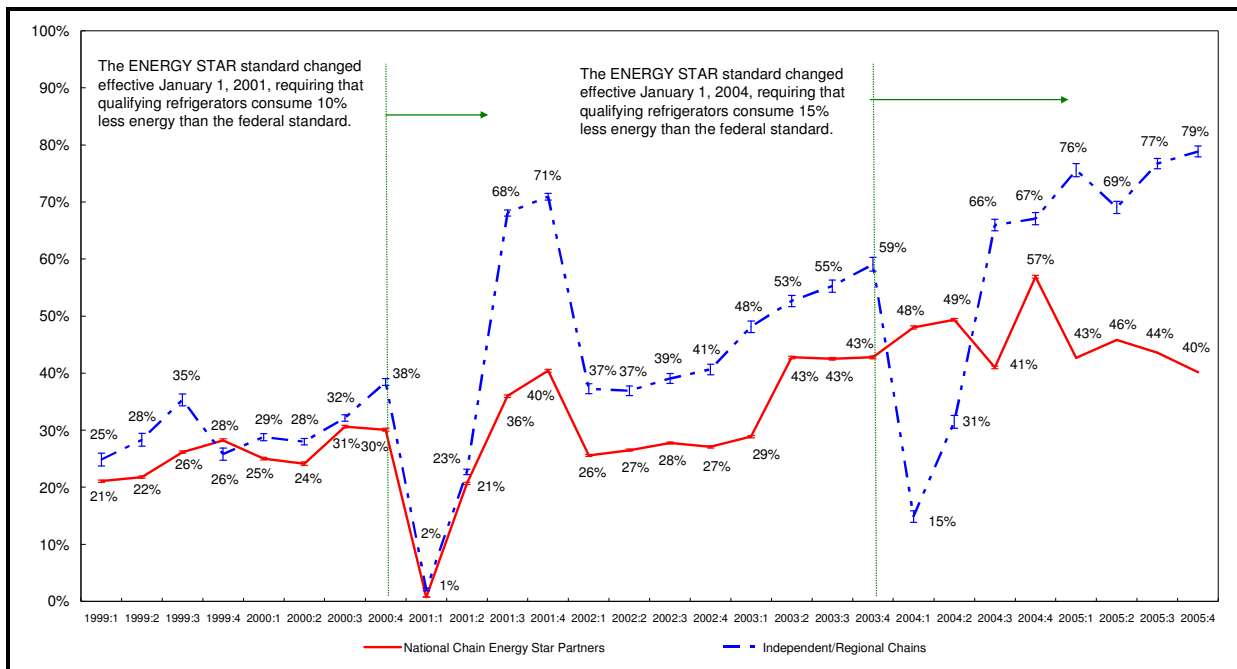
a. The "Other" category encompasses areas served by municipal utilities such as LADWP, LMUD, PP&L, SMUD, and others.

5.5. Analysis by Retailer Type

Market Share of ENERGY STAR Qualified Refrigerators

Figure 5-2 and Table 5-5 compare the market shares of ENERGY STAR qualified refrigerators sold by national chain ENERGY STAR partners to market shares of ENERGY STAR qualified refrigerators sold by independently owned stores and regional chains. With the exception of the fourth quarter of 1999 and the first half of 2004,²² the share sold by the national chains is lower than the share sold by the independent appliance retailers in California. The decrease in market shares in 2001 through both retailer types was explained previously in the discussion of Figure 5-1. As shown in Figure 5-2, there is a significant difference in shares sold through independents and national chains in 2005. By the end of 2005, the share sold through independents rebounded to 79%, while the share sold through national chains fell to 40%.

Figure 5-2: Refrigerator Sales, Percent of ENERGY STAR Qualified Units by Retailer Type



Error bands for the 90% confidence interval.

²² A much smaller sample size was used for independent chains in 1999, as compared to sample sizes in 2000 and 2001, and this should be kept in mind when considering the results.

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

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	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
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

Standard errors in parentheses.

Energy Factor Analysis

This subsection presents the distribution of refrigerator sales in the independent or regional retail segments by efficiency groupings and average EF. These results are possible due to line-item detail provided by the participating independent appliance retailers throughout California. The energy factor 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 presents the percentage of refrigerator sales by independent appliance retailers by efficiency level. Results for 2001 are presented semi-annually, where “2001:1” refers to the first six months of the year, and “2001:2” refers to the latter six months of the year. As shown, during the first half of 2001, most refrigerators sold by independent retailers did not meet ENERGY STAR criteria. During the second half of the year, however, a larger proportion of units sold met or exceeded ENERGY STAR criteria. This result is likely due to ENERGY STAR basing their specification on new standards, which were not yet in effect during the first half of the year. In 2005, nearly all refrigerator sales met the federal standard, with the vast majority of sales being at least 10% above the federal standard. However, due to the change in the ENERGY STAR standard in 2004, less than 5% of the refrigerators sold by independent retailers in 2004 and 2005 reached 20% above the federal standard.

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

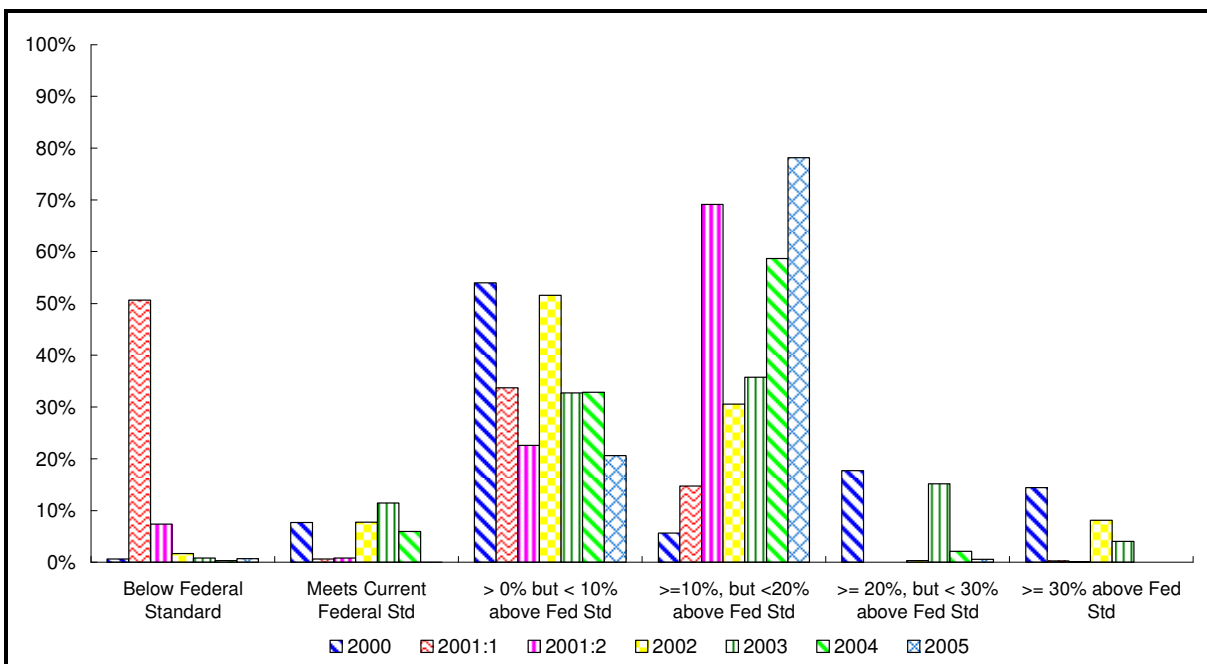
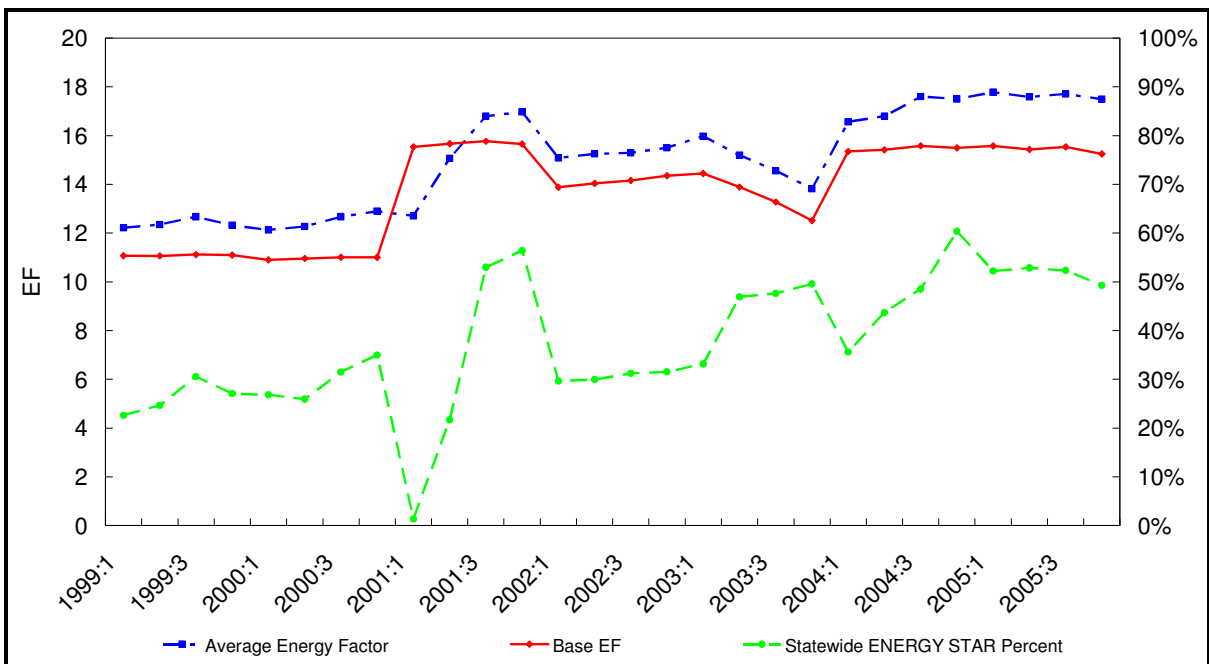


Figure 5-4 illustrates the average EF of refrigerators sold through independent appliance retailers in California from 2000 through 2005. This figure presents the trend of the average EF and a “Base EF” that represents the standard against which ENERGY STAR is measured.²³ The “Base EF” is different from the actual federal standard because, during the first two quarters of 2001, the ENERGY STAR efficiency threshold was based on the new federal standard, which did not actually take effect until July 1, 2001. As shown in Figure 5-4, both the average EF and the Base EF exhibited a marked increase from the fourth quarter of 2003 to the first quarter of 2005, and remained steady through the end of 2005.

Figure 5-4 also demonstrates the relationship between the market share for ENERGY STAR qualified refrigerators and the average EF rating. It is of interest due to the clear visual representation of the increase in ENERGY STAR specifications for refrigerators, which led to the lack of ENERGY STAR qualified units sold in the first quarter, since most units were unable to meet the July 1, 2001 federal standard at that time. However, despite the drop in ENERGY STAR share, the average efficiency rating has increased, as one would expect.

Figure 5-4: Comparison and Correlation of Independent Retailer Energy Factor Averages and ENERGY STAR Percentage Share for Refrigerators



²³ Base EF is the average EF for refrigerator models sold by independent retailers, calculated with the appropriate federal standard for that time against which the ENERGY STAR standard was measured. In 1999, 2000, the second half of 2001, 2002, and 2003, it is based on the actual federal standard. In the first half of 2001, however, the base EF is calculated from the new federal standard, which did not take effect until July 1, 2001.

6

Room Air Conditioners

6.1. Overview

This section discusses total room air conditioner unit sales, efficiency standards, market share of ENERGY STAR qualified units, and analysis of ENERGY STAR sales by retailer type.

6.2. Total Unit Sales

Itron used manufacturer shipment data from AHAM to estimate room air conditioner unit sales. Table 6-1 presents the estimates of annual unit sales of room air conditioners used in the development of market shares in this report. The number of units shipped into California has increased dramatically since the late 1990s. Sales of room air conditioner units increased in 2001, but decreased substantially in 2002. Room air conditioner shipments into California skyrocketed in 2003 and rose again in 2004. The increase in 2003 may have been weather-related as unusually high temperatures for that year were experienced throughout the state. In 2004 however, no such abnormal weather patterns were observed.²⁴ In 2005, shipments diminished, but were nearly double what they were five years ago.

It should be noted that most room air conditioning units are typically sold during the second and third quarter of the year; due to the seasonal nature of this appliance, quarterly analysis fluctuates greatly. Thus, the results in this report are presented on an annual basis.

²⁴ Hourly temperature data for several weather stations in California were examined. In 2003, the number of CDDs at non-coastal weather stations was 300 to 400 above average for the 2000-2006 period. On the other hand, the number of CDDs in 2004 was close to the average.

Table 6-1: Estimate of Total 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

Source: AHAM

6.3. Room Air Conditioner Energy Efficiency Standards

The energy efficiency of room air conditioners is expressed as an Energy Efficiency Rating (EER), which varies by cooling capacity (Btuh) and configuration.

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. In order 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. Units with reverse cycle were still excluded from ENERGY STAR qualification. However, since room air conditioner sales are seasonal, the impact of these changes upon 2003 results is likely to have been relatively minor since the new standard was effective only during the fourth quarter, which typically has very low room air conditioner sales.

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

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

California IOU Incentive Programs. Currently, some California IOU’s are rebating ENERGY STAR qualified room air conditioners.

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

Btuh	Configuration	Federal Standard		ENERGY STAR ^{a, b}	California Standards ^c
		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	*	8.5
≥ 14,000	With reverse cycle and without louvered sides	8.0	8.0	*	8.0
< 20,000	With reverse cycle and with louvered sides	8.5	9.0	*	9.0
≥ 20,000	With reverse cycle and with louvered sides	8.5	8.5	*	8.5
	Casement only	*	8.7	9.6	8.7
	Casement slider	*	9.5	10.5	9.5

a. ENERGY STAR standards apply to Btu rating categories only.

b. Prior to October 1, 2003, room air conditioners were required to exceed federal standards by at least 15% to qualify for the ENERGY STAR label.

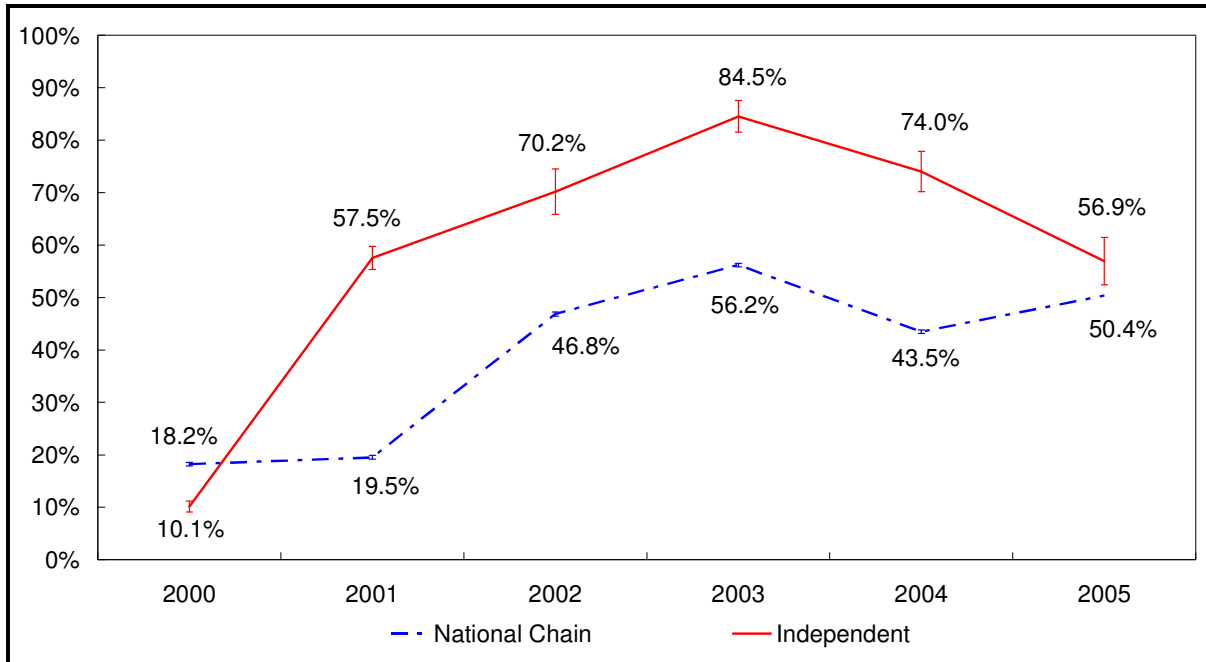
c. Standards for previous years discussed in further detail in previous reports.

6.4. Analysis by Retailer Type

Figure 6-1 and Table 6-3 present market shares of ENERGY STAR room air conditioners for independent retailers and national chains. As shown, a greater percentage of sales through independent retailers are ENERGY STAR units compared to sales of national chains.

However, the gap between the independently owned ENERGY STAR shares and the national chain ENERGY STAR shares narrowed in 2005. In 2005, 57% of independent retailer sales of room air conditioners were ENERGY STAR units, while roughly 50% of units sold through national chains qualified as ENERGY STAR.

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% (0.02334) n = 353
2005	50.4% (0.0014) n = 128,755	56.9% (0.0275) n = 325

Standard errors in parentheses.

Table 6-4 presents market shares of ENERGY STAR room air conditioners sold in the national chain appliance store segment by utility. As shown, the market shares are fairly close across utilities.

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

Year	PG&E	SCE	SDG&E	Other ^a
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

a. "Other" includes areas served by municipal utilities such as LADWP, SMUD, and others.

Appendix A

Appliance Sales Data Analysis

Itron analyzed 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 2005 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. Part of this conversion included the addition of a variable that indicated whether each line item 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, or directly from manufacturer websites. Additionally, telephone calls were made to obtain information for older models or for manufacturers without websites when necessary. For refrigerators and room air conditioners, Itron utilized AHAM's Directory of Certified Refrigerators and

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

Freezers to supplement the efficiency data.² In addition to the efficiency or energy factor data, a variable that indicates the percent above efficiency standard for each model for the independent data was created in order to identify the various efficiency levels of units sold compared to the federal standard.

A.2 Appliance Sales Analysis

The analysis of appliance sales data involved estimation of the share of units sold that met or exceeded the ENERGY STAR qualification threshold. In particular, Itron estimated the percentage of ENERGY STAR compliant units of each appliance sold in California and for the investor-owned utility service areas on an annual and quarterly basis from the first quarter of 1998 through the fourth quarter of 2005.

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 in each utility service area for each year, based on total appliance shipments to California as published by AHAM.

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

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 by national chains by expanding the sales provided in the D&R database to

² California Energy Commission. Appliance Efficiency Database. www.energy.ca.gov/efficiency/appliances. Association of Home Appliance Manufacturers. *AHAM Directory of Certified Refrigerators and Freezers. January and June Editions.* 1997 through 2000.

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

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

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:

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

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

³ D&R International provided revenue data to Itron for creation of revenue multipliers in 1999. Itron conducted research to obtain revenue data for 2004 and 2005.

⁴ Due to data availability, the 1999 proxy was used for 2000-2003. However, new data was available, and used, to calculate new weights for 2004 and 2005.

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.

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.