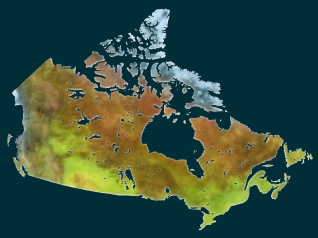
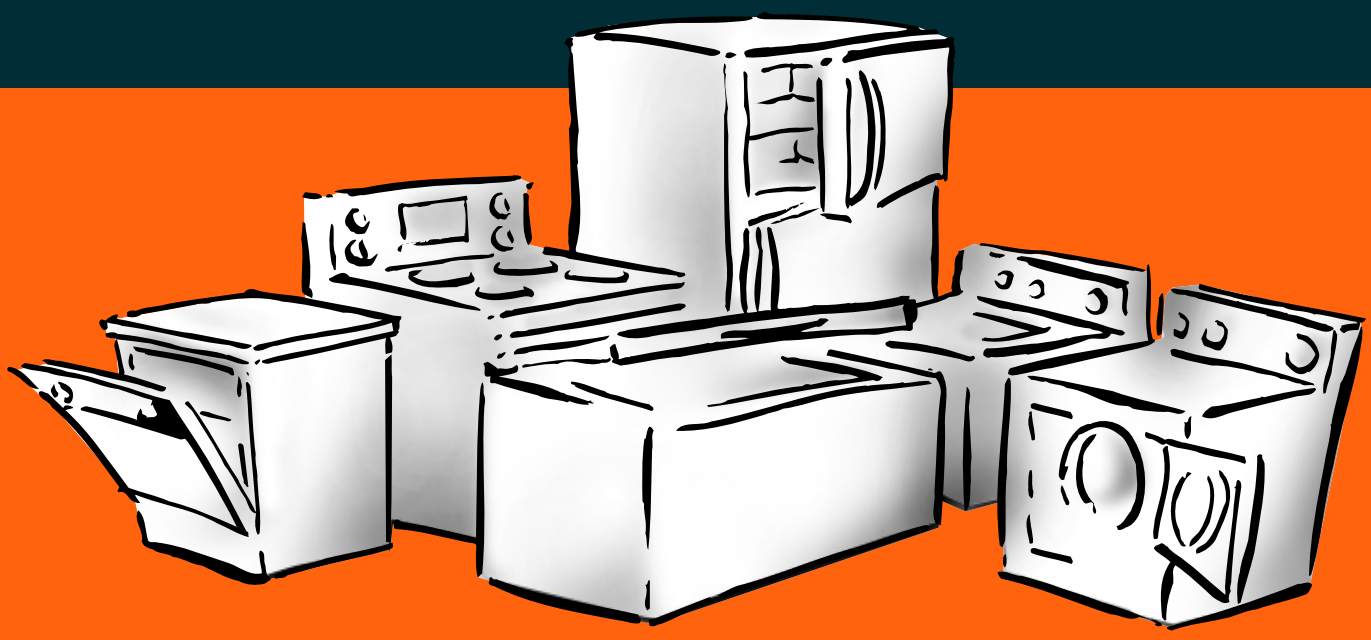


Energy Consumption of Major Household Appliances Shipped in Canada

Trends for 1990–2001

December 2003



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This digital mosaic of Canada, produced by Natural Resources Canada (Canada Centre for Remote Sensing), is a composite of individual satellite images. The colours reflect differences in the density of vegetation cover: bright green for dense vegetation in the humid southern regions; yellow for semi-arid and mountainous regions; brown for the far north where vegetation cover is very sparse; and white for the Arctic regions.

Leading Canadians to Energy Efficiency at Home, at Work and on the Road

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Foreword

In an ongoing effort to improve the monitoring of trends in Canadian energy use, Natural Resources Canada's Office of Energy Efficiency (OEE) proposed an annual data collection arrangement with members of the Canadian Appliance Manufacturers Association (CAMA) in 1996, as part of the National Energy Use Database (NEUD) initiative. Improving energy efficiency reduces greenhouse gas (GHG) emissions that contribute to climate change.

Under the arrangement, key CAMA members agreed to provide their annual Canadian appliance shipment data, by model, for the six major household appliance categories – refrigerators, freezers, electric ranges, dishwashers, clothes washers and electric clothes dryers. These manufacturers represent a large part of the Canadian market for the six appliance groups.

Each model's shipments, provided by CAMA, were matched to their associated unit energy consumption ratings found in the *EnerGuide Appliance Directory* database. The annual shipment-weighted unit energy consumption was then calculated for each appliance category. This report details the results of the analysis on the estimated shipment-weighted average unit energy consumption, in kilowatt hours (kWh) per year, of the six major household appliance categories shipped in Canada between 1990 and 2001. It also provides data on the annual distribution of shipments by unit energy consumption range for the six types of appliances during the same period. The report has found that the energy efficiency of all major household appliances improved steadily since 1990.

This is the third in the series of such reports[1] published every two years by the OEE. Readers may observe slight differences between this report and the previous reports. The differences are due to updates and an increase in the number of data contributors. For the first report, there were only four data contributors; for the second report, there were six. For this report, there are eight data contributors. The OEE plans to publish updated reports at regular intervals. To further improve the quality and representation of new appliance energy efficiency data in Canada, the OEE is exploring options to improve the coverage of the Canadian market through ongoing discussions with CAMA and other appliance manufacturers.

The ongoing co-operation between industry and government demonstrated how industry's technological improvements and the government's new regulations worked effectively to bring consumers more energy-efficient products. The OEE would like to thank the participating manufacturers and CAMA for their co-operation in this project.

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[1] The first report was based on 1990–1997 data; the second report, 1990–1999 data.

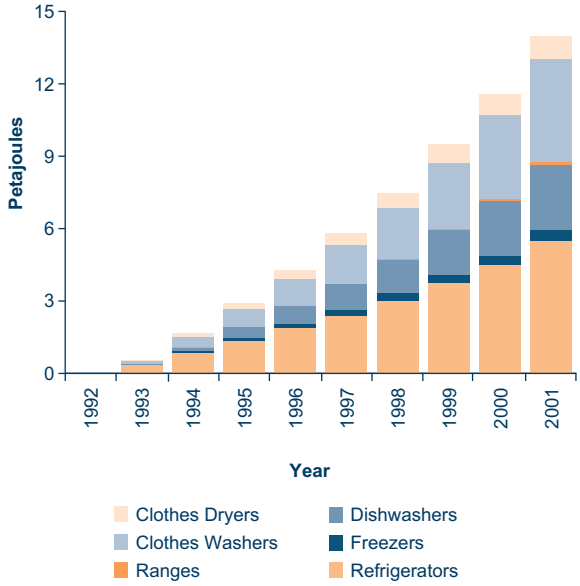
Highlights

The energy efficiency of almost all major household appliances[2] on the market improved dramatically between 1990 and 2001. Electric ranges were the only exception. Largely responsible for the improvement were the significant research and development carried out by appliance manufacturers and two initiatives authorized under the 1992 *Energy Efficiency Act*: the minimum energy performance standards (MEPS) contained in the *Energy Efficiency Regulations* and EnerGuide.

Figure A.1 depicts the cumulative energy savings by all major household appliances resulting from general efficiency improvements and the MEPS from 1992 to 2001. The cumulative energy savings are measured in petajoules. One petajoule (PJ) (1 PJ = 1 x 10^{15} joules) is equivalent to approximately the amount of energy consumed by about 9000 households in one year – assuming each household uses 112 gigajoules (GJ) (1 GJ = 1 x 10^{9} joules) annually.[3] A joule is the international unit of measure of energy – the energy produced by the power of one watt flowing for a second. There are 3.6 million joules in one kilowatt hour (kWh).

- Among major appliances, refrigerators produced the largest cumulative energy savings, 5.48 PJ from 1992 to 2001.
- Electric ranges produced the least cumulative energy savings, 0.14 PJ over the period.
- The cumulative energy savings for all major household appliances during the period was 14.02 PJ.

FIGURE A.1
CUMULATIVE ENERGY SAVINGS BY ALL MAJOR HOUSEHOLD APPLIANCES, 1992–2001



[2] Major household appliances include refrigerators, freezers, dishwashers, electric ranges, clothes washers and electric clothes dryers.
[3] *Energy Use Data Handbook, 1990 and 1995 to 2001* (Ottawa: Natural Resources Canada, 2003), pp. 22–23.

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Introduction

This report outlines changes in the energy use and distribution of major household appliances from 1990 to 2001. It is based on the shipments of the six major household appliance categories in Canada: refrigerators, freezers, dishwashers, electric ranges, clothes washers and electric clothes dryers. The data are collected through the co-operation of the Canadian Appliance Manufacturers Association (CAMA).

This trend analysis is associated with the implementation of the *Energy Efficiency Regulations* authorized under the 1992 *Energy Efficiency Act*. The Regulations ensure that new appliances imported into Canada, or manufactured in Canada and shipped from one province or territory to another, comply with federal minimum energy performance standards (MEPS). For more information on the *Energy Efficiency Regulations*, consult the *Guide to Canada's Energy Efficiency Regulations* (ISBN 0-662-26948-9, Catalogue No. M92-98/1998E) or visit our Web site at oee.nrcan.gc.ca/regulations/home_page.cfm.

Readers should also note that the quantity and profile of new appliances closely reflect Canadian purchases. Most retailers rely on a distribution strategy that responds quickly to consumer demand ("just in time" inventory). In fact, retailers keep inventory as low as possible. For this reason, we believe that the shipment data in this report closely reflect the purchasing behaviour of consumers.

EACH CHAPTER IN THIS REPORT COVERS A SPECIFIC TYPE OF APPLIANCE:

- refrigerators (Chapter 1)
- freezers (Chapter 2)
- dishwashers (Chapter 3)
- electric ranges (Chapter 4)
- clothes washers (Chapter 5)
- electric clothes dryers (Chapter 6)

Finally, Chapter 7 discusses the overall energy savings achieved from improvements in these appliances.

The chapter dealing with refrigerators is more detailed. Because of the diversity of types and sizes, it seemed inappropriate to group all refrigerators together to calculate the average energy consumption. As a result, there is no analysis of overall average energy consumption for refrigerators by model year.

Note that even though the MEPS did not come into effect until 1995, the baseline year used for all estimates of energy savings was 1992. This is because market forces such as the regulations in the U.S. and the impending regulations expected from the *Energy Efficiency Act* of 1992 showed that impact on energy efficiency improvements began almost immediately after the Act came into force.

Specific definitions of the various types of appliances are given in Appendix B.

1 Refrigerators

1.1 2001 MARKET SNAPSHOT

In 2001, as in all previous years since 1990, Type 3 refrigerators were by far the most popular type in Canada, accounting for 71 percent of all refrigerators shipped on the Canadian market (see Table 1.1). Type 3 includes refrigerator-freezers with automatic defrost, with top-mounted freezer and without through-the-door ice service, as well as all refrigerators without freezers but with automatic defrost. The shipment-weighted average annual unit energy consumption of all refrigerators shipped in 2001 was 559 kWh. The most popular size category, 16.5–18.4 cu. ft., accounted for 36 percent of the market.

The various types of refrigerators are defined in Appendix B.

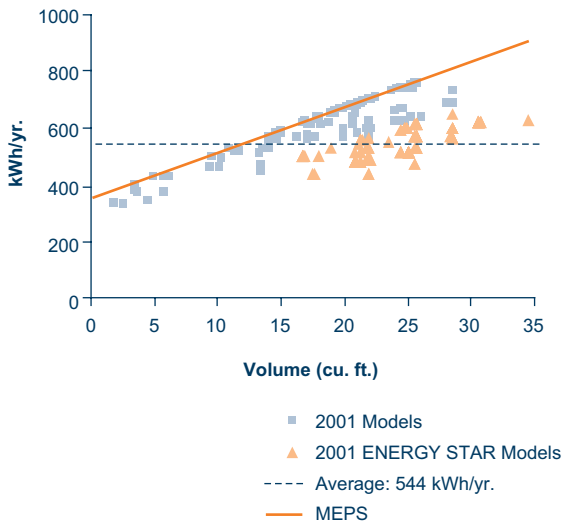
TABLE 1.1
REFRIGERATOR MARKET, 2001

	Market Share %
Type of Refrigerator*	
1	3.3
2	0.0
3	71.0
4	2.1
5	11.3
6	0.4
7	9.1
11	2.8
Through-the-Door Ice Service	9.5
Type of Freezer	
Top-mounted	71.4
Side-mounted	11.2
Bottom-mounted	11.3

**For definitions of types of refrigerators, see Appendix B.*

Figure 1.1 depicts the energy consumption of Type 3 models shipped in 2001 and shows where they stood in relation to the minimum energy performance standards (MEPS) implemented in 1995. The figure shows that all refrigerators met the MEPS and that many exceeded it. Of the Type 3 models available in 2001, 16 percent were ENERGY STAR® qualified products – that is, they were at least 10 percent more efficient than those meeting the MEPS. In 2001, the shipment-weighted average annual unit energy consumption of Type 3 refrigerators was 544 kWh per year.

FIGURE 1.1
ENERGY CONSUMPTION OF TYPE 3 REFRIGERATOR MODELS AVAILABLE IN 2001



1.2 DISTRIBUTION OF SHIPMENTS

1.2.1 DISTRIBUTION BY TYPE

TABLE 1.2
DISTRIBUTION OF REFRIGERATORS BY TYPE

Model Year	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 11
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1990	3.6	2.0	86.2	7.6	0.6	0.0	0.0	0.0
1991	3.4	0.3	86.3	9.0	0.8	0.0	0.3	0.0
1992	2.2	0.4	86.1	7.5	0.3	0.0	3.5	0.0
1993	1.2	0.6	86.4	6.8	0.7	0.0	4.2	0.0
1994	1.9	0.7	86.1	4.9	2.0	0.1	4.3	0.0
1995	2.1	0.6	85.8	4.6	1.6	0.1	5.2	0.0
1996	0.9	0.5	85.2	4.4	2.2	0.1	6.6	0.0
1997	0.8	0.1	83.8	3.8	3.2	0.0	8.3	0.0
1998	4.0	0.0	76.5	3.3	8.6	0.3	7.3	0.0
1999	4.7	0.0	76.6	2.4	8.4	0.4	7.5	0.0
2000	5.3	0.0	72.6	2.1	11.6	0.5	7.9	0.0
2001	3.3	0.0	71.0	2.1	11.3	0.4	9.1	2.8
Average Annual Change	0.0%	0.2%	1.4%	0.5%	1.0%	0.0%	0.8%	0.3%

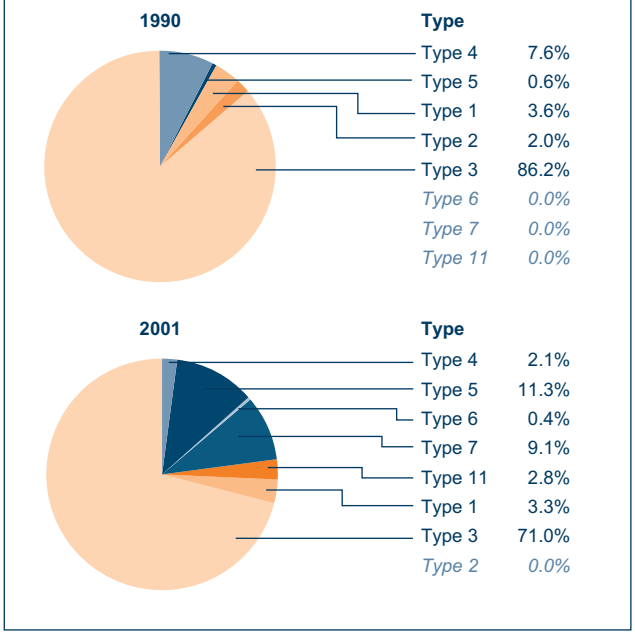
Although Type 3 refrigerators were consistently the most shipped model between 1990 and 2001, their market share declined from 86.2 to 71.0 percent of all refrigerators shipped (see Figure 1.2). Readers may notice significant differences between the distribution of the refrigerators in Table 1.2 and that shown in previous reports.[4] These are largely because an increase in data contributors significantly improved the coverage of the market.

Shipments of refrigerators with through-the-door ice service (Types 6 and 7) and refrigerators with bottom-mounted freezers (Type 5) continued to rise in popularity. They did not have a significant market share in 1990; but, with a large increase in popularity, Type 7 refrigerators accounted for 9.1 percent and Type 5 accounted for 11.3 percent of the market by 2001.

The market shares of Type 1 also increased significantly between 1990 and 2001. However, it is not clear whether this increase is actual, or if it simply reflects the addition of new data contributors, some of whom did not provide full years of data.

Types 2 and 4, though, had almost disappeared from the market by 2001.

FIGURE 1.2
DISTRIBUTION OF REFRIGERATORS BY TYPE FOR 1990 AND 2001



[4] *Energy Consumption of Major Household Appliances Shipped in Canada – Trends for 1990–1999* (Ottawa: Natural Resources Canada, 2001), Table 1.2, p. 3.

1.2.2 DISTRIBUTION BY VOLUME

TABLE 1.3
DISTRIBUTION OF REFRIGERATORS BY VOLUME

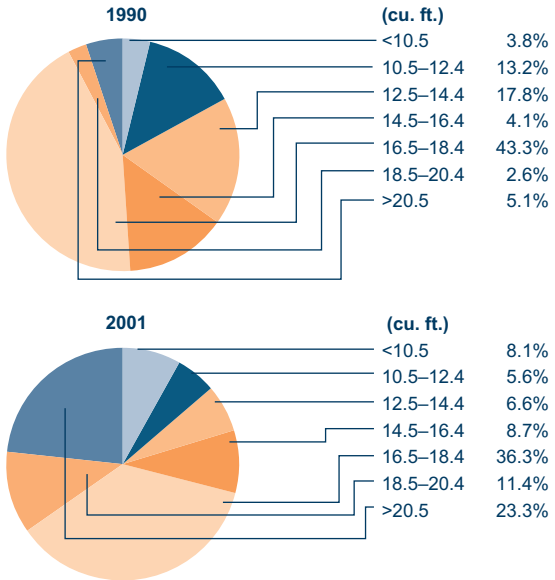
Model Year	Volume (cu. ft.) <10.5	10.5–12.4	12.5–14.4	14.5–16.4	16.5–18.4	18.5–20.4	>20.5
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1990	3.8	13.2	17.8	14.1	43.3	2.6	5.1
1991	2.6	14.2	11.0	14.2	47.9	5.4	4.7
1992	1.6	10.9	10.0	19.6	42.0	8.3	7.6
1993	2.2	8.0	7.1	16.6	45.3	12.2	8.7
1994	3.4	9.5	6.9	16.5	45.8	8.7	9.3
1995	3.7	14.1	6.7	15.0	39.5	10.8	10.2
1996	1.9	13.5	6.7	13.4	38.6	12.5	13.4
1997	0.9	11.1	6.9	12.2	39.2	12.7	16.9
1998	4.0	9.3	7.1	10.6	42.7	11.1	15.2
1999	5.3	7.6	6.9	9.9	43.5	10.0	16.8
2000	6.5	6.5	7.6	9.0	41.0	9.2	20.1
2001	8.1	5.6	6.6	8.7	36.3	11.4	23.3
Average Annual Change	0.4%	0.7%	1.0%	0.5%	0.6%	0.8%	1.7%

Refrigerators with a volume between 16.5 and 18.4 cu. ft. remain the most popular, on average accounting for 42 percent of the market from 1990 to 2001. However, a trend toward larger refrigerators has emerged. The market share of refrigerators smaller than 18.5 cu. ft. has decreased, while that of refrigerators larger than 18.4 cu. ft. has increased.

From 1990 to 2001, the largest refrigerators (those with a volume of at least 20.5 cu. ft.) more than quadrupled market share – rising from 5.1 to 23.3 percent. The market share of refrigerators with volumes ranging from 18.5 to 20.4 cu. ft. also increased significantly – from 2.6 percent in 1990 to 11.4 percent in 2001.

The market share of refrigerators smaller than 10.5 cu. ft. also rose over this period. It is not clear whether the increase is actual or if it simply reflects the addition of new data contributors, some of whom did not provide full years of data.

FIGURE 1.3
DISTRIBUTION OF REFRIGERATORS BY VOLUME FOR 1990 AND 2001



1.2.3 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT

TABLE 1.4
DISTRIBUTION OF REFRIGERATORS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT

Model Year	kWh/cu. ft./yr. <30	30–39	40–49	50–59	60–69	70–79	80–89	>90
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1990	0.0	1.5	3.9	15.3	60.2	15.4	3.0	0.7
1991	0.0	2.9	10.7	26.9	41.3	12.2	3.6	2.4
1992	0.0	4.8	26.9	33.2	16.0	10.4	4.0	4.8
1993	0.1	51.0	29.7	9.1	1.4	4.2	1.9	2.6
1994	0.4	70.9	22.4	4.0	0.0	0.0	1.7	0.6
1995	2.8	63.3	29.3	1.6	0.0	0.1	2.5	0.5
1996	6.6	60.0	31.2	0.9	0.1	0.0	0.7	0.4
1997	6.9	60.4	31.4	0.9	0.1	0.0	0.2	0.1
1998	5.9	62.4	27.1	0.8	0.0	0.6	2.9	0.2
1999	8.4	61.2	25.0	0.6	0.2	0.7	3.4	0.6
2000	12.2	57.6	23.5	0.9	0.4	0.7	3.6	1.2
2001	44.5	34.6	12.6	1.3	0.8	4.0	0.7	1.5
Average Annual Change	▲ 4.0%	▲ 3.0%	▲ 0.8%	▼ 1.3%	▼ 5.4%	▼ 1.0%	▼ 0.2%	▲ 0.1%

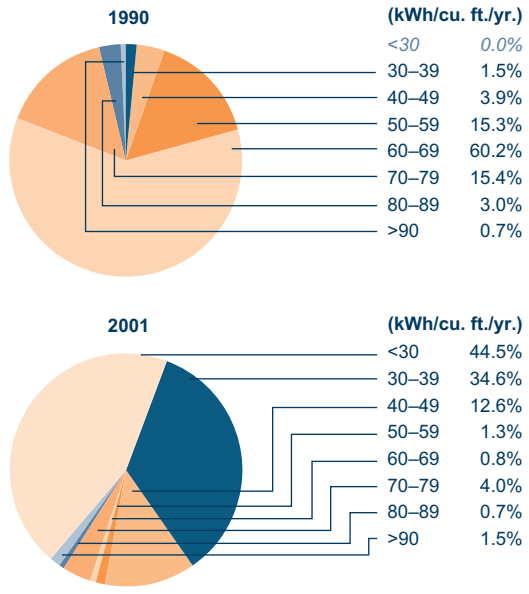
Refrigerators are becoming more efficient, thanks largely to the ongoing efforts of manufacturers and the MEPS. From 1990 to 2001, the market share of refrigerators requiring less than 50 kWh per cu. ft. per year increased from 5.4 to 91.7 percent.

The greatest increase in market share was for refrigerators that used less than 30 kWh per cu. ft. per year. There were very few refrigerators in this range of energy consumption in 1990, but they became the dominant model in 2001, accounting for 44.5 percent of the market.

In 1990, refrigerators requiring at least 50 kWh per cu. ft. per year dominated the market, accounting for 94.6 percent of units shipped on the market. Since 1993, in a dramatic shift, the majority of the refrigerators have required less than 50 kWh per cu. ft. per year.

There was a slight increase in the proportion of refrigerators requiring more than 90 kWh per cu. ft. per year. This may be because consumers are purchasing bigger refrigerators, as noted previously. It may also be because some of the additional data contributors typically manufacture bigger refrigerators.

FIGURE 1.4
DISTRIBUTION OF REFRIGERATORS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT FOR 1990 AND 2001



1.3 ENERGY CONSUMPTION

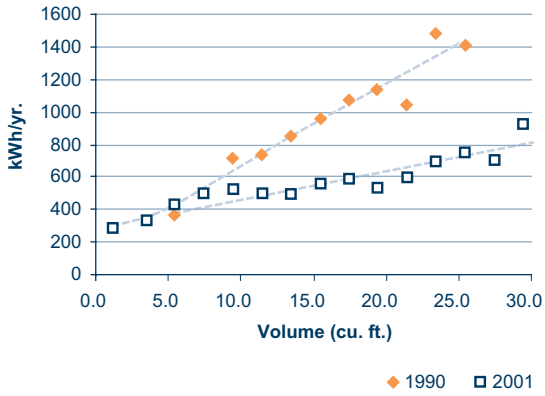
1.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY VOLUME

The energy performance of refrigerators improved remarkably between 1990 and 2001. As illustrated in Figure 1.5, the larger the volume, the greater the decrease in average annual unit energy consumption. The average annual unit energy consumption of refrigerators with volumes below 5 cu. ft. remained relatively unchanged during the period.

In 1990, refrigerators larger than 16.4 cu. ft. consumed on average more than 1000 kWh of electricity per year. By 2001, refrigerators that size consumed only half as much energy, and the largest units (28.5 to 30.4 cu. ft.) consumed, on average, only 919 kWh of electricity per year.

The gap between the average annual unit energy consumption of the largest and smallest units narrowed between 1990 and 2001. When the period began, the difference between the average annual unit energy consumption of the largest and smallest units was over 1000 kWh. By 2001, with manufacturers improving the energy efficiency of larger models, the difference had shrunk to about 640 kWh per year.

FIGURE 1.5
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF REFRIGERATORS BY VOLUME*



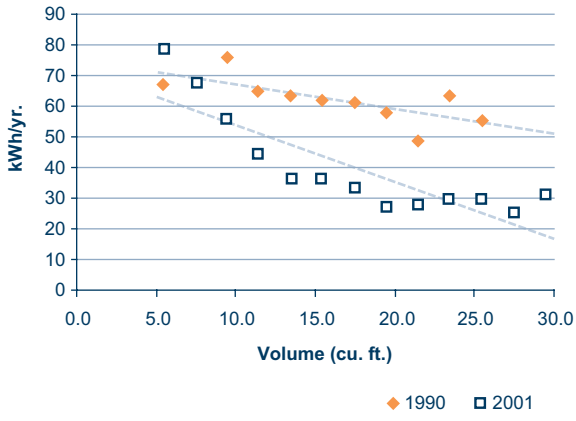
For greater detail, see Table C.1.

1.3.2 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT

The trend in the average annual unit energy consumption of refrigerators, on a per-cubic-foot basis, is consistent with the above findings. Figure 1.6 shows that larger models consume less energy per cubic foot than smaller ones.

This was the case in both 1990 and 2001. The most marked difference is that 2001 models, on average, consumed 22 kWh per cu. ft. less than 1990 models of equal volume.

FIGURE 1.6
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT OF REFRIGERATORS BY VOLUME*



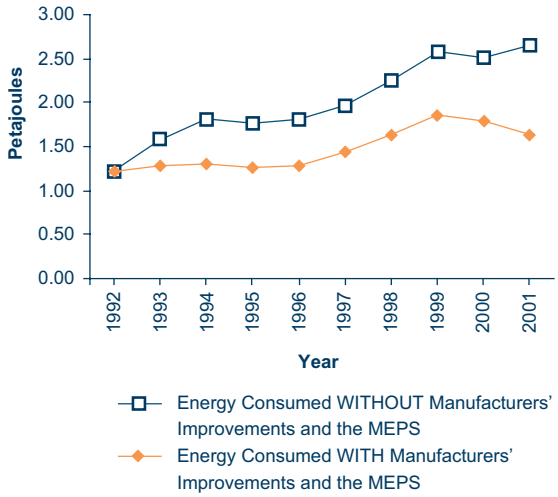
For greater detail, see Table C.2.

1.4 ENERGY SAVINGS

It is estimated that annual refrigerator energy consumption was significantly lower during the study period than it would have been in the absence of two factors: manufacturers' improvements in the general energy efficiency of refrigerators, and the MEPS. Figure 1.7 shows how much energy refrigerators might have consumed annually between 1992 and 2001 without the energy efficiency improvements made by manufacturers and the MEPS (top line) and how much energy actually was consumed by refrigerators during those years (bottom line).

The divergence of the two lines in Figure 1.7 represents incremental annual energy savings. Even though the MEPS did not come into effect until 1995, the calculation of energy savings is based on data from 1992 onward. This is because energy efficiency began to improve almost immediately after the *Energy Efficiency Act* came into force in 1992, thanks to market forces, such as the regulations expected from the Act plus U.S. regulations.

FIGURE 1.7
ANNUAL ENERGY SAVINGS BY REFRIGERATORS, 1992–2001*

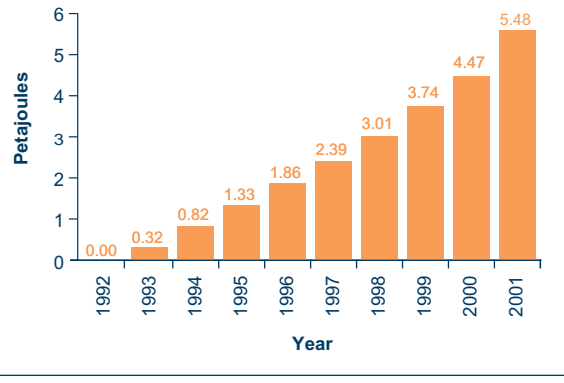


*For greater detail, see Table C.3.

The average annual energy savings for refrigerators were estimated to be 0.61 petajoules (PJ) between 1993 and 2001. (No savings were expected in 1992.) This indicates that, on average, refrigerators consumed about 0.61 PJ less annually than they would have without the energy efficiency improvements made by manufacturers and the MEPS set out in the *Energy Efficiency Regulations*.

Cumulative energy savings for refrigerators are shown in Figure 1.8 and in Table C.3 (on page 37). The largest annual savings occurred in 2001, when refrigerators consumed about 1.0 PJ less than they otherwise would have. Since energy savings accrue over time, cumulative energy savings grew steadily between 1992 and 2001. They reached a total savings of 5.48 PJ in 2001.

FIGURE 1.8
CUMULATIVE ENERGY SAVINGS BY REFRIGERATORS, 1992–2001*



*For greater detail, see Table C.3.

2 Freezers

2.1 2001 MARKET SNAPSHOT

Type 10 freezers were the most popular in 2001, accounting for 67.5 percent of all freezers shipped in Canada. Their shipment-weighted average annual unit energy consumption was 337 kWh. Type 10 freezers are defined as chest freezers and all other freezers not defined as Type 8 (upright freezers with manual defrost) or Type 9 (upright freezers with automatic defrost). Type 18 (compact chest freezers and all other freezers) was added as a category in 2001. All of the freezers available on the market in 2001 met the minimum energy performance standards (MEPS) (Figures 2.1, 2.2, 2.3).

The various types of freezers are defined in Appendix B.

FIGURE 2.1
ENERGY CONSUMPTION OF TYPE 10 FREEZER MODELS AVAILABLE IN 2001

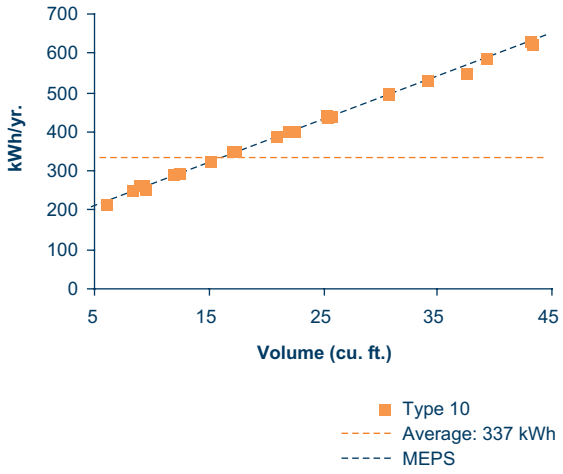


FIGURE 2.2
ENERGY CONSUMPTION OF TYPE 9 FREEZER MODELS AVAILABLE IN 2001

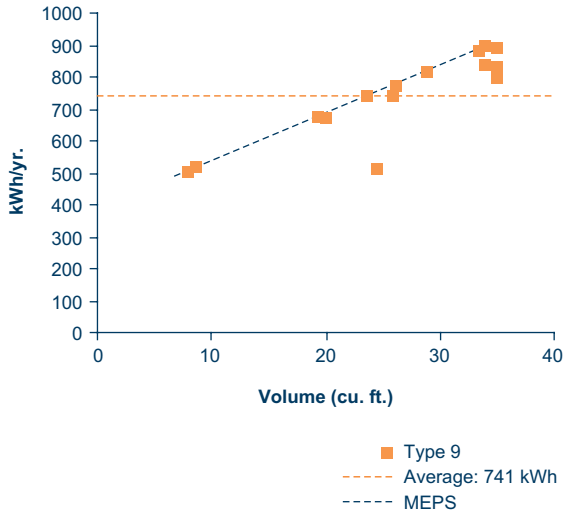
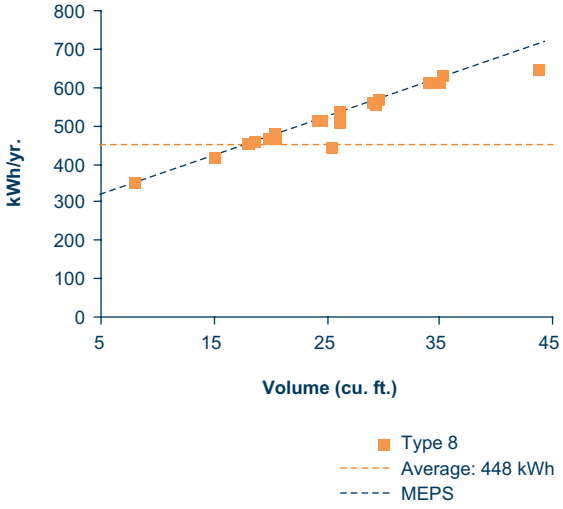


FIGURE 2.3
ENERGY CONSUMPTION OF TYPE 8 FREEZER MODELS AVAILABLE IN 2001



2.2 DISTRIBUTION OF SHIPMENTS

2.2.1 DISTRIBUTION BY TYPE

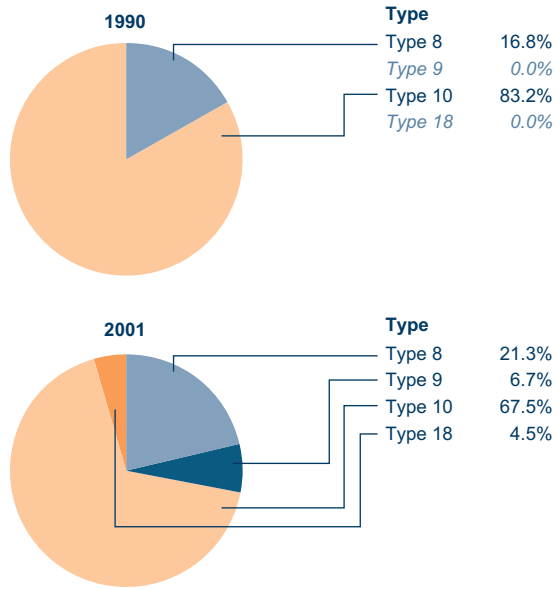
Type 10 freezers have dominated the freezer market in Canada throughout the study period. However, the market share of chest freezers (Types 10 and 18) declined from 83.2 to 72.0 percent during those years.

Conversely, upright freezers (Types 8 and 9) gained an 11.2 percent increase in market share between 1990 and 2001. They accounted for 28 percent of the market in 2001.

TABLE 2.1
DISTRIBUTION OF FREEZERS BY TYPE

Model Year	Type 8	Type 9	Type 10	Type 18
	(%)	(%)	(%)	(%)
1990	16.8	0.0	83.2	0.0
1991	11.8	0.4	87.8	0.0
1992	12.9	0.3	86.7	0.0
1993	14.4	0.6	85.0	0.0
1994	12.9	0.6	86.4	0.0
1995	16.1	0.7	83.2	0.0
1996	17.2	1.1	81.7	0.0
1997	19.5	1.0	79.5	0.0
1998	21.3	1.8	77.0	0.0
1999	21.7	2.5	75.8	0.0
2000	25.1	3.1	71.8	0.0
2001	21.3	6.7	67.5	4.5
Average Annual Change	**0.4%**	**0.6%**	**1.4%**	**0.4%**

FIGURE 2.4
DISTRIBUTION OF FREEZERS BY TYPE FOR 1990 AND 2001



2.2.2 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT

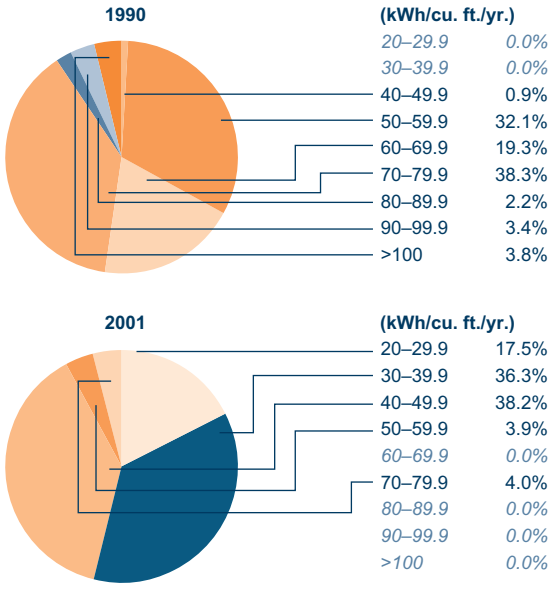
TABLE 2.2
DISTRIBUTION OF FREEZERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT

Model Year	kWh/cu. ft./yr. 20–29.9	30–39.9	40–49.9	50–59.9	60–69.9	70–79.9	80–89.9	90–99.9	>100
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1990	0.0	0.0	0.9	32.1	19.3	38.3	2.2	3.4	3.8
1991	0.0	28.3	20.3	31.2	4.1	15.9	0.0	0.0	0.3
1992	3.1	18.9	58.3	15.0	4.5	0.3	0.0	0.0	0.0
1993	16.5	57.0	16.5	8.4	1.6	0.0	0.0	0.0	0.0
1994	15.4	39.0	34.9	9.0	1.9	0.0	0.0	0.0	0.0
1995	12.7	39.6	41.2	5.4	1.2	0.0	0.0	0.0	0.0
1996	12.4	40.4	37.0	10.3	0.0	0.0	0.0	0.0	0.0
1997	11.7	36.7	39.0	12.0	0.0	0.6	0.0	0.0	0.0
1998	11.0	34.6	43.1	11.3	0.0	0.0	0.0	0.0	0.0
1999	10.8	42.3	37.0	9.6	0.0	0.3	0.0	0.0	0.0
2000	10.0	37.6	41.3	8.8	0.0	2.3	0.0	0.0	0.0
2001	17.5	36.3	38.2	3.9	0.0	4.0	0.0	0.0	0.0
Average Annual Change	1.6%	3.3%	3.4%	2.6%	1.8%	3.1%	0.2%	0.3%	0.3%

The energy efficiency of freezers improved steadily between 1990 and 2001. In 1990, almost all freezers required more than 50 kWh per year to freeze each cubic foot of space. With steady improvements in energy efficiency, by 2001 nearly all freezers (92.1 percent) required less than 50 kWh per year to freeze each cubic foot of space.

At the beginning of the study period, freezers with an average level of energy consumption between 70 and 79.9 kWh per cu. ft. per year dominated the market, accounting for 38.3 percent of the market. By comparison, freezers in 2001 most commonly consumed between 40 and 49.9 kWh per cu. ft. per year. These freezers accounted for 38.2 percent of the market, up from 20.3 percent in 1991.

FIGURE 2.5
DISTRIBUTION OF FREEZERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT FOR 1990 AND 2001

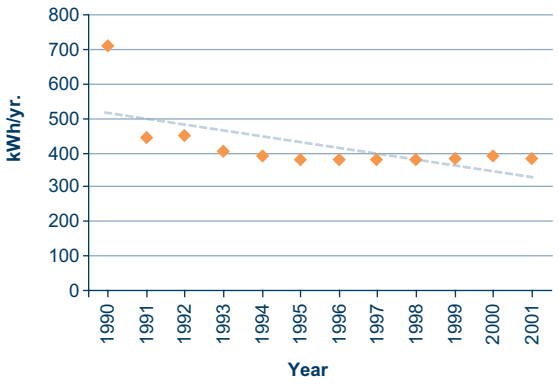


2.3 ENERGY CONSUMPTION

2.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

Freezers became significantly more energy efficient between 1990 and 2001. As Figure 2.6 shows, the average annual unit energy consumption decreased significantly in 1991 and then decreased gradually until 1997. After 1997, the average annual unit energy consumption held steady. Overall, the average annual unit energy consumption decreased by 46 percent, or 330 kWh, during the study period.

FIGURE 2.6
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF FREEZERS BY MODEL YEAR*



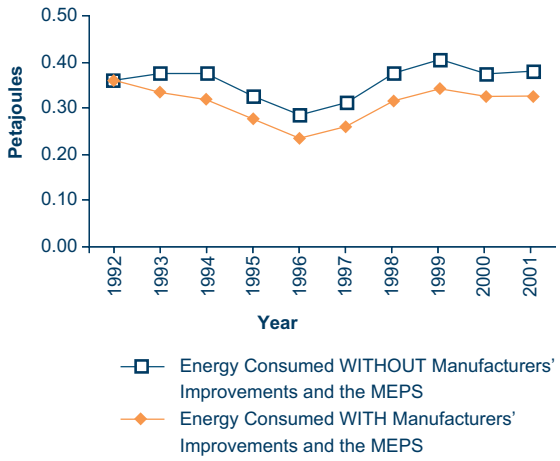
For greater detail, see Table C.4.

2.4 ENERGY SAVINGS

It is estimated that annual freezer energy consumption was slightly lower between 1993 and 2001 than it would have been without the energy efficiency improvements made by manufacturers and the MEPS.

As with refrigerators, the difference between the two lines in Figure 2.7 represents the incremental annual energy savings that resulted when manufacturers met the MEPS and made related technological improvements.

FIGURE 2.7
ANNUAL ENERGY SAVINGS BY FREEZERS, 1992–2001*

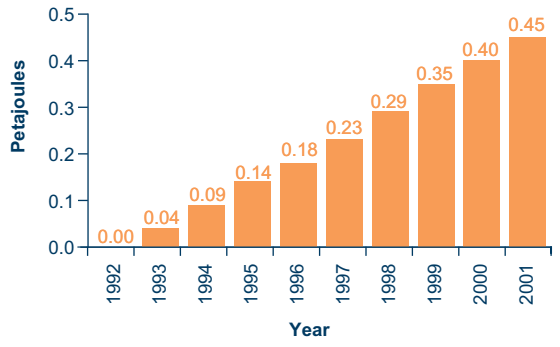


*For greater detail, see Table C.5.

The average annual energy savings for new freezers were estimated to be 0.05 PJ from 1993 to 2001. (No savings were expected for 1992.) The largest annual energy savings occurred in 1998, 1999 and 2001, when freezers consumed about 0.06 PJ less than they otherwise might have.

Cumulative energy savings grew steadily between 1992 and 2001 to reach 0.45 PJ in 2001. These energy savings are shown in Figure 2.8.

FIGURE 2.8
CUMULATIVE ENERGY SAVINGS BY FREEZERS, 1992–2001*



*For greater detail, see Table C.5.

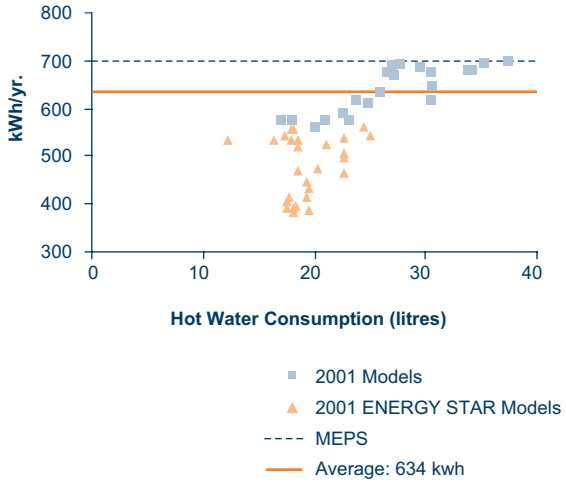
3 Dishwashers

3.1 2001 MARKET SNAPSHOT

The shipment-weighted average annual unit energy consumption of dishwashers in 2001 was 634 kWh. Nearly 30 percent of the standard models on the market that year – that is, those with an exterior width of more than 56 cm – were ENERGY STAR qualified products, exceeding the federal minimum energy performance standards (MEPS) in Canada's *Energy Efficiency Regulations* by at least 25 percent.

Dishwasher is defined in Appendix B.

FIGURE 3.1
ENERGY CONSUMPTION OF DISHWASHER MODELS AVAILABLE IN 2001



3.2 DISTRIBUTION OF SHIPMENTS

3.2.1 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

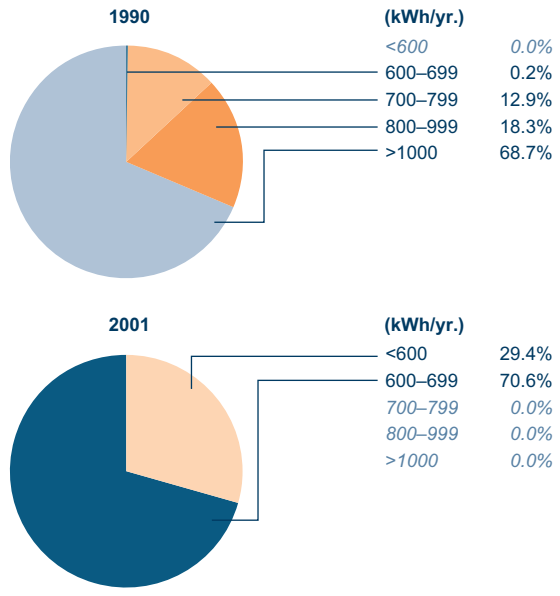
In 1990, dishwashers consuming more than 700 kWh per year represented 99.8 percent of the market. The majority (68.7 percent) of these dishwashers consumed at least 1000 kWh per year.

By 2001, nearly all dishwashers consumed less than 700 kWh per year, with 70.6 percent consuming between 600 and 699 kWh per year.

TABLE 3.1
DISTRIBUTION OF STANDARD DISHWASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model Year	kWh/yr. <600	600–699	700–799	800–999	>1000
	(%)	(%)	(%)	(%)	(%)
1990	0.0	0.2	12.9	18.3	68.7
1991	0.0	5.8	15.3	27.5	51.4
1992	0.0	8.5	7.4	63.1	20.9
1993	0.4	7.7	6.9	62.0	23.0
1994	1.0	32.9	31.0	23.4	11.7
1995	2.0	63.7	34.1	0.1	0.1
1996	5.0	63.0	31.9	0.0	0.1
1997	21.9	56.9	21.2	0.0	0.0
1998	24.7	71.6	3.7	0.0	0.0
1999	26.4	73.6	0.0	0.0	0.0
2000	23.3	76.7	0.0	0.0	0.0
2001	29.4	70.6	0.0	0.0	0.0
Average Annual Change	2.7%	6.4%	1.2%	1.7%	6.2%

FIGURE 3.2
DISTRIBUTION OF DISHWASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001

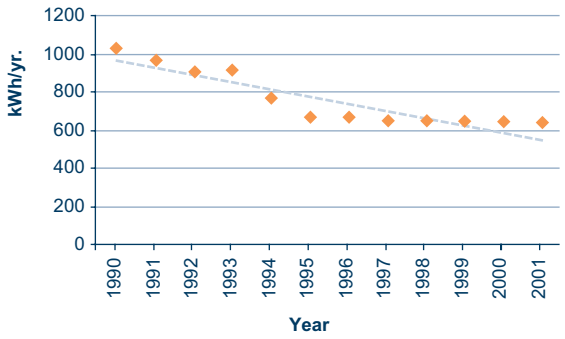


3.3 ENERGY CONSUMPTION

3.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

Between 1990 and 2001, the energy performance of dishwashers improved remarkably. As Figure 3.3 shows, the average annual unit energy consumption decreased by about 38 percent, or 392 kWh, during the study period. Most of the improvement occurred before 1995, when the average annual unit energy consumption decreased from 1026 to 671 kWh – an impressive decrease of 355 kWh, or 35 percent. From 1995 to 2001, the decrease in the average annual unit energy consumption tapered off to 633.7 kWh per year, a difference of 37.2 kWh, or 6 percent, from the 1995 level.

FIGURE 3.3
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF DISHWASHERS BY MODEL YEAR*

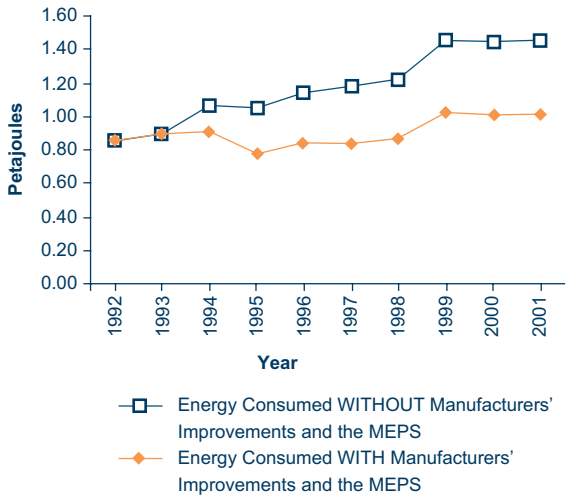


For greater detail, see Table C.6.

3.4 ENERGY SAVINGS

It is estimated that annual energy consumption for dishwashers was significantly less between 1993 and 2001 than it would have been without the energy efficiency improvements made by manufacturers and the 1995 MEPS.

FIGURE 3.4
ANNUAL ENERGY SAVINGS BY DISHWASHERS, 1992–2001*

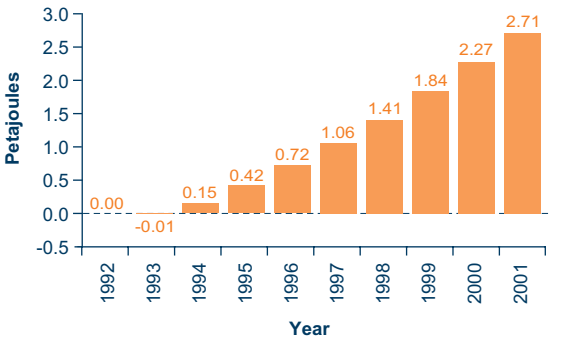


*For greater detail, see Table C.7.

The average annual energy savings for dishwashers were estimated to be 0.30 PJ during 1993 to 2001. (No savings were expected for 1992.) This indicates that, on average, dishwashers consumed about 0.30 PJ less annually than they would have without the energy efficiency improvements made by manufacturers and the MEPS. The largest annual energy savings occurred in 2001, when dishwashers consumed 0.44 PJ less than they otherwise might have.

The cumulative energy savings for dishwashers are shown in Figure 3.5. Since annual energy savings accrue over time, cumulative energy savings grew steadily between 1992 and 2001. Cumulative energy savings reached a total of 2.71 PJ in 2001.

FIGURE 3.5
CUMULATIVE ENERGY SAVINGS BY DISHWASHERS, 1992–2001*



*For greater detail, see Table C.7.

4 Electric Ranges

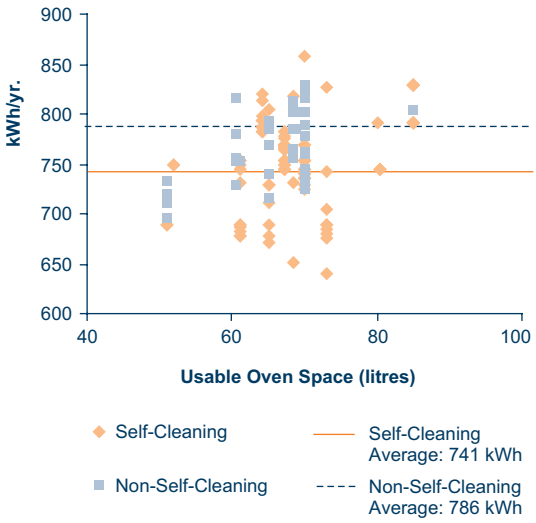
4.1 2001 MARKET SNAPSHOT

In 2001, 52 percent of the electric ranges shipped in Canada were self-cleaning units. The shipment-weighted average annual unit energy consumption for self-cleaning ranges was 741 kWh, compared with 786 kWh per year for regular electric ranges. Even though the energy consumption rating takes into account the energy used during the self-cleaning cycles (based on 11 cleanings per year), these ranges use less energy than the regular electric ranges because their ovens are generally better insulated and the door seals are better than those in the non-self-cleaning ovens. This means that the self-cleaning units lose less heat through the oven door.

Electric ranges typically make up 92 percent of the market; gas ranges constitute the remainder.

Electric range is defined in Appendix B.

FIGURE 4.1
ENERGY CONSUMPTION OF ELECTRIC RANGE MODELS AVAILABLE IN 2001



4.2 DISTRIBUTION OF SHIPMENTS

4.2.1 DISTRIBUTION BY TYPE

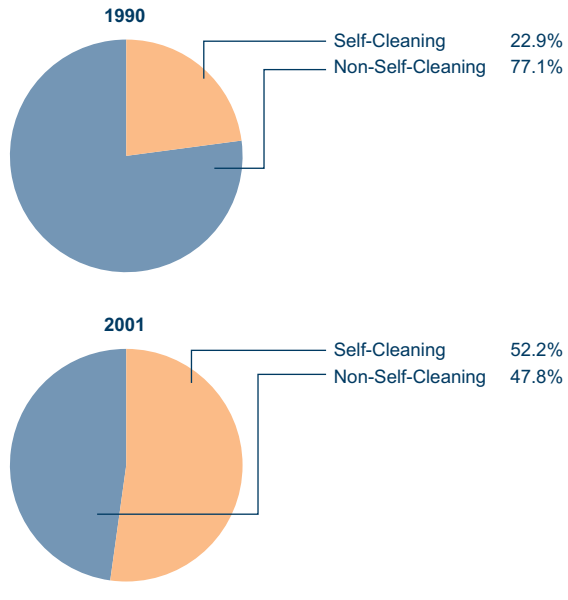
In 1990, self-cleaning electric ranges accounted for less than one quarter (22.9 percent) of all electric ranges available on the market. By 2001, self-cleaning ranges had increased in popularity, with market share increasing to 52.2 percent. This represents a 30 percent increase since 1990, or an annual growth rate of 2.7 percent (Table 4.1).

In contrast, the market share of electric ranges that were not self-cleaning decreased by 30 percent, dropping from 77.1 percent in 1990 to 47.8 percent in 2001 (Table 4.1).

TABLE 4.1
DISTRIBUTION OF ELECTRIC RANGES BY TYPE

Model Year	Non-Self-Cleaning	Self-Cleaning
	(%)	(%)
1990	77.1	22.9
1991	71.3	28.7
1992	71.6	28.4
1993	70.1	29.9
1994	69.4	30.6
1995	68.3	31.7
1996	66.6	33.4
1997	64.1	35.9
1998	58.7	41.3
1999	59.4	40.6
2000	55.6	44.4
2001	47.8	52.2
Average Annual Change	2.7%	2.7%

FIGURE 4.2
DISTRIBUTION OF ELECTRIC RANGES BY TYPE FOR 1990 AND 2001



4.2.2 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

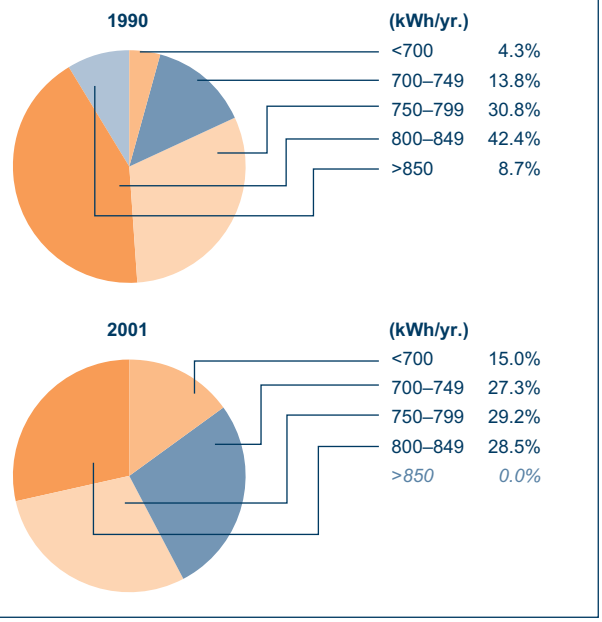
Between 1990 and 2001, there were limited but noticeable improvements in the energy efficiency of electric ranges. Before 1992, the ranges that dominated the market (42–54 percent) consumed between 800 and 849 kWh per year. In 2001, the market share of electric ranges in this category fell to 28.5 percent. By then, the ranges that dominated the market consumed between 700 and 799 kWh per year and enjoyed a 56.5 percent market share, an increase of 12 percent during the study period.

TABLE 4.2
DISTRIBUTION OF ELECTRIC RANGES BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model	kWh/yr. <700	700–749	750–799	800–849	>850
	(%)	(%)	(%)	(%)	(%)
1990	4.3	13.8	30.8	42.4	8.7
1991	0.8	15.9	27.6	54.0	1.8
1992	0.0	15.0	58.1	26.5	0.3
1993	0.1	18.4	42.8	38.5	0.2
1994	1.7	32.2	28.5	37.4	0.1
1995	3.3	35.0	22.5	39.2	0.0
1996	3.2	27.6	26.4	42.8	0.0
1997	3.6	27.6	29.0	39.8	0.0
1998	8.6	23.3	30.6	37.4	0.0
1999	15.3	28.2	31.6	24.9	0.0
2000	14.3	30.9	29.5	25.3	0.0
2001	15.0	27.3	29.2	28.5	0.0
Average Annual Change	1.0%	1.2%	0.1%	1.3%	0.8%

Other energy efficiency improvements between 1990 and 2001 included an increase of 10.7 percent for electric ranges that consumed less than 700 kWh per year, as well as the disappearance of the category for the most-energy-consuming electric ranges (850 kWh per year or more).

FIGURE 4.3
DISTRIBUTION OF ELECTRIC RANGES BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001



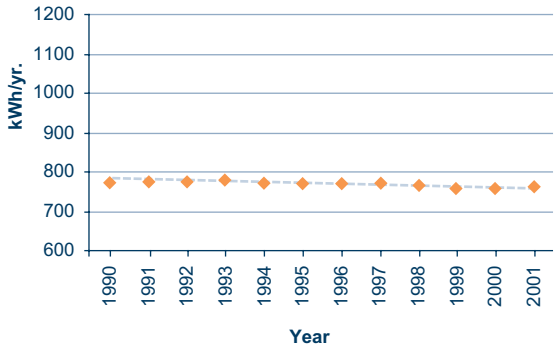
4.3 ENERGY CONSUMPTION

4.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

Between 1990 and 2001, the energy consumption of electric ranges remained relatively unchanged.

The decrease in average annual unit energy consumption, as illustrated in Figure 4.4, was about 1 percent, or 9 kWh. But even as the rate of consumption remained relatively unchanged, the structure of the cooking market did not. Many alternatives to oven cooking are now encouraged by the industry, including microwave ovens, bread-making machines and barbecues.

FIGURE 4.4
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC RANGES BY MODEL YEAR*



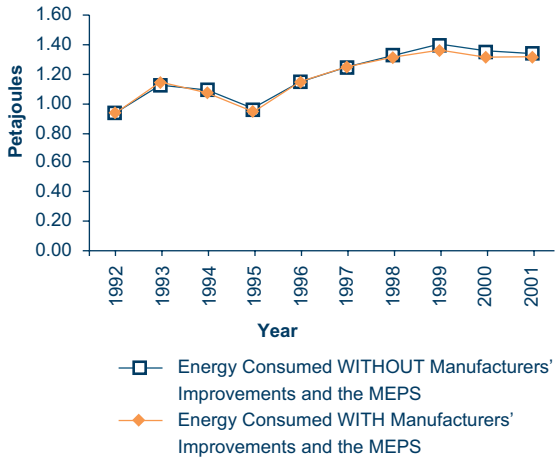
*For greater detail, see Table C.8.

4.4 ENERGY SAVINGS

Electric ranges were the only appliances that did not experience a notable decline in energy consumption following the introduction of the MEPS in 1995.

Figure 4.5 shows that electric ranges consumed about the same amount of energy that they would have used without the energy efficiency improvements made by manufacturers and the MEPS.

FIGURE 4.5
ANNUAL ENERGY SAVINGS BY ELECTRIC RANGES, 1992–2001*

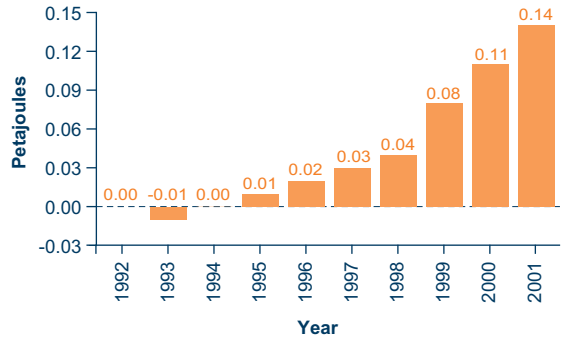


*For greater detail, see Table C.9.

The average annual energy savings for electric ranges during 1993 to 2001 were estimated to be 0.02 PJ. (No savings were expected for 1992.) The largest annual energy savings occurred in 1999, when electric ranges consumed 0.04 PJ less than they otherwise might have.

The cumulative energy savings for electric ranges are shown in Figure 4.6. Although cumulative energy savings declined marginally from 1992 to 1993, they grew steadily between 1994 and 2001, as annual energy savings began to accrue. However, cumulative energy savings were still considerably smaller than those for other appliance types. Savings reached a total of 0.14 PJ in 2001.

FIGURE 4.6
CUMULATIVE ENERGY SAVINGS BY ELECTRIC RANGES, 1992–2001*



For greater detail, see Table C.9.

5 Clothes Washers

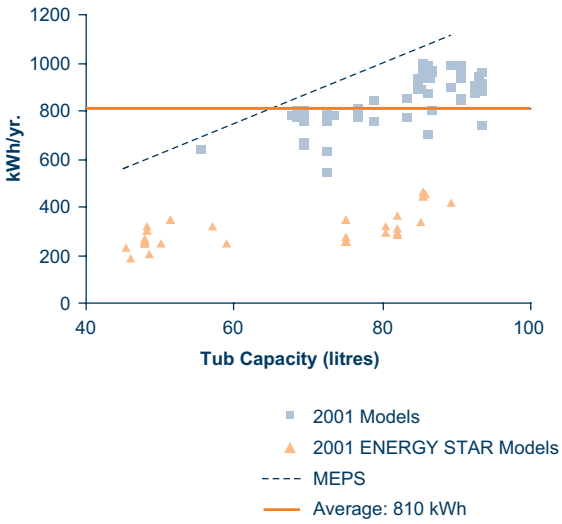
5.1 2001 MARKET SNAPSHOT

In 2001, the shipment-weighted average annual unit energy consumption of clothes washers was 810 kWh.

Among standard models, 16.9 percent were ENERGY STAR® qualified products, with an energy consumption level of less than 470 kWh per year.

Clothes washer is defined in Appendix B.

FIGURE 5.1
ENERGY CONSUMPTION OF CLOTHES WASHER MODELS AVAILABLE IN 2001



5.2 DISTRIBUTION OF SHIPMENTS

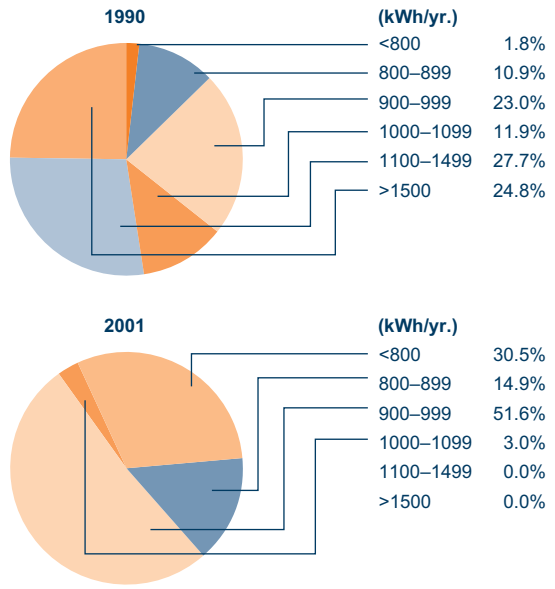
5.2.1 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

TABLE 5.1
DISTRIBUTION OF CLOTHES WASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model	kWh/yr. <800	800–899	900–999	1000–1099	1100–1499	>1500
	(%)	(%)	(%)	(%)	(%)	(%)
1990	1.8	10.9	23.0	11.9	27.7	24.8
1991	0.4	21.8	12.2	12.8	22.3	30.6
1992	0.1	10.4	12.2	26.8	34.9	15.6
1993	0.4	15.6	13.4	38.0	27.2	5.4
1994	0.7	23.5	25.5	45.8	3.9	0.6
1995	0.9	26.7	28.0	42.7	1.4	0.4
1996	2.3	34.9	17.9	42.9	1.7	0.3
1997	4.6	37.1	10.4	46.1	1.8	0.0
1998	10.8	28.5	11.1	48.1	1.5	0.0
1999	23.8	18.4	31.3	25.4	1.0	0.0
2000	27.1	15.7	45.9	10.5	0.9	0.0
2001	30.5	14.9	51.6	3.0	0.0	0.0
Average Annual Change	2.6%	0.4%	2.6%	0.8%	2.5%	2.3%

As shown in Table 5.1, the energy consumption of clothes washers improved significantly during the study period. In 1990, well over half (64.4 percent) of the clothes washers shipped used more than 1000 kWh per year. By 2001, practically all (97 percent) clothes washers were below that level. The proportion of clothes washers that consumed over 1100 kWh per year almost disappeared.

FIGURE 5.2
DISTRIBUTION OF CLOTHES WASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001

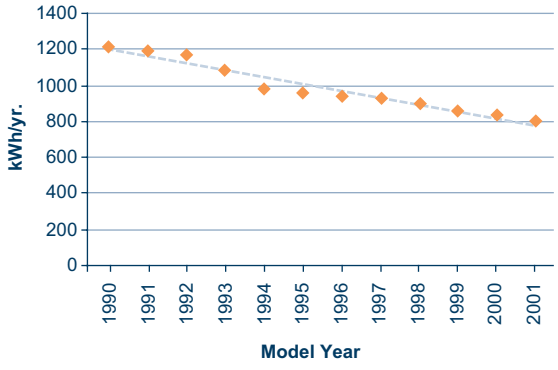


5.3 ENERGY CONSUMPTION

5.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

Between 1990 and 2001, the average annual unit energy consumption of clothes washers improved remarkably. As Figure 5.3 shows, the average annual unit energy consumption decreased by 408 kWh over the study period, or about 33 percent.

FIGURE 5.3
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF CLOTHES WASHERS BY MODEL YEAR*



For greater detail, see Table C.10.

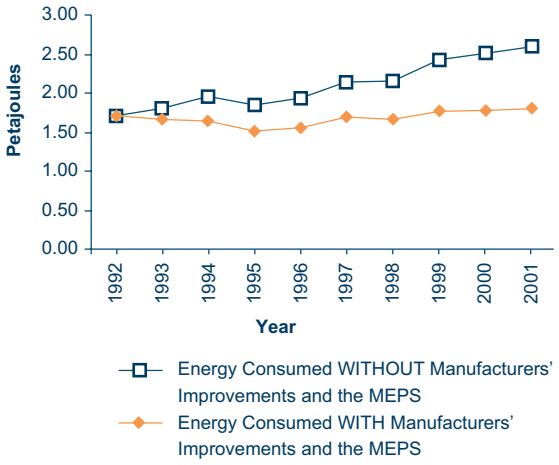
5.4 ENERGY SAVINGS

It is estimated that the annual energy consumption of clothes washers was slightly less from 1993 to 2001 than it would have been without the energy efficiency improvements made by manufacturers and the minimum energy performance standards (MEPS). The annual savings have been increasing steadily since 1996.

Figure 5.4 illustrates the likely annual energy consumption by clothes washers if manufacturers had not met the MEPS and improved technology (top line) and how much energy actually was consumed (bottom line).

Graphically, the divergence of the two lines in Figure 5.4 represents incremental annual energy savings. On average, clothes washers would have consumed 0.47 PJ more per year without the energy efficiency improvements made by manufacturers and the MEPS. The largest annual energy savings occurred in 2001, when clothes washers consumed about 0.81 PJ than they otherwise might have.

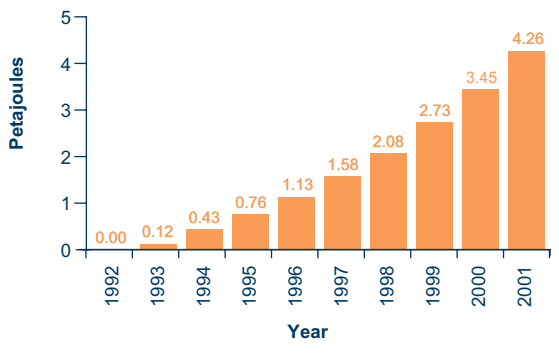
FIGURE 5.4
ANNUAL ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001*



For greater detail, see Table C.11.

The cumulative energy savings for clothes washers are shown in Figure 5.5. There was steady growth between 1992 and 2001, and accrued energy savings reached 4.26 PJ in 2001.

FIGURE 5.5
CUMULATIVE ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001*



For greater detail, see Table C.11.

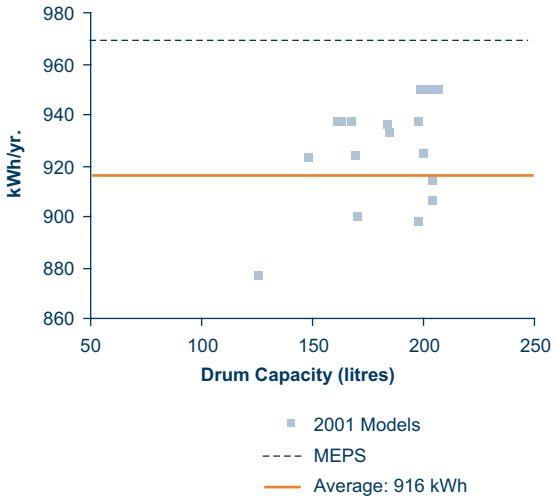
6 Electric Clothes Dryers

6.1 2001 MARKET SNAPSHOT

In 2001, the shipment-weighted average annual unit energy consumption of all electric clothes dryers was 916 kWh per year.

Electric clothes dryer is defined in Appendix B.

FIGURE 6.1
ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYER MODELS AVAILABLE IN 2001



6.2 DISTRIBUTION OF SHIPMENTS

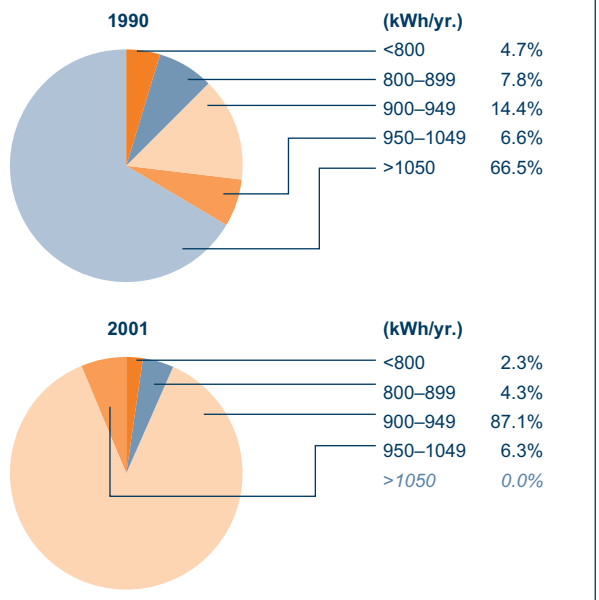
6.2.1 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Between 1990 and 2001, electric clothes dryers exhibited significant improvements in energy efficiency. The consumption level of over 1050 kWh per year, which dominated the market (66.5 percent) in 1990, had almost disappeared by 2001 (see Table 6.1). That year, 87.1 percent of electric clothes dryers consumed between 900 and 949 kWh. The improvement was remarkable. By the end of the study period, 93.7 percent of electric dryers on the market required less than 950 kWh per year, an impressive jump from 26.9 percent in 1990 (see Figure 6.2).

TABLE 6.1
DISTRIBUTION OF ELECTRIC CLOTHES DRYERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model Year	kWh/yr. <800	800–899	900–949	950–1049	>1050
	(%)	(%)	(%)	(%)	(%)
1990	4.7	7.8	14.4	6.6	66.5
1991	5.3	0.2	30.0	38.0	26.5
1992	4.4	28.9	37.5	18.2	11.0
1993	4.1	28.9	53.6	7.2	6.1
1994	4.3	24.0	54.6	14.9	2.2
1995	3.2	16.2	68.5	10.8	1.3
1996	4.2	11.8	82.8	1.2	0.0
1997	4.9	12.9	80.7	1.4	0.0
1998	3.2	8.8	87.0	1.0	0.0
1999	2.7	7.2	88.3	1.8	0.0
2000	2.7	7.7	84.6	5.0	0.0
2001	2.3	4.3	87.1	6.3	0.0
Average Annual Change	**0.2%**	**0.3%**	**6.6%**	**0.0%**	**6.0%**

FIGURE 6.2
DISTRIBUTION OF ELECTRIC CLOTHES DRYERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001

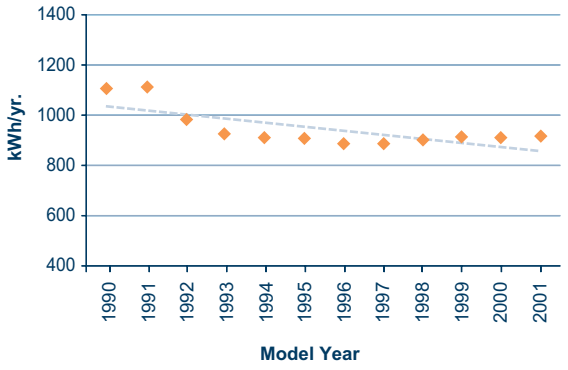


6.3 ENERGY CONSUMPTION

6.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

The improvement in energy efficiency for electric clothes dryers between 1990 and 2001 is illustrated in Figure 6.3. It shows a decrease in the average annual unit energy consumption of 186 kWh, or about 16.9 percent. This figure and Table C.12 (on page 41) show a significant improvement from 1991 to 1993, when the average annual unit energy consumption decreased from 1109 to 929 kWh – an impressive 180 kWh, or 16 percent. After 1993, the decrease in the average annual unit energy consumption tapered off. Average annual consumption began to increase slightly after 1997, and by 2001 it was higher than in 1994.

FIGURE 6.3
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYERS BY MODEL YEAR*



For greater detail, see Table C.12.

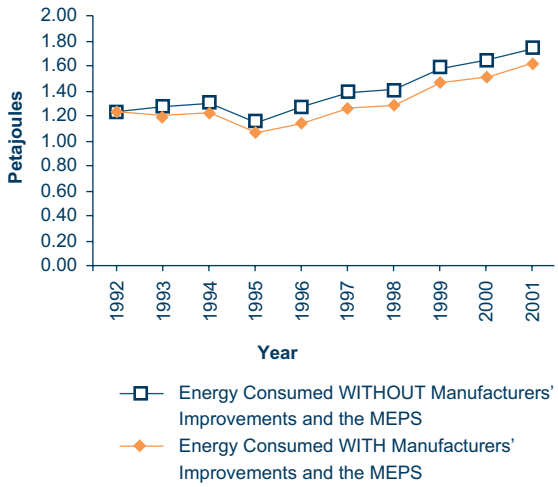
6.4 ENERGY SAVINGS

It is estimated that from 1993 to 2001, the annual energy consumption of electric clothes dryers was less than it would have been had manufacturers not met the minimum energy performance standards (MEPS) or improved energy efficiency.

Figure 6.4 shows how much energy might have been consumed annually by electric clothes dryers without the energy efficiency improvements made by manufacturers and the MEPS (top line) and how much energy they actually consumed (bottom line).

Graphically, the gap between the two lines represents incremental annual energy savings – on average, 0.11 PJ a year. The largest annual energy savings occurred in 1997, when electric clothes dryers consumed 0.14 PJ less than they otherwise might have.

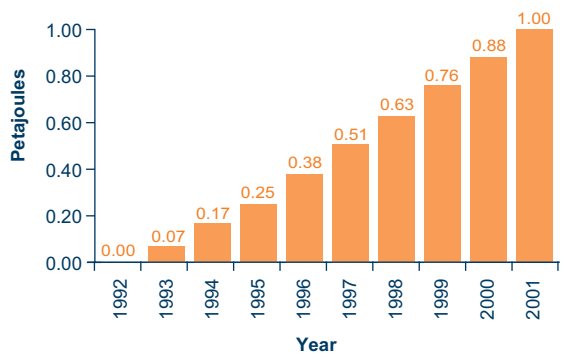
FIGURE 6.4
ANNUAL ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001*



*For greater detail, see Table C.13.

The cumulative energy savings for electric clothes dryers are shown in Figure 6.5. Savings grew steadily between 1992 and 2001, as annual energy savings began to accrue. They reached a total of 1.00 PJ in 2001.

FIGURE 6.5
CUMULATIVE ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001*



*For greater detail, see Table C.13.

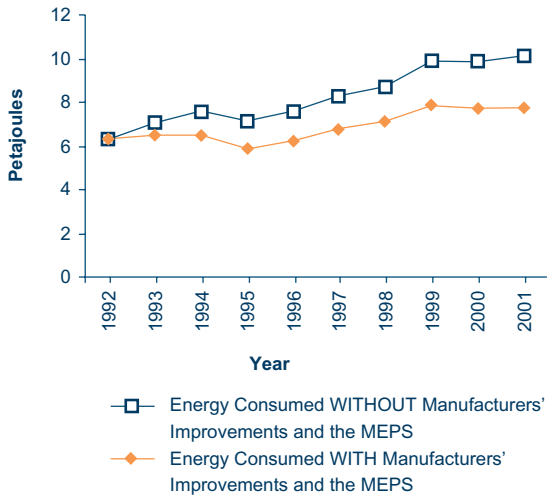
7 All Major Appliances

7.1 TOTAL ENERGY SAVINGS

Annual energy consumption for all major household appliances during the study period was reduced likely as a result of two factors: an increase in general energy efficiency resulted from manufacturers' technological improvements and the implementation of the minimum energy performance standards (MEPS) in 1995. Figure 7.1 shows the estimated annual energy consumption of major appliances between 1992 and 2001 without these two factors, as well as how much energy was actually consumed by major appliances.

The gap between the two lines in Figure 7.1 represents incremental annual energy savings. Energy efficiency began to improve almost immediately after the *Energy Efficiency Act* came into force in 1992, thanks to market forces, such as the regulations expected from the Act plus U.S. regulations.

FIGURE 7.1
ANNUAL ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001*

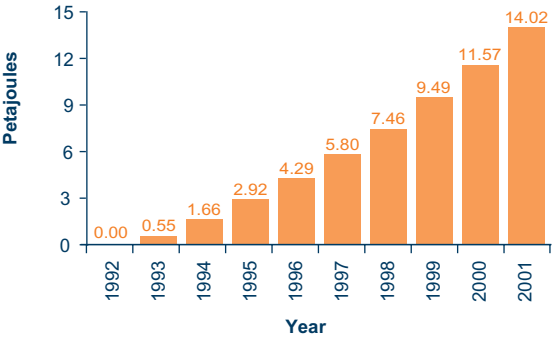


*For greater detail, see Table C.14.

The average annual energy savings for major appliances were estimated to be 1.56 PJ between 1993 and 2001. (No savings were expected in 1992.) This indicates that, on average, major appliances consumed about 1.56 PJ less per year than they would have without the energy efficiency improvements made by manufacturers and the MEPS set out in Canada's *Energy Efficiency Regulations*.

The largest annual energy savings occurred in 2001, when major appliances consumed about 2.45 PJ less than they otherwise would have. Cumulative energy savings for major appliances are shown in Figure 7.2 and Table C.14 (on page 42). Since the energy saved in any given year accrues over time, cumulative energy savings grew steadily between 1992 and 2001. They reached a total savings of 14.02 PJ in 2001, the equivalent of a year's energy for about 126 000 Canadian households.

FIGURE 7.2
CUMULATIVE ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001*



*For greater detail, see Table C.14.

Appendix A – Methodology

A.1 DATA PREPARATION

A.1.1 INTRODUCTION

In an ongoing effort to improve the monitoring of trends in Canadian energy use, Natural Resources Canada's (NRCan's) Office of Energy Efficiency (OEE) proposed an annual data collection arrangement with members of the Canadian Appliance Manufacturers Association (CAMA) in 1996, as part of the National Energy Use Database (NEUD) initiative.

Under this agreement, CAMA members contributed their annual shipment data for six appliance categories – refrigerators, freezers, electric ranges, dishwashers, clothes washers and electric clothes dryers – for analysis. To keep each appliance manufacturer's data confidential, appliance manufacturers suggested that a third party receive and prepare the database in a format in which no one (other than the third party) could determine the shipment data for an individual model or manufacturer. NRCan retained the services of Electro-Federation Canada (EFC), chosen by CAMA, as the third party to receive the data.

The following sections describe the database preparation process conducted by EFC.

The data presented in this report combine shipment figures from the major appliance manufacturers in Canada with the energy use information contained in NRCan's annual *EnerGuide Appliance Directory*. Analysts from EFC matched the model number from the manufacturer with the corresponding model in the *EnerGuide Directory*. Thus they arrived at the total energy consumption represented by all shipments of that model within each year. Then they aggregated these figures to provide the data presented in this report.

The analysts used the standard database and spreadsheet software to assemble the data, manipulated them as required and passed them to NRCan for analysis and report generation. For the reporting stages, they stripped all data of any information that could identify the manufacturer or the model number.

A.1.2 MANUFACTURERS' DATA

NRCan sent initial letters to the appliance manufacturers, requesting annual shipment data for each model of electric clothes dryer, clothes washer, dishwasher, freezer, electric range and refrigerator on the Canadian market from 1990 to 2001. When the project began in 1996, only three manufacturers provided shipment data. The number of data contributors increased to eight in 2001, covering the vast majority of appliance models sold in Canada. NRCan is approaching additional manufacturers in order to improve the coverage for future data collection.

Manufacturers sent the data in various electronic and printed formats. EFC converted the electronic data to a common database format. The analysts key-edited the printed reports and then converted them to the same format.

The data consisted of the appliance type, model number and number of shipments in each year. Manufacturers supplied individual files for each year. As each manufacturer provided data in a different format, the analysts harmonized and amalgamated the files to produce a single file for all models, by appliance type and model year.

The nature of the freezer market prevented EFC from obtaining a model-by-model breakdown of shipments. Instead, the analysts received total shipments and average energy use by freezer type. NRCan used this information to generate the freezer reports.

A.1.3 ENERGUIDE DATA

The analysts used the size, type and unit energy information from NRCan's EnerGuide ratings for each appliance to calculate the shipment-weighted energy use of each appliance type.

A.1.4 DATA MATCHING

Analysts from EFC matched the manufacturer's data for each model with the corresponding energy consumption data from the *EnerGuide Directory* for that model. They then multiplied the manufacturer's shipments for each model by the corresponding EnerGuide model's energy rating. This gave the shipment-weighted total energy consumption for that model. Each appliance category (e.g. refrigerator, dishwasher) and type and size category (as defined in the EnerGuide books) was then sub-totalled so that the average consumption could be worked out.

The *EnerGuide Appliance Directory* shows the basic model numbers available on the Canadian market. Many slight model variants have the same energy rating, so the listings use symbols (such as * and #) to indicate model families. As some model numbers have additional prefixes or suffixes to indicate features (e.g. colour, door-swing) that do not affect energy use, there were relatively few direct one-to-one matches.

Analysts needed to manipulate the data to perform pattern matching. They wrote programs to compare the model numbers supplied by the manufacturers with those in the *EnerGuide Directory*. When a match was found, the corresponding energy consumption figure and the information on the type from the *EnerGuide Directory* were added to the record for the annual shipments of the model.

Because there were many combinations of character substitution, the analysts adopted a method to work from the closest matches to the least likely matches. Thus they flagged matches in which only one character differed and removed them from further matching attempts. Attempts were then made with a difference of two characters, and so on.

The analysts developed reasonability tests to ensure the integrity of the data-matching process. For example, if the manufacturer's model number contained many characters but was matched by a model in the *EnerGuide Directory* that had considerably fewer characters, the model was flagged for manual checking. They also realized that manufacturers might re-use the same numbers for different models after several years. For example, 128 models of refrigerators in the file containing 1980 to 1993 data from the *EnerGuide Directory* have the same model number as those in the 1997 file, but with different energy ratings. They flagged these models for special treatment. During the matching process, analysts applied a "reasonability" criterion: a model would be checked manually if its shipments were reported more than three years after the last time the corresponding model appeared in the EnerGuide list.

Some difficulties occurred when the model number in NRCan's *EnerGuide Directory* differed from the actual model numbers used by the manufacturers in their internal shipment recording systems. In some cases, for example, manufacturers used special codes to denote models that were branded for other companies (such as department stores). The manufacturers helped resolve most of these cases.

A number of models remained unmatched even after the automated processes were performed. Whenever one of these models represented a substantial number of shipments for that appliance type, analysts handled it on an exceptional basis. Manufacturers were again helpful in the identification of these models and the verification of energy ratings and types.

The process continued until all but a few minor models were matched.

A.1.5 DATA SUMMARY AND TRANSFER

After the matching process, analysts summarized the data. To calculate the total annual energy consumption for each model, they multiplied the energy rating of the model by the number of shipments for the year. This yielded the shipment-weighted total energy used by that model for that year. For example, model XYZ has annual shipments of 5238 units and an annual energy consumption of 683 kWh per unit; its shipment-weighted total energy use for the year is 5238 x 683 = 3 577 554 kWh. This aggregate figure and the shipment figures were summed as necessary to provide totals for specific categories as appropriate for each appliance type.

For refrigerators, the actual volume of each model was available from the *EnerGuide Directory*. Therefore, it was possible to monitor the trend of changes in the size of refrigerators over the years. Furthermore, it was possible to determine the amount of energy used by each size category. Analysts also summarized this information and added it to the database for NRCan.

The final database prepared by EFC consisted of such information as the appliance type, model year, total energy consumption and average unit consumption. Refrigerators were further categorized by type and size. All the information was transferred to a spreadsheet and sent to NRCan for analysis and reporting.

A.2 ANALYSIS

The shipment-weighted average annual unit energy consumption (UEC) by category was calculated as total energy consumption of all the refrigerators sold in Canada in that category divided by total number of shipments in that category. The following gives an example of the shipment-weighted average energy consumption for the refrigerators:

$$\frac{\sum_{i=1}^{7} S\_type_i \times \overline{UEC\_type_i}}{\sum_{i=1}^{7} S\_type_i}$$

where S_type_i = Number of Sales of Type *i* refrigerators, and
$\overline{UEC\_type_i}$ = Average Unit Energy Consumption of Type *i* refrigerators

As mentioned in Data Preparation (Section A.1, above), data were obtained for some appliances by size category. Therefore, unit energy consumption per cubic foot was calculated by dividing the UEC of a given size category by the midpoint of the category.

Calculating the incremental energy savings for each appliance type was a three-step process. First, baseline levels of energy consumption were estimated for each appliance type for each year between 1990 and 2001. For all appliances, baseline levels of energy consumption reflected our assumptions about how much energy each appliance type would have consumed without the energy efficiency improvements made by manufacturers and the minimum energy performance standards (MEPS). To estimate baseline levels of energy consumption, we assumed the following:

- Without the implementation of Canada's *Energy Efficiency Regulations* and the general energy efficiency improvements made by manufacturers, the unit energy consumption for all appliance types would have remained constant at the 1992 levels.
- The number of units shipped would have remained the same between 1990 and 2001 even in the absence of the general efficiency improvements made by manufacturers and the implementation of the *Energy Efficiency Regulations*.

"Actual" or current levels of energy consumption for all appliances were calculated in an identical fashion. Even though the MEPS were not introduced until 1995, the baseline year used for all estimates of energy savings was 1992. This is because energy efficiency began to improve almost immediately after the *Energy Efficiency Act* came into force in 1992, thanks to market forces, which anticipated regulations to the Act and accounted for U.S. regulations. The average annual unit energy consumption for each appliance type for each model year was used, instead of holding it constant at 1992 levels. Incremental energy savings for all appliances were then calculated as the difference between baseline and actual levels of energy consumption.

Appendix B – Definitions

CLOTHES WASHER

An appliance that is designed to clean clothes using a water solution of soap or detergent or both, and mechanical agitation or other movement.

The Regulations apply to standard or compact electrically operated household clothes washers that are top- or front-loaded, and that have an internal control system that regulates the water temperature without the need for user intervention after the machine starts.

DISHWASHER

A cabinet-like appliance, either built-in or portable, that, with the aid of water and detergent, washes, rinses and dries (when a drying process is included) dishware, glassware, eating utensils and most cooking utensils by chemical, mechanical and electrical means and then discharges the water into the plumbing drainage system.

The Regulations apply to electrically operated automatic household dishwashers that are not commercial, industrial or institutional machines.

ELECTRIC CLOTHES DRYER

A cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced-air circulation. The heat source is electricity, and the drum and the blower(s) are driven by an electric motor(s).

The *EnerGuide Appliance Directory* groups electric clothes dryers into two categories:

- Compact Size – a clothes dryer with drum volume of less than 125 litres
- Standard Size – a clothes dryer with drum volume of 125 litres or greater

The Regulations apply to standard and compact electrically operated and electrically heated household tumble-type clothes dryers.

ELECTRIC RANGE

A consumer product utilizing electric resistance heating and used as the major household cooking appliance. The product may consist of a cook top, one or more ovens, or a combination of the two, and may be built-in or free-standing.

THE REGULATIONS APPLY TO HOUSEHOLD RANGES THAT ARE

a) free-standing appliances equipped with one or more surface elements and one or more ovens;
b) built-in appliances equipped with one or more surface elements and one or more ovens;
c) built-in appliances equipped with one or more ovens and no surface elements;
d) wall-mounted appliances equipped with one or more ovens and no surface elements; or
e) counter-mounted appliances equipped with one or more surface elements and no ovens;

BUT DO *NOT* INCLUDE THE FOLLOWING:

f) microwave cooking appliances;
g) appliances designed for an electrical supply of 120 volts; or
h) household appliances with one or more tungsten-halogen heating elements.

FREEZER

An appliance designed (i) for the extended storage of food frozen at an average temperature of –17.8ºC (0ºF) or lower; (ii) with the inherent capability for freezing food; and (iii) with a minimum freezing capability of 2 kg/100 L/24 h. The process of freezing involves removing heat from products to lower their temperature to a point where most of the water contained therein is solidified.

In 2001, freezers were typically built as either a vertical model or a chest model, and grouped into the following three types:

TYPE 8
Upright freezers with manual defrost

TYPE 9
Upright freezers with automatic defrost

TYPE 10
Chest freezers and all other freezers

The following types of freezers were added in 2002, however, some models had already appeared in the freezer market in 2001:

TYPE 16
Compact upright freezers with manual defrost

TYPE 17
Compact upright freezers with automatic defrost

TYPE 18
Compact chest freezers and all other freezers

The Regulations apply to household freezers that have a capacity of not more than 850 litres (30 cubic feet).

REFRIGERATOR

An appliance that consists of one or more compartments, with at least one of the compartments designed for the refrigerated storage of foods at temperatures above 0ºC (32ºF) and, if the model is a refrigerator-freezer, with at least one of the compartments designed for the freezing and storage of frozen foods at or below an average temperature of –15ºC (5ºF) and typically capable of being adjusted by the user to a temperature at or below –17.8ºC (0ºF). The refrigerator with a freezer compartment is capable of maintaining simultaneously an average freezer temperature ≤ –15ºC (5ºF) and an average fresh food compartment temperature ≥ 0ºC ≤ 5ºC (≥ 32ºF ≤ 41ºF).

In 2001, refrigerators as per the *EnerGuide Appliance Directory* were grouped under seven main categories:

TYPE 1
Refrigerators and refrigerator-freezers with manual defrost

TYPE 2
Refrigerator-freezers with partial automatic defrost

TYPE 3
Refrigerator-freezers with automatic defrost, with top-mounted freezer and without through-the-door service, as well as all refrigerators without freezers but with automatic defrost

TYPE 4
Refrigerator-freezers with automatic defrost, with side-mounted freezer and without through-the-door ice service

TYPE 5
Refrigerator-freezers with automatic defrost, with bottom-mounted freezer and without through-the-door ice service

TYPE 6
Refrigerator-freezers with automatic defrost, with top-mounted freezer and with through-the-door ice service

TYPE 7
Refrigerator-freezers with automatic defrost, with side-mounted freezer and with through-the-door ice service

The following types of refrigerators were added in 2002, though some models had already appeared on the refrigerator market in 2001:

TYPE 11
Compact refrigerators and refrigerator-freezers with manual defrost

TYPE 12
Compact refrigerators and refrigerator-freezers with partial automatic defrost

TYPE 13
Compact refrigerator-freezers with automatic defrost with top-mounted freezer and compact all-refrigerators with automatic defrost

TYPE 14
Compact refrigerator-freezers with automatic defrost with side-mounted freezer

TYPE 15
Compact refrigerator-freezers with automatic defrost with bottom-mounted freezer

The Regulations apply to household refrigerators or combination refrigerator-freezers that have a capacity of not more than 1100 litres (39 cubic feet), with the exception of refrigerators that employ an absorption refrigeration system.

Appendix C – Tables

TABLE C.1
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF REFRIGERATORS BY VOLUME

	Volume (cu. ft.)														
Model Year	0–2.4	2.5–4.4	4.5–6.4	6.5–8.4	8.5–10.4	10.5–12.4	12.5–14.4	14.5–16.4	16.5–18.4	18.5–20.4	20.5–22.4	22.5–24.4	24.5–26.4	26.5–28.4	28.5–30.4
	(kWh/yr.)														
1990	–	–	367	–	716	740	850	955	1067	1133	1041	1478	1416	–	–
1991	–	–	366	–	658	727	877	915	1018	978	950	1481	1371	–	–
1992	–	–	367	465	478	697	750	924	940	998	1047	1269	1400	1486	–
1993	–	–	367	465	440	593	600	700	731	799	848	939	1004	1228	1110
1994	308	336	365	465	407	563	547	627	665	720	805	906	856	1206	1105
1995	308	336	364	465	383	554	540	626	662	715	775	872	829	1123	977
1996	304	330	364	461	385	547	570	631	646	680	731	894	885	1051	1070
1997	299	315	338	440	400	548	568	632	664	695	716	924	901	923	1092
1998	299	322	436	385	415	564	562	629	675	703	722	853	883	860	983
1999	287	324	430	483	500	552	575	629	666	667	723	833	900	844	977
2000	283	325	430	503	521	550	583	625	667	637	699	809	894	820	976
2001	279	333	430	503	521	502	493	562	582	534	597	689	749	698	919

TABLE C.2
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT OF REFRIGERATORS BY VOLUME

	Volume (cu. ft.)											
Model Year	4.5–6.4	6.5–8.4	8.5–10.4	10.5–12.4	12.5–14.4	14.5–16.4	16.5–18.4	18.5–20.4	20.5–22.4	22.5–24.4	24.5–26.4	26.5–28.4	28.5–30.4
	(kWh/cu. ft./yr.)												
1990	67	–	76	65	63	62	61	58	49	63	56	–	–
1991	67	–	70	64	65	59	58	50	44	63	54	–	–
1992	67	62	51	61	56	60	54	51	49	54	55	54	–
1993	67	62	47	52	45	45	42	41	40	40	39	45	38
1994	67	62	43	49	41	41	38	37	38	39	34	44	38
1995	67	62	41	48	40	41	38	37	36	37	33	41	33
1996	67	62	41	48	42	41	37	35	34	38	35	38	36
1997	62	59	42	48	42	41	38	36	33	39	35	34	37
1998	80	52	44	49	42	41	39	36	34	36	35	31	33
1999	79	65	53	48	43	41	38	34	34	36	35	31	33
2000	79	67	55	48	43	40	38	33	33	35	35	30	33
2001	79	68	55	44	37	36	33	27	28	29	29	25	31

Table C.3
ENERGY SAVINGS BY REFRIGERATORS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.22	1.22	0.00	0.00
1993	1.27	1.59	0.32	0.32
1994	1.30	1.80	0.50	0.82
1995	1.26	1.77	0.51	1.33
1996	1.28	1.80	0.52	1.86
1997	1.43	1.96	0.53	2.39
1998	1.63	2.24	0.62	3.01
1999	1.84	2.58	0.73	3.74
2000	1.79	2.52	0.73	4.47
2001	1.64	2.64	1.00	5.48

TABLE C.4
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF FREEZERS BY MODEL YEAR

Model Year	Type 8	Type 9	Type 10	Type 18	Total
	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)
1990	992.1	–	657.7	–	713.8
1991	706.4	1068.0	406.8	–	444.7
1992	670.4	1078.0	413.8	–	449.3
1993	581.3	863.3	368.2	–	401.7
1994	535.9	846.1	363.9	–	389.2
1995	508.9	817.1	353.2	–	381.6
1996	502.9	820.7	344.0	–	376.7
1997	494.8	823.7	341.9	–	376.5
1998	496.0	829.6	339.5	–	381.5
1999	492.1	838.6	337.5	–	383.4
2000	487.8	839.4	337.4	–	390.9
2001	447.6	740.5	336.7	258.3	383.9

Note: Prior to 2001 Type 18 freezers were included in Type 10 freezers.

TABLE C.5
ENERGY SAVINGS BY FREEZERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.36	0.36	0.00	0.00
1993	0.34	0.38	0.04	0.04
1994	0.32	0.37	0.05	0.09
1995	0.28	0.32	0.05	0.14
1996	0.24	0.28	0.05	0.18
1997	0.26	0.31	0.05	0.23
1998	0.32	0.38	0.06	0.29
1999	0.34	0.40	0.06	0.35
2000	0.33	0.37	0.05	0.40
2001	0.32	0.38	0.06	0.45

TABLE C.6
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF DISHWASHERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1025.7
1991	959.0
1992	908.0
1993	913.5
1994	776.7
1995	670.9
1996	668.2
1997	649.2
1998	646.7
1999	640.1
2000	637.4
2001	633.7

TABLE C.7
ENERGY SAVINGS BY DISHWASHERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.85	0.85	0.00	0.00
1993	0.90	0.89	-0.01	-0.01
1994	0.90	1.06	0.15	0.15
1995	0.77	1.04	0.27	0.42
1996	0.84	1.14	0.30	0.72
1997	0.84	1.18	0.34	1.06
1998	0.87	1.21	0.35	1.41
1999	1.02	1.45	0.43	1.84
2000	1.01	1.45	0.43	2.27
2001	1.01	1.45	0.44	2.71

TABLE C.8
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC RANGES BY MODEL YEAR

Model Year	Non-Self-Cleaning	Self-Cleaning	Total
	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)
1990	785.7	726.8	772.2
1991	787.4	755.1	778.1
1992	788.3	754.1	778.6
1993	795.2	751.5	782.1
1994	785.4	746.6	773.6
1995	778.3	756.4	771.3
1996	780.3	762.5	774.4
1997	780.2	758.5	772.4
1998	778.2	759.7	770.6
1999	770.3	741.8	758.7
2000	770.7	746.3	759.9
2001	785.7	741.2	762.5

TABLE C.9
ENERGY SAVINGS BY ELECTRIC RANGES, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.94	0.94	0.00	0.00
1993	1.14	1.13	-0.01	-0.01
1994	1.08	1.09	0.01	0.00
1995	0.95	0.96	0.01	0.01
1996	1.14	1.15	0.01	0.02
1997	1.24	1.25	0.01	0.03
1998	1.31	1.32	0.01	0.04
1999	1.36	1.39	0.04	0.08
2000	1.31	1.35	0.03	0.11
2001	1.32	1.34	0.03	0.14

TABLE C.10
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF CLOTHES WASHERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1218.0
1991	1197.4
1992	1175.5
1993	1094.1
1994	989.1
1995	965.9
1996	948.7
1997	930.1
1998	903.3
1999	859.9
2000	838.3
2001	810.1

TABLE C.11
ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.70	1.70	0.00	0.00
1993	1.67	1.80	0.12	0.12
1994	1.64	1.94	0.31	0.43
1995	1.51	1.84	0.33	0.76
1996	1.56	1.93	0.37	1.13
1997	1.69	2.14	0.45	1.58
1998	1.66	2.16	0.50	2.08
1999	1.78	2.43	0.65	2.73
2000	1.78	2.50	0.72	3.45
2001	1.79	2.60	0.81	4.26

TABLE C.12
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1102.6
1991	1108.7
1992	983.3
1993	928.5
1994	910.4
1995	909.1
1996	887.4
1997	887.3
1998	900.2
1999	907.5
2000	909.8
2001	916.3

TABLE C.13
ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.23	1.23	0.00	0.00
1993	1.20	1.27	0.07	0.07
1994	1.21	1.31	0.10	0.17
1995	1.07	1.15	0.09	0.25
1996	1.15	1.27	0.12	0.38
1997	1.26	1.39	0.14	0.51
1998	1.29	1.41	0.12	0.63
1999	1.47	1.59	0.12	0.76
2000	1.52	1.64	0.12	0.88
2001	1.62	1.73	0.12	1.00

TABLE C.14
ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	6.30	6.30	0.00	0.00
1993	6.51	7.05	0.55	0.55
1994	6.45	7.57	1.12	1.66
1995	5.84	7.09	1.26	2.92
1996	6.21	7.58	1.37	4.29
1997	6.72	8.23	1.51	5.80
1998	7.07	8.73	1.66	7.46
1999	7.81	9.84	2.03	9.49
2000	7.74	9.83	2.08	11.57
2001	7.70	10.15	2.45	14.02

5 Clothes Washers

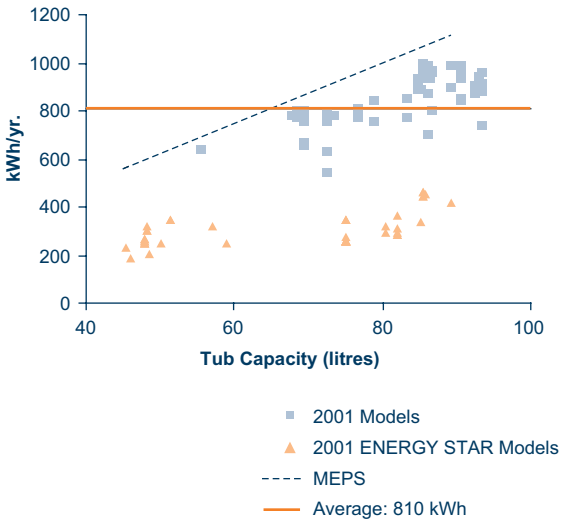
5.1 2001 MARKET SNAPSHOT

In 2001, the shipment-weighted average annual unit energy consumption of clothes washers was 810 kWh.

Among standard models, 16.9 percent were ENERGY STAR® qualified products, with an energy consumption level of less than 470 kWh per year.

Clothes washer is defined in Appendix B.

FIGURE 5.1
ENERGY CONSUMPTION OF CLOTHES WASHER MODELS AVAILABLE IN 2001



5.2 DISTRIBUTION OF SHIPMENTS

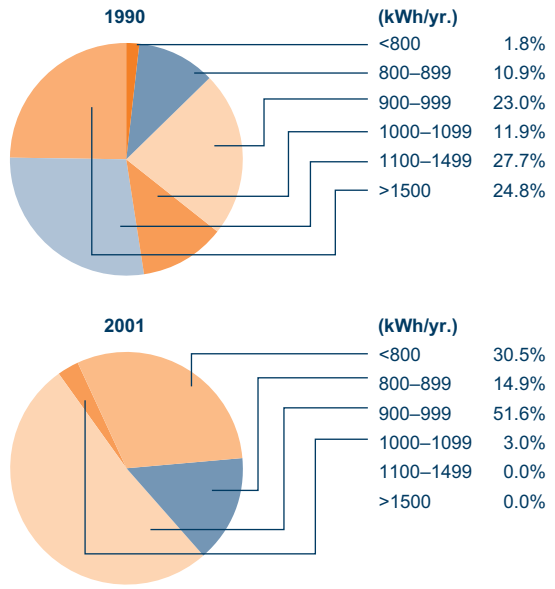
5.2.1 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

TABLE 5.1
DISTRIBUTION OF CLOTHES WASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model	kWh/yr. <800	800–899	900–999	1000–1099	1100–1499	>1500
	(%)	(%)	(%)	(%)	(%)	(%)
1990	1.8	10.9	23.0	11.9	27.7	24.8
1991	0.4	21.8	12.2	12.8	22.3	30.6
1992	0.1	10.4	12.2	26.8	34.9	15.6
1993	0.4	15.6	13.4	38.0	27.2	5.4
1994	0.7	23.5	25.5	45.8	3.9	0.6
1995	0.9	26.7	28.0	42.7	1.4	0.4
1996	2.3	34.9	17.9	42.9	1.7	0.3
1997	4.6	37.1	10.4	46.1	1.8	0.0
1998	10.8	28.5	11.1	48.1	1.5	0.0
1999	23.8	18.4	31.3	25.4	1.0	0.0
2000	27.1	15.7	45.9	10.5	0.9	0.0
2001	30.5	14.9	51.6	3.0	0.0	0.0
Average Annual Change	2.6%	0.4%	2.6%	0.8%	2.5%	2.3%

As shown in Table 5.1, the energy consumption of clothes washers improved significantly during the study period. In 1990, well over half (64.4 percent) of the clothes washers shipped used more than 1000 kWh per year. By 2001, practically all (97 percent) clothes washers were below that level. The proportion of clothes washers that consumed over 1100 kWh per year almost disappeared.

FIGURE 5.2
DISTRIBUTION OF CLOTHES WASHERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001

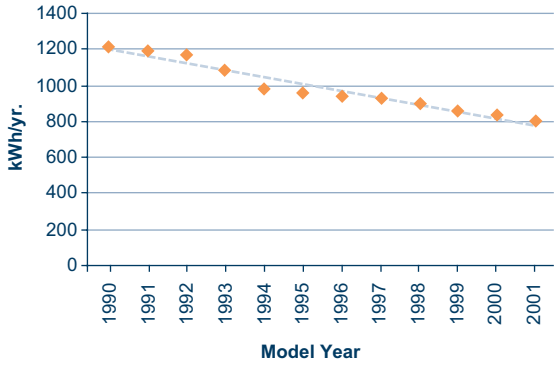


5.3 ENERGY CONSUMPTION

5.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

Between 1990 and 2001, the average annual unit energy consumption of clothes washers improved remarkably. As Figure 5.3 shows, the average annual unit energy consumption decreased by 408 kWh over the study period, or about 33 percent.

FIGURE 5.3
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF CLOTHES WASHERS BY MODEL YEAR*



For greater detail, see Table C.10.

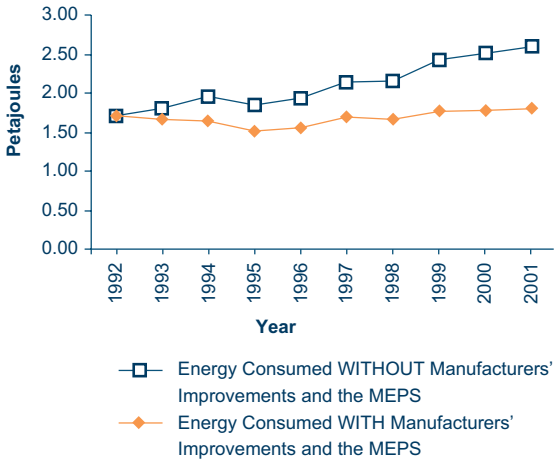
5.4 ENERGY SAVINGS

It is estimated that the annual energy consumption of clothes washers was slightly less from 1993 to 2001 than it would have been without the energy efficiency improvements made by manufacturers and the minimum energy performance standards (MEPS). The annual savings have been increasing steadily since 1996.

Figure 5.4 illustrates the likely annual energy consumption by clothes washers if manufacturers had not met the MEPS and improved technology (top line) and how much energy actually was consumed (bottom line).

Graphically, the divergence of the two lines in Figure 5.4 represents incremental annual energy savings. On average, clothes washers would have consumed 0.47 PJ more per year without the energy efficiency improvements made by manufacturers and the MEPS. The largest annual energy savings occurred in 2001, when clothes washers consumed about 0.81 PJ than they otherwise might have.

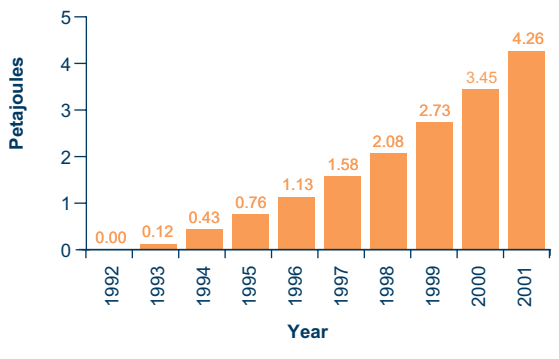
FIGURE 5.4
ANNUAL ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001*



For greater detail, see Table C.11.

The cumulative energy savings for clothes washers are shown in Figure 5.5. There was steady growth between 1992 and 2001, and accrued energy savings reached 4.26 PJ in 2001.

FIGURE 5.5
CUMULATIVE ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001*



For greater detail, see Table C.11.

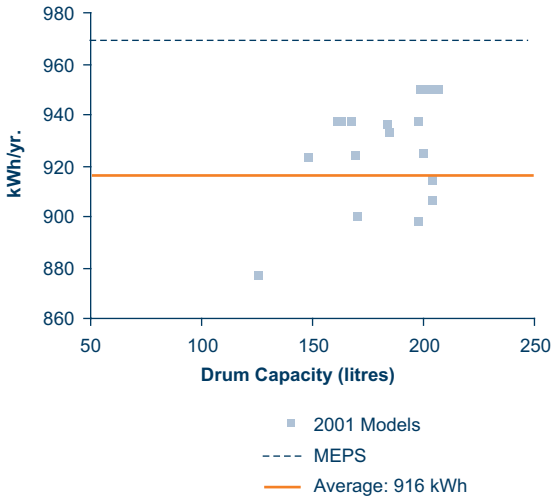
6 Electric Clothes Dryers

6.1 2001 MARKET SNAPSHOT

In 2001, the shipment-weighted average annual unit energy consumption of all electric clothes dryers was 916 kWh per year.

Electric clothes dryer is defined in Appendix B.

FIGURE 6.1
ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYER MODELS AVAILABLE IN 2001



6.2 DISTRIBUTION OF SHIPMENTS

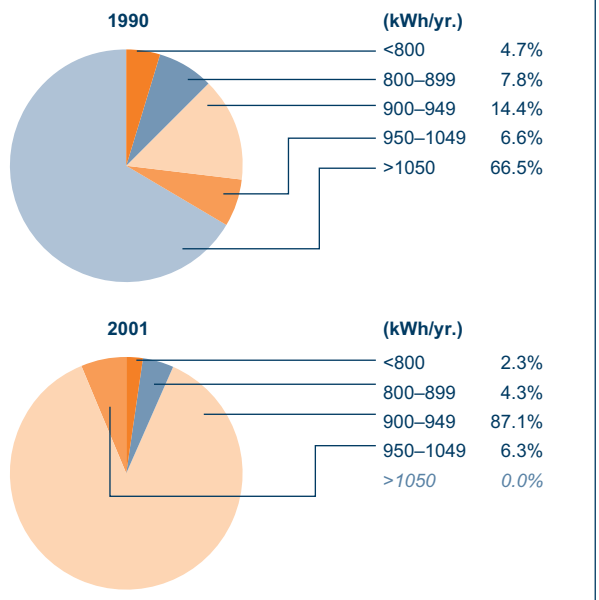
6.2.1 DISTRIBUTION BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Between 1990 and 2001, electric clothes dryers exhibited significant improvements in energy efficiency. The consumption level of over 1050 kWh per year, which dominated the market (66.5 percent) in 1990, had almost disappeared by 2001 (see Table 6.1). That year, 87.1 percent of electric clothes dryers consumed between 900 and 949 kWh. The improvement was remarkable. By the end of the study period, 93.7 percent of electric dryers on the market required less than 950 kWh per year, an impressive jump from 26.9 percent in 1990 (see Figure 6.2).

TABLE 6.1
DISTRIBUTION OF ELECTRIC CLOTHES DRYERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION

Model Year	kWh/yr. <800	800–899	900–949	950–1049	>1050
	(%)	(%)	(%)	(%)	(%)
1990	4.7	7.8	14.4	6.6	66.5
1991	5.3	0.2	30.0	38.0	26.5
1992	4.4	28.9	37.5	18.2	11.0
1993	4.1	28.9	53.6	7.2	6.1
1994	4.3	24.0	54.6	14.9	2.2
1995	3.2	16.2	68.5	10.8	1.3
1996	4.2	11.8	82.8	1.2	0.0
1997	4.9	12.9	80.7	1.4	0.0
1998	3.2	8.8	87.0	1.0	0.0
1999	2.7	7.2	88.3	1.8	0.0
2000	2.7	7.7	84.6	5.0	0.0
2001	2.3	4.3	87.1	6.3	0.0
Average Annual Change	**0.2%**	**0.3%**	**6.6%**	**0.0%**	**6.0%**

FIGURE 6.2
DISTRIBUTION OF ELECTRIC CLOTHES DRYERS BY AVERAGE ANNUAL UNIT ENERGY CONSUMPTION FOR 1990 AND 2001

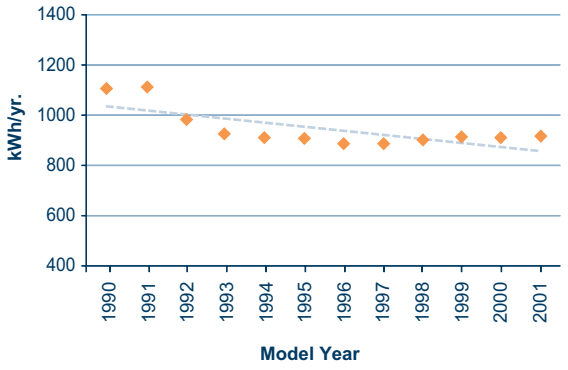


6.3 ENERGY CONSUMPTION

6.3.1 AVERAGE ANNUAL UNIT ENERGY CONSUMPTION BY MODEL YEAR

The improvement in energy efficiency for electric clothes dryers between 1990 and 2001 is illustrated in Figure 6.3. It shows a decrease in the average annual unit energy consumption of 186 kWh, or about 16.9 percent. This figure and Table C.12 (on page 41) show a significant improvement from 1991 to 1993, when the average annual unit energy consumption decreased from 1109 to 929 kWh – an impressive 180 kWh, or 16 percent. After 1993, the decrease in the average annual unit energy consumption tapered off. Average annual consumption began to increase slightly after 1997, and by 2001 it was higher than in 1994.

FIGURE 6.3
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYERS BY MODEL YEAR*



For greater detail, see Table C.12.

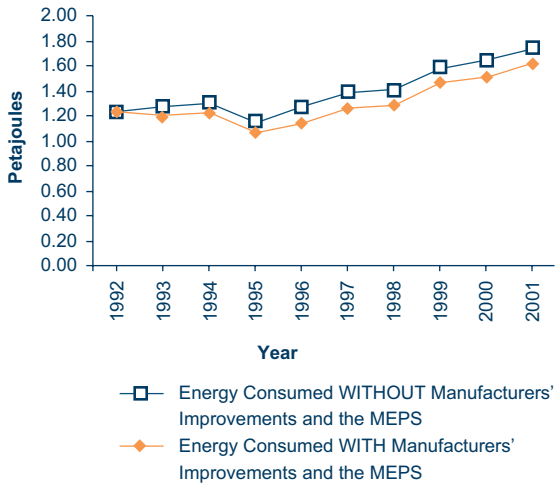
6.4 ENERGY SAVINGS

It is estimated that from 1993 to 2001, the annual energy consumption of electric clothes dryers was less than it would have been had manufacturers not met the minimum energy performance standards (MEPS) or improved energy efficiency.

Figure 6.4 shows how much energy might have been consumed annually by electric clothes dryers without the energy efficiency improvements made by manufacturers and the MEPS (top line) and how much energy they actually consumed (bottom line).

Graphically, the gap between the two lines represents incremental annual energy savings – on average, 0.11 PJ a year. The largest annual energy savings occurred in 1997, when electric clothes dryers consumed 0.14 PJ less than they otherwise might have.

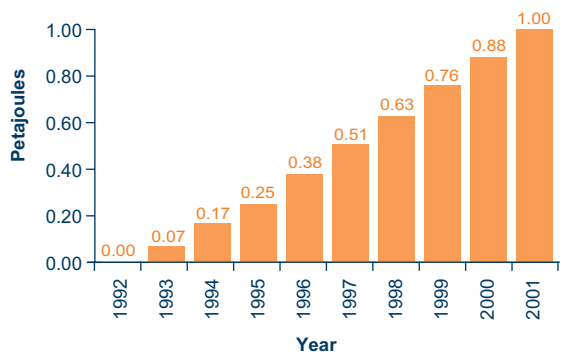
FIGURE 6.4
ANNUAL ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001*



*For greater detail, see Table C.13.

The cumulative energy savings for electric clothes dryers are shown in Figure 6.5. Savings grew steadily between 1992 and 2001, as annual energy savings began to accrue. They reached a total of 1.00 PJ in 2001.

FIGURE 6.5
CUMULATIVE ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001*



*For greater detail, see Table C.13.

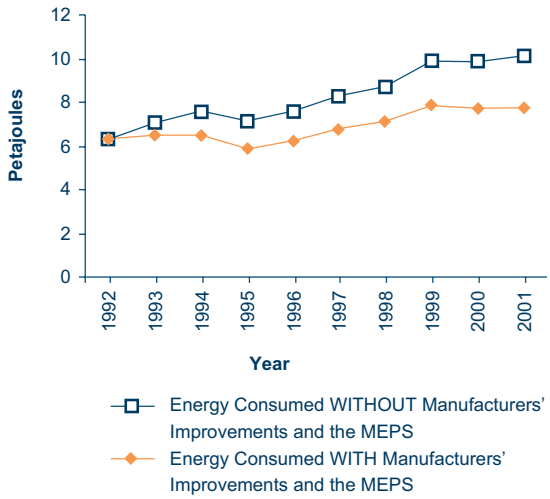
7 All Major Appliances

7.1 TOTAL ENERGY SAVINGS

Annual energy consumption for all major household appliances during the study period was reduced likely as a result of two factors: an increase in general energy efficiency resulted from manufacturers' technological improvements and the implementation of the minimum energy performance standards (MEPS) in 1995. Figure 7.1 shows the estimated annual energy consumption of major appliances between 1992 and 2001 without these two factors, as well as how much energy was actually consumed by major appliances.

The gap between the two lines in Figure 7.1 represents incremental annual energy savings. Energy efficiency began to improve almost immediately after the *Energy Efficiency Act* came into force in 1992, thanks to market forces, such as the regulations expected from the Act plus U.S. regulations.

FIGURE 7.1
ANNUAL ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001*

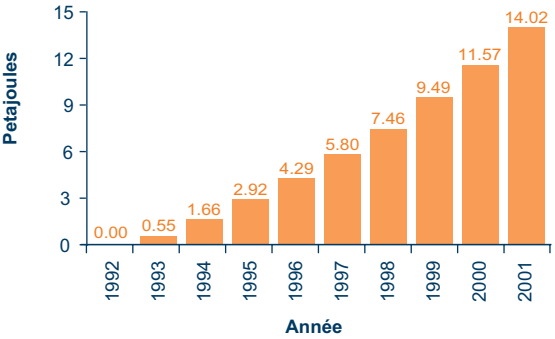


*For greater detail, see Table C.14.

The average annual energy savings for major appliances were estimated to be 1.56 PJ between 1993 and 2001. (No savings were expected in 1992.) This indicates that, on average, major appliances consumed about 1.56 PJ less per year than they would have without the energy efficiency improvements made by manufacturers and the MEPS set out in Canada's *Energy Efficiency Regulations*.

The largest annual energy savings occurred in 2001, when major appliances consumed about 2.45 PJ less than they otherwise would have. Cumulative energy savings for major appliances are shown in Figure 7.2 and Table C.14 (on page 42). Since the energy saved in any given year accrues over time, cumulative energy savings grew steadily between 1992 and 2001. They reached a total savings of 14.02 PJ in 2001, the equivalent of a year's energy for about 126 000 Canadian households.

FIGURE 7.2
CUMULATIVE ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001*



*For greater detail, see Table C.14.

Appendix A – Methodology

A.1 DATA PREPARATION

A.1.1 INTRODUCTION

In an ongoing effort to improve the monitoring of trends in Canadian energy use, Natural Resources Canada's (NRCan's) Office of Energy Efficiency (OEE) proposed an annual data collection arrangement with members of the Canadian Appliance Manufacturers Association (CAMA) in 1996, as part of the National Energy Use Database (NEUD) initiative.

Under this agreement, CAMA members contributed their annual shipment data for six appliance categories – refrigerators, freezers, electric ranges, dishwashers, clothes washers and electric clothes dryers – for analysis. To keep each appliance manufacturer's data confidential, appliance manufacturers suggested that a third party receive and prepare the database in a format in which no one (other than the third party) could determine the shipment data for an individual model or manufacturer. NRCan retained the services of Electro-Federation Canada (EFC), chosen by CAMA, as the third party to receive the data.

The following sections describe the database preparation process conducted by EFC.

The data presented in this report combine shipment figures from the major appliance manufacturers in Canada with the energy use information contained in NRCan's annual *EnerGuide Appliance Directory*. Analysts from EFC matched the model number from the manufacturer with the corresponding model in the *EnerGuide Directory*. Thus they arrived at the total energy consumption represented by all shipments of that model within each year. Then they aggregated these figures to provide the data presented in this report.

The analysts used the standard database and spreadsheet software to assemble the data, manipulated them as required and passed them to NRCan for analysis and report generation. For the reporting stages, they stripped all data of any information that could identify the manufacturer or the model number.

A.1.2 MANUFACTURERS' DATA

NRCan sent initial letters to the appliance manufacturers, requesting annual shipment data for each model of electric clothes dryer, clothes washer, dishwasher, freezer, electric range and refrigerator on the Canadian market from 1990 to 2001. When the project began in 1996, only three manufacturers provided shipment data. The number of data contributors increased to eight in 2001, covering the vast majority of appliance models sold in Canada. NRCan is approaching additional manufacturers in order to improve the coverage for future data collection.

Manufacturers sent the data in various electronic and printed formats. EFC converted the electronic data to a common database format. The analysts key-edited the printed reports and then converted them to the same format.

The data consisted of the appliance type, model number and number of shipments in each year. Manufacturers supplied individual files for each year. As each manufacturer provided data in a different format, the analysts harmonized and amalgamated the files to produce a single file for all models, by appliance type and model year.

The nature of the freezer market prevented EFC from obtaining a model-by-model breakdown of shipments. Instead, the analysts received total shipments and average energy use by freezer type. NRCan used this information to generate the freezer reports.

A.1.3 ENERGUIDE DATA

The analysts used the size, type and unit energy information from NRCan's EnerGuide ratings for each appliance to calculate the shipment-weighted energy use of each appliance type.

A.1.4 DATA MATCHING

Analysts from EFC matched the manufacturer's data for each model with the corresponding energy consumption data from the *EnerGuide Directory* for that model. They then multiplied the manufacturer's shipments for each model by the corresponding EnerGuide model's energy rating. This gave the shipment-weighted total energy consumption for that model. Each appliance category (e.g. refrigerator, dishwasher) and type and size category (as defined in the EnerGuide books) was then sub-totalled so that the average consumption could be worked out.

The *EnerGuide Appliance Directory* shows the basic model numbers available on the Canadian market. Many slight model variants have the same energy rating, so the listings use symbols (such as * and #) to indicate model families. As some model numbers have additional prefixes or suffixes to indicate features (e.g. colour, door-swing) that do not affect energy use, there were relatively few direct one-to-one matches.

Analysts needed to manipulate the data to perform pattern matching. They wrote programs to compare the model numbers supplied by the manufacturers with those in the *EnerGuide Directory*. When a match was found, the corresponding energy consumption figure and the information on the type from the *EnerGuide Directory* were added to the record for the annual shipments of the model.

Because there were many combinations of character substitution, the analysts adopted a method to work from the closest matches to the least likely matches. Thus they flagged matches in which only one character differed and removed them from further matching attempts. Attempts were then made with a difference of two characters, and so on.

The analysts developed reasonability tests to ensure the integrity of the data-matching process. For example, if the manufacturer's model number contained many characters but was matched by a model in the *EnerGuide Directory* that had considerably fewer characters, the model was flagged for manual checking. They also realized that manufacturers might re-use the same numbers for different models after several years. For example, 128 models of refrigerators in the file containing 1980 to 1993 data from the *EnerGuide Directory* have the same model number as those in the 1997 file, but with different energy ratings. They flagged these models for special treatment. During the matching process, analysts applied a "reasonability" criterion: a model would be checked manually if its shipments were reported more than three years after the last time the corresponding model appeared in the EnerGuide list.

Some difficulties occurred when the model number in NRCan's *EnerGuide Directory* differed from the actual model numbers used by the manufacturers in their internal shipment recording systems. In some cases, for example, manufacturers used special codes to denote models that were branded for other companies (such as department stores). The manufacturers helped resolve most of these cases.

A number of models remained unmatched even after the automated processes were performed. Whenever one of these models represented a substantial number of shipments for that appliance type, analysts handled it on an exceptional basis. Manufacturers were again helpful in the identification of these models and the verification of energy ratings and types.

The process continued until all but a few minor models were matched.

A.1.5 DATA SUMMARY AND TRANSFER

After the matching process, analysts summarized the data. To calculate the total annual energy consumption for each model, they multiplied the energy rating of the model by the number of shipments for the year. This yielded the shipment-weighted total energy used by that model for that year. For example, model XYZ has annual shipments of 5238 units and an annual energy consumption of 683 kWh per unit; its shipment-weighted total energy use for the year is 5238 x 683 = 3 577 554 kWh. This aggregate figure and the shipment figures were summed as necessary to provide totals for specific categories as appropriate for each appliance type.

For refrigerators, the actual volume of each model was available from the *EnerGuide Directory*. Therefore, it was possible to monitor the trend of changes in the size of refrigerators over the years. Furthermore, it was possible to determine the amount of energy used by each size category. Analysts also summarized this information and added it to the database for NRCan.

The final database prepared by EFC consisted of such information as the appliance type, model year, total energy consumption and average unit consumption. Refrigerators were further categorized by type and size. All the information was transferred to a spreadsheet and sent to NRCan for analysis and reporting.

A.2 ANALYSIS

The shipment-weighted average annual unit energy consumption (UEC) by category was calculated as total energy consumption of all the refrigerators sold in Canada in that category divided by total number of shipments in that category. The following gives an example of the shipment-weighted average energy consumption for the refrigerators:

$$\frac{\sum_{i=1}^{7} S\_type_i \times \overline{UEC\_type_i}}{\sum_{i=1}^{7} S\_type_i}$$

where S_type_i = Number of Sales of Type *i* refrigerators, and
$\overline{UEC\_type_i}$ = Average Unit Energy Consumption of Type *i* refrigerators

As mentioned in Data Preparation (Section A.1, above), data were obtained for some appliances by size category. Therefore, unit energy consumption per cubic foot was calculated by dividing the UEC of a given size category by the midpoint of the category.

Calculating the incremental energy savings for each appliance type was a three-step process. First, baseline levels of energy consumption were estimated for each appliance type for each year between 1990 and 2001. For all appliances, baseline levels of energy consumption reflected our assumptions about how much energy each appliance type would have consumed without the energy efficiency improvements made by manufacturers and the minimum energy performance standards (MEPS). To estimate baseline levels of energy consumption, we assumed the following:

- Without the implementation of Canada's *Energy Efficiency Regulations* and the general energy efficiency improvements made by manufacturers, the unit energy consumption for all appliance types would have remained constant at the 1992 levels.
- The number of units shipped would have remained the same between 1990 and 2001 even in the absence of the general efficiency improvements made by manufacturers and the implementation of the *Energy Efficiency Regulations*.

"Actual" or current levels of energy consumption for all appliances were calculated in an identical fashion. Even though the MEPS were not introduced until 1995, the baseline year used for all estimates of energy savings was 1992. This is because energy efficiency began to improve almost immediately after the *Energy Efficiency Act* came into force in 1992, thanks to market forces, which anticipated regulations to the Act and accounted for U.S. regulations. The average annual unit energy consumption for each appliance type for each model year was used, instead of holding it constant at 1992 levels. Incremental energy savings for all appliances were then calculated as the difference between baseline and actual levels of energy consumption.

Appendix B – Definitions

CLOTHES WASHER

An appliance that is designed to clean clothes using a water solution of soap or detergent or both, and mechanical agitation or other movement.

The Regulations apply to standard or compact electrically operated household clothes washers that are top- or front-loaded, and that have an internal control system that regulates the water temperature without the need for user intervention after the machine starts.

DISHWASHER

A cabinet-like appliance, either built-in or portable, that, with the aid of water and detergent, washes, rinses and dries (when a drying process is included) dishware, glassware, eating utensils and most cooking utensils by chemical, mechanical and electrical means and then discharges the water into the plumbing drainage system.

The Regulations apply to electrically operated automatic household dishwashers that are not commercial, industrial or institutional machines.

ELECTRIC CLOTHES DRYER

A cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced-air circulation. The heat source is electricity, and the drum and the blower(s) are driven by an electric motor(s).

The *EnerGuide Appliance Directory* groups electric clothes dryers into two categories:

- Compact Size – a clothes dryer with drum volume of less than 125 litres
- Standard Size – a clothes dryer with drum volume of 125 litres or greater

The Regulations apply to standard and compact electrically operated and electrically heated household tumble-type clothes dryers.

ELECTRIC RANGE

A consumer product utilizing electric resistance heating and used as the major household cooking appliance. The product may consist of a cook top, one or more ovens, or a combination of the two, and may be built-in or free-standing.

THE REGULATIONS APPLY TO HOUSEHOLD RANGES THAT ARE

a) free-standing appliances equipped with one or more surface elements and one or more ovens;
b) built-in appliances equipped with one or more surface elements and one or more ovens;
c) built-in appliances equipped with one or more ovens and no surface elements;
d) wall-mounted appliances equipped with one or more ovens and no surface elements; or
e) counter-mounted appliances equipped with one or more surface elements and no ovens;

BUT DO *NOT* INCLUDE THE FOLLOWING:

f) microwave cooking appliances;
g) appliances designed for an electrical supply of 120 volts; or
h) household appliances with one or more tungsten-halogen heating elements.

FREEZER

An appliance designed (i) for the extended storage of food frozen at an average temperature of –17.8ºC (0ºF) or lower; (ii) with the inherent capability for freezing food; and (iii) with a minimum freezing capability of 2 kg/100 L/24 h. The process of freezing involves removing heat from products to lower their temperature to a point where most of the water contained therein is solidified.

In 2001, freezers were typically built as either a vertical model or a chest model, and grouped into the following three types:

TYPE 8
Upright freezers with manual defrost

TYPE 9
Upright freezers with automatic defrost

TYPE 10
Chest freezers and all other freezers

The following types of freezers were added in 2002, however, some models had already appeared in the freezer market in 2001:

TYPE 16
Compact upright freezers with manual defrost

TYPE 17
Compact upright freezers with automatic defrost

TYPE 18
Compact chest freezers and all other freezers

The Regulations apply to household freezers that have a capacity of not more than 850 litres (30 cubic feet).

REFRIGERATOR

An appliance that consists of one or more compartments, with at least one of the compartments designed for the refrigerated storage of foods at temperatures above 0ºC (32ºF) and, if the model is a refrigerator-freezer, with at least one of the compartments designed for the freezing and storage of frozen foods at or below an average temperature of –15ºC (5ºF) and typically capable of being adjusted by the user to a temperature at or below –17.8ºC (0ºF). The refrigerator with a freezer compartment is capable of maintaining simultaneously an average freezer temperature ≤ –15ºC (5ºF) and an average fresh food compartment temperature ≥ 0ºC ≤ 5ºC (≥ 32ºF ≤ 41ºF).

In 2001, refrigerators as per the *EnerGuide Appliance Directory* were grouped under seven main categories:

TYPE 1
Refrigerators and refrigerator-freezers with manual defrost

TYPE 2
Refrigerator-freezers with partial automatic defrost

TYPE 3
Refrigerator-freezers with automatic defrost, with top-mounted freezer and without through-the-door service, as well as all refrigerators without freezers but with automatic defrost

TYPE 4
Refrigerator-freezers with automatic defrost, with side-mounted freezer and without through-the-door ice service

TYPE 5
Refrigerator-freezers with automatic defrost, with bottom-mounted freezer and without through-the-door ice service

TYPE 6
Refrigerator-freezers with automatic defrost, with top-mounted freezer and with through-the-door ice service

TYPE 7
Refrigerator-freezers with automatic defrost, with side-mounted freezer and with through-the-door ice service

The following types of refrigerators were added in 2002, though some models had already appeared on the refrigerator market in 2001:

TYPE 11
Compact refrigerators and refrigerator-freezers with manual defrost

TYPE 12
Compact refrigerators and refrigerator-freezers with partial automatic defrost

TYPE 13
Compact refrigerator-freezers with automatic defrost with top-mounted freezer and compact all-refrigerators with automatic defrost

TYPE 14
Compact refrigerator-freezers with automatic defrost with side-mounted freezer

TYPE 15
Compact refrigerator-freezers with automatic defrost with bottom-mounted freezer

The Regulations apply to household refrigerators or combination refrigerator-freezers that have a capacity of not more than 1100 litres (39 cubic feet), with the exception of refrigerators that employ an absorption refrigeration system.

Appendix C – Tables

TABLE C.1
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF REFRIGERATORS BY VOLUME

	Volume (cu. ft.)														
Model Year	0–2.4	2.5–4.4	4.5–6.4	6.5–8.4	8.5–10.4	10.5–12.4	12.5–14.4	14.5–16.4	16.5–18.4	18.5–20.4	20.5–22.4	22.5–24.4	24.5–26.4	26.5–28.4	28.5–30.4
	(kWh/yr.)														
1990	–	–	367	–	716	740	850	955	1067	1133	1041	1478	1416	–	–
1991	–	–	366	–	658	727	877	915	1018	978	950	1481	1371	–	–
1992	–	–	367	465	478	697	750	924	940	998	1047	1269	1400	1486	–
1993	–	–	367	465	440	593	600	700	731	799	848	939	1004	1228	1110
1994	308	336	365	465	407	563	547	627	665	720	805	906	856	1206	1105
1995	308	336	364	465	383	554	540	626	662	715	775	872	829	1123	977
1996	304	330	364	461	385	547	570	631	646	680	731	894	885	1051	1070
1997	299	315	338	440	400	548	568	632	664	695	716	924	901	923	1092
1998	299	322	436	385	415	564	562	629	675	703	722	853	883	860	983
1999	287	324	430	483	500	552	575	629	666	667	723	833	900	844	977
2000	283	325	430	503	521	550	583	625	667	637	699	809	894	820	976
2001	279	333	430	503	521	502	493	562	582	534	597	689	749	698	919

TABLE C.2
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION PER CUBIC FOOT OF REFRIGERATORS BY VOLUME

	Volume (cu. ft.)											
Model Year	4.5–6.4	6.5–8.4	8.5–10.4	10.5–12.4	12.5–14.4	14.5–16.4	16.5–18.4	18.5–20.4	20.5–22.4	22.5–24.4	24.5–26.4	26.5–28.4	28.5–30.4
	(kWh/cu. ft./yr.)												
1990	67	–	76	65	63	62	61	58	49	63	56	–	–
1991	67	–	70	64	65	59	58	50	44	63	54	–	–
1992	67	62	51	61	56	60	54	51	49	54	55	54	–
1993	67	62	47	52	45	45	42	41	40	40	39	45	38
1994	67	62	43	49	41	41	38	37	38	39	34	44	38
1995	67	62	41	48	40	41	38	37	36	37	33	41	33
1996	67	62	41	48	42	41	37	35	34	38	35	38	36
1997	62	59	42	48	42	41	38	36	33	39	35	34	37
1998	80	52	44	49	42	41	39	36	34	36	35	31	33
1999	79	65	53	48	43	41	38	34	34	36	35	31	33
2000	79	67	55	48	43	40	38	33	33	35	35	30	33
2001	79	68	55	44	37	36	33	27	28	29	29	25	31

Table C.3
ENERGY SAVINGS BY REFRIGERATORS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.22	1.22	0.00	0.00
1993	1.27	1.59	0.32	0.32
1994	1.30	1.80	0.50	0.82
1995	1.26	1.77	0.51	1.33
1996	1.28	1.80	0.52	1.86
1997	1.43	1.96	0.53	2.39
1998	1.63	2.24	0.62	3.01
1999	1.84	2.58	0.73	3.74
2000	1.79	2.52	0.73	4.47
2001	1.64	2.64	1.00	5.48

TABLE C.4
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF FREEZERS BY MODEL YEAR

Model Year	Type 8	Type 9	Type 10	Type 18	Total
	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)
1990	992.1	–	657.7	–	713.8
1991	706.4	1068.0	406.8	–	444.7
1992	670.4	1078.0	413.8	–	449.3
1993	581.3	863.3	368.2	–	401.7
1994	535.9	846.1	363.9	–	389.2
1995	508.9	817.1	353.2	–	381.6
1996	502.9	820.7	344.0	–	376.7
1997	494.8	823.7	341.9	–	376.5
1998	496.0	829.6	339.5	–	381.5
1999	492.1	838.6	337.5	–	383.4
2000	487.8	839.4	337.4	–	390.9
2001	447.6	740.5	336.7	258.3	383.9

Note: Prior to 2001 Type 18 freezers were included in Type 10 freezers.

TABLE C.5
ENERGY SAVINGS BY FREEZERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.36	0.36	0.00	0.00
1993	0.34	0.38	0.04	0.04
1994	0.32	0.37	0.05	0.09
1995	0.28	0.32	0.05	0.14
1996	0.24	0.28	0.05	0.18
1997	0.26	0.31	0.05	0.23
1998	0.32	0.38	0.06	0.29
1999	0.34	0.40	0.06	0.35
2000	0.33	0.37	0.05	0.40
2001	0.32	0.38	0.06	0.45

TABLE C.6
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF DISHWASHERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1025.7
1991	959.0
1992	908.0
1993	913.5
1994	776.7
1995	670.9
1996	668.2
1997	649.2
1998	646.7
1999	640.1
2000	637.4
2001	633.7

TABLE C.7
ENERGY SAVINGS BY DISHWASHERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.85	0.85	0.00	0.00
1993	0.90	0.89	-0.01	-0.01
1994	0.90	1.06	0.15	0.15
1995	0.77	1.04	0.27	0.42
1996	0.84	1.14	0.30	0.72
1997	0.84	1.18	0.34	1.06
1998	0.87	1.21	0.35	1.41
1999	1.02	1.45	0.43	1.84
2000	1.01	1.45	0.43	2.27
2001	1.01	1.45	0.44	2.71

TABLE C.8
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC RANGES BY MODEL YEAR

Model Year	Non-Self-Cleaning	Self-Cleaning	Total
	(kWh/yr.)	(kWh/yr.)	(kWh/yr.)
1990	785.7	726.8	772.2
1991	787.4	755.1	778.1
1992	788.3	754.1	778.6
1993	795.2	751.5	782.1
1994	785.4	746.6	773.6
1995	778.3	756.4	771.3
1996	780.3	762.5	774.4
1997	780.2	758.5	772.4
1998	778.2	759.7	770.6
1999	770.3	741.8	758.7
2000	770.7	746.3	759.9
2001	785.7	741.2	762.5

TABLE C.9
ENERGY SAVINGS BY ELECTRIC RANGES, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	0.94	0.94	0.00	0.00
1993	1.14	1.13	-0.01	-0.01
1994	1.08	1.09	0.01	0.00
1995	0.95	0.96	0.01	0.01
1996	1.14	1.15	0.01	0.02
1997	1.24	1.25	0.01	0.03
1998	1.31	1.32	0.01	0.04
1999	1.36	1.39	0.04	0.08
2000	1.31	1.35	0.03	0.11
2001	1.32	1.34	0.03	0.14

TABLE C.10
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF CLOTHES WASHERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1218.0
1991	1197.4
1992	1175.5
1993	1094.1
1994	989.1
1995	965.9
1996	948.7
1997	930.1
1998	903.3
1999	859.9
2000	838.3
2001	810.1

TABLE C.11
ENERGY SAVINGS BY CLOTHES WASHERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.70	1.70	0.00	0.00
1993	1.67	1.80	0.12	0.12
1994	1.64	1.94	0.31	0.43
1995	1.51	1.84	0.33	0.76
1996	1.56	1.93	0.37	1.13
1997	1.69	2.14	0.45	1.58
1998	1.66	2.16	0.50	2.08
1999	1.78	2.43	0.65	2.73
2000	1.78	2.50	0.72	3.45
2001	1.79	2.60	0.81	4.26

TABLE C.12
AVERAGE ANNUAL UNIT ENERGY CONSUMPTION OF ELECTRIC CLOTHES DRYERS BY MODEL YEAR

Model Year	kWh/yr.
1990	1102.6
1991	1108.7
1992	983.3
1993	928.5
1994	910.4
1995	909.1
1996	887.4
1997	887.3
1998	900.2
1999	907.5
2000	909.8
2001	916.3

TABLE C.13
ENERGY SAVINGS BY ELECTRIC CLOTHES DRYERS, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	1.23	1.23	0.00	0.00
1993	1.20	1.27	0.07	0.07
1994	1.21	1.31	0.10	0.17
1995	1.07	1.15	0.09	0.25
1996	1.15	1.27	0.12	0.38
1997	1.26	1.39	0.14	0.51
1998	1.29	1.41	0.12	0.63
1999	1.47	1.59	0.12	0.76
2000	1.52	1.64	0.12	0.88
2001	1.62	1.73	0.12	1.00

TABLE C.14
ENERGY SAVINGS BY ALL MAJOR APPLIANCES, 1992–2001

Model Year	Energy Consumed WITH Manufacturers' Improvements and the MEPS	Energy Consumed WITHOUT Manufacturers' Improvements and the MEPS	Annual Energy Savings	Cumulative Energy Savings
	(PJ)	(PJ)	(PJ)	(PJ)
1992	6.30	6.30	0.00	0.00
1993	6.51	7.05	0.55	0.55
1994	6.45	7.57	1.12	1.66
1995	5.84	7.09	1.26	2.92
1996	6.21	7.58	1.37	4.29
1997	6.72	8.23	1.51	5.80
1998	7.07	8.73	1.66	7.46
1999	7.81	9.84	2.03	9.49
2000	7.74	9.83	2.08	11.57
2001	7.70	10.15	2.45	14.02