A Report on Global Warming and Energy Consumption Trends of Major Appliances

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Executive Summary

Energy and global warming indices for ten major appliances have been examined. A two-page summary report for each appliance category has been written as well as a combined summary for major appliances. The appliances studied are: refrigerators, room air conditioners (RACs), freezers, gas ranges, electric ranges, microwave ovens, clothes washers, gas dryers, electric dryers, and dishwashers. This report contains copies of the summary reports, bibliographical data, assumptions, and data tables developed by this investigation. Computational spreadsheets have been developed that allows new data to be easily incorporated for future reports.

In general terms, most major appliance categories have reduced energy requirements over the past two decades. At the same time, increased appliance production causes overall energy demand and global warming effects to remain relatively constant. "Direct" global warming effects decrease significantly after the year 2010 as appliances using chlorinated refrigerants (primarily R11 and R12) are scrapped.

Acknowledgements

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Introduction

The focus of this study is energy consumption of major appliances and the resulting side effect of global warming. Today's appliances have been significantly improved in many ways over the past few decades. Continued advancements in sensors, microprocessors, and actuation devices should further advance the efficiency of today's appliances as well as improve an appliance's ability to meet each consumer's needs. The benefit to society as a whole will be a more efficient application of energy to an appliance, thus reducing an appliance's energy requirements and global warming impact.

Although several improvement areas exist for appliances, some of the most significant gains in energy efficiency may be external to the appliance industries. Improvement in overall electrical energy generation/transmission efficiency has a direct effect on energy and global warming. Changes in the average mix of energy generation technologies, assuming no change in efficiency, can also have a pronounced effect on global warming. Coal for example, results in significantly higher global warming effects than natural gas, which in turn, is significantly greater than renewable energy technologies (e.g., hydro, wind and solar energy).

The next section describes information to most appliance categories. The succeeding sections present information obtained or derived for each appliance category. Results from the analyses are contained in two-page summaries for each appliance category. These summaries are contained in Appendix A. A spreadsheet computational basis has been used for the numerical analyses. Copies of the spreadsheets for each appliance category are in Appendix B. Efforts have been made to develop spreadsheets that can be easily modified or appended as better information and data becomes available.

This study is meant to be a neutral examination of appliance energy trends over the past few decades along with a simple extension of these trends into the future. No recommendations or assessments of any particular appliance are made. Areas which need better data are identified. The variation of consumer usage patterns for many appliances makes energy demand a dynamic area with a continued need for assessment.

General Background Information

Information common to more than one appliance category analysis is discussed in this section. Primary considerations for all appliances are the forms of energy used by the appliance. The sources of energy that supply an appliance determines the overall global warming potential of an appliance's operation. Refrigeration/air conditioning appliances also require the added consideration of global warming indices for refrigerant compounds.

Energy is required in different forms for different appliances. Many appliances only use electrical energy. In this case, the carbon dioxide output from an average mix of electrical energy generation sources (coal, natural gas, oil, nuclear energy, renewable energy) for North America are used. The following mix of energy sources and their corresponding carbon dioxide production rates have been used throughout this study.

Generation Source	% N.American	kg-CO_2/kWhr$_e$
Coal	37	1.14
Oil	19	0.96
Gas	12	0.58
Hydro	19	0.00
Nuclear	13	0.00
Average Mix		0.67

The values for carbon dioxide production have been taken from section 3.4 of the "Alternative Fluorocarbons Environmental Acceptability Study" (AFEAS) report entitled "Energy and Global Warming Impacts of CFC Alternative Technologies" published by the U.S. Department of Energy, December, 1991. One should note that regional and seasonal energy mixes may differ significantly from the above average values. No attempt has been made in this study to weight overall energy requirements and global warming impact on a regionally and/or seasonally weighted basis.

Natural gas is an energy source used directly in conjunction with dishwashers, clothes washers, clothes dryers, and cooking ranges. Dishwashers and clothes washers use water that is often heated by natural gas. Clothes dryers and cooking ranges may use gas directly. Natural gas has been assumed to have a heating value of 38,200 kJ/m^3 (1025 Btu/ft^3). Global warming effects of natural gas have been assumed to be 51.1 gCO_2/MJ (53.9 gCO_2/1000Btu). The 1991 AFEAS report has been used as the source for this data (section 3.4).

All residential hot water is assumed to be heated by natural gas or electrical power. Natural gas is somewhat more popular (59%) than electric water heating (41%). Contributions from propane, fuel oil, and other sources of water heating (e.g., solar energy) have been neglected due to the dominance of electric and gas water heating systems. Fuel oil and propane account for less than 10% of all residential water heating, and solar thermal water heaters account for less than 1% of all residential water heating

(data taken from "Supplement to the Annual Energy Outlook 1994", Energy Information Administration, U.S. D.O.E., publication DOE/EIA-0554(94), p.120, March, 1994).

Appliances that use refrigerants impact global warming through releases of refrigerant compounds in addition to the carbon dioxide production from fossil fuel sources. The effect of refrigerant release is called the "direct" contribution to global warming while fossil fuel generated carbon dioxide is referred to as the "indirect" effect. Refrigerators and freezers have two contributing direct sources while room air conditioners (RACs) have only one direct contributing source. Refrigerators and freezers use refrigerant compounds for both the refrigeration system working fluid and for foam insulation in the cabinet walls. Prior to 1994-1995, "R12" (dichlorodifluoromethane) and "R11" (trichlorofluoromethane) were used for refrigerator/freezer cooling systems and wall insulation, respectively. Current refrigerator/freezer units use "R134a" (tetrafluoroethane) and "R141b" (dichlorofluoroethane) for cooling system and wall insulation, respectively. RACs currently use "R22" (chlorodifluoroethane), an HCFC, that is scheduled to be phased out by the year 2010. Future projections beyond 2010 in this study do not assume a change from R22 to a replacement substance because of the relatively small impact R22 from RACs on global warming and the uncertainty on its future replacement. Similar comments apply to the refrigerator/freezer use of R141b, another HCFC, for foam insulation.

Refrigerant compounds have various levels of infrared radiation absorption and atmospheric lifetime. The combination of these characteristics leads to a debate over the lifetime of a given refrigerant release. A "global warming index", or GWI, has been devised that equates a given amount of refrigerant to an amount of carbon dioxide. Carbon dioxide has a long atmospheric lifetime compared to common refrigerants. When a relatively short lifetime is used to define the GWI, the impact of a refrigerant is increased compared to the relatively long lifetime of carbon dioxide. Common time levels assumed for defining the GWI are 100 years and 500 years. Data for both time frames have been analyzed in the study. A table of GWI's for refrigerants used in appliances are listed below. The source of the data is a DOE report on CFC alternatives ("Energy Efficient Alternatives to Chlorofluorocarbons (CFCs)", U.S. Dept. of Energy, DOE/ER/30115-H1, June, 1993).

Refrigerant	100 year GWI	500 year GWI
CFC-11	3500	1500
CFC-12	7300	4500
HFC-134a	1200	420
HCFC-141b	440	150

A final issue common to all appliances is the estimated lifetime of each appliance. Detailed data on appliance lifetime is documented in the AHAM survey of appliance owners (final report to AHAM by NFO Research, Inc., job #13871-02, October, 1990). Average appliance lifetime, in general, impacts the amount of energy an appliance is capable of using during its useful lifetime. The results of the AHAM NFO study is in general

agreement with average appliance lifetime reported in Appliance ("A Portrait of the U.S. Appliance Industry 1994", September, 1994, p.66-71). Both reports also list information related to the distribution of an appliance's lifetime around the average value. Comparisons were made between the various forms of appliance lifetimes. NFO survey data tends to show that most appliances are discarded within three years of the average appliance lifetime.

The distribution assumed for a discarding an appliance has not been found to be significant. For example, if an appliance's average lifetime is 10 years and significant discarding occurs from year 7 to year 13, an average discarding rate (approximately 16% per year) yields trends similar to a Gaussian discarding pattern. Overall, because both have the same average lifetime and because there are very few years in which significant shifts in appliance characteristics occurs, there is negligible impact on the use of energy and production of carbon dioxide. The change of refrigerants for domestic refrigerators and freezers is somewhat more sensitive to the distribution, however, the effect is primarily a smoothing or sharpening of the future scrapping effect as old CFC refrigerators and freezers are replaced by the scrapping of non-CFC units.

A generalized distribution has been used for the appliance analyses in this report. All appliances have been assumed to be scrapped over a six year period surrounding their average lifetime. The table below shows the symmetrical distribution used.

Time from Average Lifetime (years)	Percent of Units Scrapped
-3	5
-2	10
-1	20
0	30
1	20
2	10
3	5

This concludes general parameters affecting more than one category of appliances. Specific information for each appliance category are listed in the succeeding section.

Specific Appliance Report Background Information

Clothes Washers

Clothes washers require information related to usage characteristics by consumers and energy requirements for heating water. General information is available in terms of "per unit" energy requirements per wash cycle (memo to Home Laundry Council from AHAM, "1994 Energy Efficiency and Consumption Data", May 19, 1995) . Also, information is available regarding estimates for overall clothes washing and water heating requirements for the United States (Energy Information Agency report, DOE/EIA-0321(90), February, 1993). Comparing overall information to per unit data spread over the appliance population indicates that additional field data is required to reduce uncertainties. EIA estimates show a total of 0.115 Quads per year for clothes washing activities. Assuming 400 wash cycles per year with 1990's reported 2.67 kW-hr per cycle from AHAM data results in an overall clothes washing energy of 0.245 Quads per year. This discrepancy has not been resolved. A conservative approach using the AHAM information for energy requirements combined with information from the EIA report on water has been used for this analysis. The trends shown in the summary sheet are reasonable, however, the magnitude in terms of overall energy and carbon dioxide production may be overestimated by as much as a factor of two.

Primary assumptions required for clothes washing analysis consist of choosing the number of wash cycles per year, the amount of heated water, and the temperature of the heated water. Additionally, the hot water must be broken into electrically heated and gas heated water. Some of these factors are related, such as the temperature change of the heated water and the amount of water heated.

An average clothes washing cycle is assumed to require 8.6kg (18.9 pounds) of water that is heated from 15C (59F) to 35C (95F). This amount of hot water is estimated based on the EIA report that 0.088 Quads of energy per year are used for heating water for clothes washing. Additionally, 400 wash cycles per year have been assumed. The mix of electrically heated and natural gas heated water follows the breakdown previously described. Hot water from natural gas is assumed to be 59 percent with a heating efficiency of 51 percent. Electrically heated water is assumed to be the other 41 percent with a heating efficiency of 83 percent. No improvements to water heating efficiency have been projected although this is an area in which improvements may occur.

The amount of energy for water heating is subtracted from the total energy per cycle reported from AHAM data. Years in which the industry-averaged energy per cycle is not reported have been linearly interpolated. This allows the energy and carbon dioxide production per cycle to be broken into the amounts related to operating the electrical components of the washing machine, the amount attributed to natural gas heating of water, and the amount attributed to electrically heated water. The overall amount of energy, and therefore carbon dioxide production, is proportional to the number of wash cycles per year. The summary sheet assumes 400 wash cycles per year, however, the

overall energy attributed to clothes washing from the EIA data suggests that the number of wash cycles per year may be 200.

Gas and Electric Dryers

Gas and electric clothes dryers are relatively straightforward to analyze because no auxiliary energy such as that required for water heating is required. Gas dryers require electric energy for operating motors and controls in addition to the gas used for drying clothes. Overall energy per drying cycle has been available from AHAM reports. The analyses are sensitive to the number of drying cycles per year. Overall energy reported by the EIA report (Energy Information Agency report, DOE/EIA-0321(90), February, 1993) has been used with information from AHAM data for average energy per drying cycle to estimate the number of drying cycles per year per dryer. 180 drying cycles per year has been assumed based on this analysis. Gas dryers are assumed to have electrical energy requirements that are 25 percent of the reported overall energy per cycle. Carbon dioxide production is based on this estimate for electrical and natural gas energy components.

Trends from reported dryer energy requirements have been used to project future energy trends. A reduction rate of 0.2 percent per year has been assumed for electric dryer energy requirements. Gas dryers have been assumed to have an annual energy reduction rate of 0.8 percent per year. These projected improvements in dryer energy requirements should be altered for future studies as data becomes available that more accurately shows changes of dryer technology. Gas dryer improvements would probably reduce to a level similar to that of electric dryers as their overall energy usage requirements become similar. Under the current assumptions, this condition is reached near the end of the projected study.

Dishwashers

Dishwashers are very similar to clothes washers because both appliances' energy demands are directly related to the number of operation cycles per year assumed. Also, both appliances use heated water in addition to the electrical energy required for motors, controls, and auxiliary heating. Similar difficulties are also encountered when estimating overall energy usage and carbon dioxide production characteristics. A typical dishwater load has been assumed to require 8.6 kg (18.9 pounds) of water heated from 15C (59F) to 45C (113F). Dishwasher usage has been assumed to be 180 cycles per year. Assumptions used for clothes washer water heating energy requirements have been used for dishwashers as well. References and assumptions for water heating are listed in the previous clothes washer section.

Gas and Electric Ranges

Range energy requirements are dependent on the amount of cooking time assumed, and the type of cooking (i.e., baking, broiling, stove top). Changes in cooking habits, "convenience" foods (precooked), microwave oven usage, and "eating out" all effect the amount of oven usage. Range usage, and other appliances as well, indirectly effects overall house conditioning energy requirements. During winter seasons in northern latitudes, range usage displaces some energy supplied by furnaces and humidifiers. Range

usage during summer periods results in an additional energy load on air conditioning systems. Residences without air conditioning often avoid range usage during warm weather periods. The combined effects of appliance usage and home conditioning have not been addressed by this study.

A wide range of annual energy usage for ranges are available, however, very little information is available that is based on extensive field data. The results from a Northern Illinois Gas Corp. shows an average usage of 56 therms per year for standing pilot units and 22 therms per year for electronic ignition units. These values have been used for all gas units. Prior to 1980, all gas units are assumed to have standing pilots. Units from 1980 to 1990 are assumed to be a 50/50 mix of standing pilot and electronic ignition. After 1990, all units are assumed to have electronic ignition.

Electronic ranges are also difficult to quantify because of lack of extensive field data. Assuming similar cooking efficiencies for electric ranges are similar to electronic ignition gas ranges, an electric range would require 653 kW-hr per year of energy. This energy would be the equivalent of that required to boil 2.7 kg (5.9 pounds) of water per day. This value has been used for all years of the study.

Testimonies regarding general cooking technology and potential efficiency improvements (DOE public hearing of proposed rulemaking for residential range/oven efficiency standards; Washington, D.C., June 7-8. 1994) indicates that cooking style rather than unit efficiency is the primary factor in energy consumption. Overall, field data from a variety of geographic and demographic regions is required to reduce the uncertainty in this data.

Microwave Ovens

Microwave oven popularity grew significantly over the past two decades. An especially high growth rate occurred during the mid-1980s. Unlike a "mature" appliance field such as refrigerators, this synchronized, first-time purchasing of microwave ranges by a large number of consumers may result in some future purchasing oscillations as scrapping of these units occur. Future projections in this study do not examine this potential effect. A steady 2 percent growth rate has been assumed.

Similar to conventional range/oven units, the primary factor affecting microwave oven energy requirements is the usage time. Significant debate exists regarding the average usage of microwave ovens. Microwave ovens, unlike other appliance categories, are often found in many other places such as workplaces and student dormitories. The significance of units sold for these areas are unknown.

Microwave oven usage has been assumed to be 100 kW-hr per year. Average input power of microwave ovens is 1443 watts which results in an average daily usage time of 11.4 minutes per day. Significant technology changes that affect microwave energy efficiency do not appear imminent. No advances have been assumed for future microwave oven usage.

Freezers

Freezer effects are more easily quantified than most of the previous appliances because the usage pattern is not significantly affected by the lifestyle/conventions of the consumer. The unit is connected, a basic thermostat setting is chosen, and the unit supplies the energy needed for maintaining the internal temperature of the cabinet relative to the surrounding room temperature. The primary difficulties for determining global warming affects of freezers is the "direct" contribution of refrigerant compounds used for both the refrigeration system and the foam insulation. The release, and therefore effects of these compounds primarily occurs when the unit is scrapped. Freezer global warming effects are more sensitive to the assumed scrapping distribution than other appliances because of the end-of-use.

Global warming indices for the primary refrigerant compounds used in refrigerators and freezers are given in the general section of this report. Amounts of refrigerants used for freezers and refrigerators have been taken from the previously referenced AFEAS report ("Energy and Global Warming Impacts of CFC Alternative Technologies" published by the U.S. Department of Energy, December, 1991).

Freezer cabinet insulation is assumed to be R11 prior to 1994 with a switch to R141b during 1994. An average freezer prior to 1994 is assumed to have 0.91 kg (2 pounds) of R11. Freezers beginning in 1994 are assumed to have an average of 1.0 kg (2.2 pounds) of R141b blowing agent.

Refrigeration system refrigerants for freezers are assumed to change from R12 to R134a during 1995. R12-based systems are assumed to have an average of 0.23 kg (0.5 pounds) of R12. R134a-based systems are assumed to have an average of 0.17 kg (0.375 pounds).

No reclamation of refrigerant compounds has been assumed in the analyses. Scrapping of units prior to the 1994/1995 switch in refrigerants will result in a significant direct effect caused by refrigerant compound releases. These releases will occur until approximately 2010, at which time scrapping of non-CFC freezers becomes significant.

Refrigerators

Refrigerators are treated in a similar manner to freezers. The refrigeration system is considered to be the same and the cabinet insulation is assumed to be the same. The primary difference is that freezers maintain the entire cabinet at a low temperature while refrigerators maintain different temperatures in the freshfood and freezer sections of the cabinet. This results in different energy requirements which have been taken into account from industry-averaged performance data. The direct global warming effect caused by refrigerant compounds has been assumed to be the same as the effects assumed per unit for freezers. All comments in the previous section regarding the types and amount of refrigerants used for freezers have also been used for refrigerator global warming modeling.

Room Air Conditioners

Room air conditioners (RACs) have both a direct effect caused by the use of an HCFC refrigerant compound and an indirect effect caused by its electrical energy demand. The overall level of energy usage, as in other appliances, is difficult to quantify because it depends on user preferences.

R22 is the primary refrigerant used in RACs. Although HCFCs are scheduled to be phased out in the future with no HCFC appliances built after 2010, no assumptions have been made regarding a replacement for R22 in the future. The direct effect of R22, relative to RAC indirect effects, is relatively small, and the associated global warming effects of potential replacements would have an uncertainty that is similar to R22's direct effect. For example, a future system utilizing air as a refrigerant may have a somewhat poorer energy efficiency that replaces R22's direct effect with an increased indirect effect.

The basic parameters assumed for R22-based RACs consist of 750 hours of operation per year and a refrigerant charge requirement of 0.72kg (1.58 pounds) of R22. The primary assumption is the usage. Field data over a range of demographic and geographic areas would help reduce this uncertainty. Similar to microwave ovens, RACs are also used fairly extensively for spot cooling in non-residential situations (office buildings, schools, etc.). The significance of these uses on the overall analysis has not been addressed.

Summary

This study has developed a basis for examining the relative energy consumption and global warming effects of several major appliance categories. Collection of more extensive field data for several appliance categories would help reduce the uncertainty of the analyses. Development of a series of computational spreadsheets for each appliance category allows new information to be incorporated to this study's results.

A series of summary reports have been developed and are contained in appendix A of this report. The summary reports are intended to be a general reference base for examining and discussing the effects of various major appliance categories on energy and global warming trends. The results are meant to be a beginning basis for dialogue and, as a means for deciding which information requires improvement. Assumptions regarding future trends such as appliance growth rates, scrapping distributions, and usage hours per year have been kept in basic terms to allow adjustments to be made to the analysis in a straightforward manner. No judgments regarding the trends and effects of any appliance are made or intended in this report.

Appendix A: Two-Page Summary Reports

The primary goal of this investigation has been the development of a series of two page "summary reports" that describe the characteristics of each major appliance category. This appendix contains copies of each summary report. Nine reports have been developed and are listed below. Eight are for specific appliance categories and one is an overall summary that combines results for all specific categories.

1) A Summary of Major Appliance Global Warming Impact
2) A Summary of Clothes Washer Global Warming Impact
3) A Summary of Gas and Electric Dryer Global Warming Impact
4) A Summary of Dishwasher Global Warming Impact
5) A Summary of Gas and Electric Range Global Warming Impact
6) A Summary of Microwave Oven Global Warming Impact
7) A Summary of Freezer Global Warming Impact
8) A Summary of Refrigerator Global Warming Impact
9) A Summary of Room Air Conditioner Global Warming Impact

A Summary of Major Appliance Global Warming Impact

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Today's major appliances show several interesting trends in terms of energy and global warming effects. Appliance energy requirements, as a whole, have consistently decreased over the past two decades. Global warming effects, which are primarily due to energy requirements, have also decreased on a unit basis. Increased numbers of major appliances offset the gains of increased energy efficiency such that future projections indicate a relatively level output of carbon dioxide. Figure 1 is a plot of total major appliance shipments since 1970. A constant 2 percent growth for all categories has been assumed beyond 1994. Current total appliance shipments have reached the 50 million per year level. All categories of appliances have had significant year-to-year variations in shipments due to economic climate variations. An overall 2 percent growth trend appears to be a reasonable extension of past shipment trends.

Figure 1 Total major appliance shipments since 1970 (2% growth assumed after 1994).

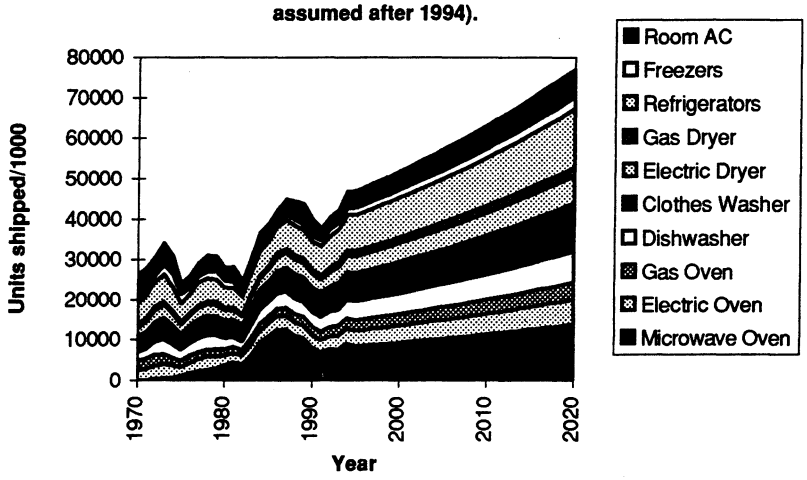


Figure 2 shows the annual contribution of all appliances to global warming in terms of total equivalent carbon dioxide production. Appliances with direct global warming effects (refrigerators, freezers, and room air conditioners) are assumed to release the direct effect compounds at the end of their useful lifetimes. No assumptions have been made regarding recovery of direct effect components. Significant recovery of R12 and R11 from pre-1994 refrigerator and freezer units can reduce the "hump" observed from the years 2000 to 2010.

Beyond 2010, most units using R11 and R12 are retired and the succeeding units using R134a and R141b have significantly lower global warming effects. Beyond the year 2010, a steady growth of carbon dioxide occurs due to increased numbers of appliance units.

Figure 2 Integrated annual appliance carbon dioxide output.

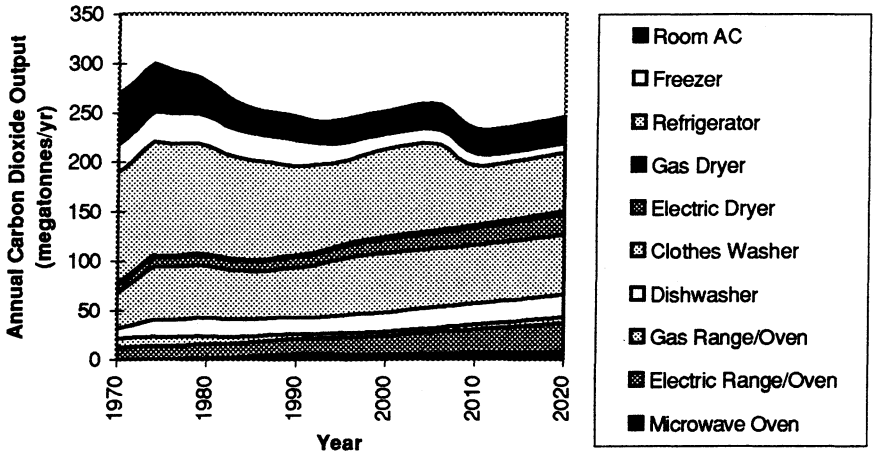
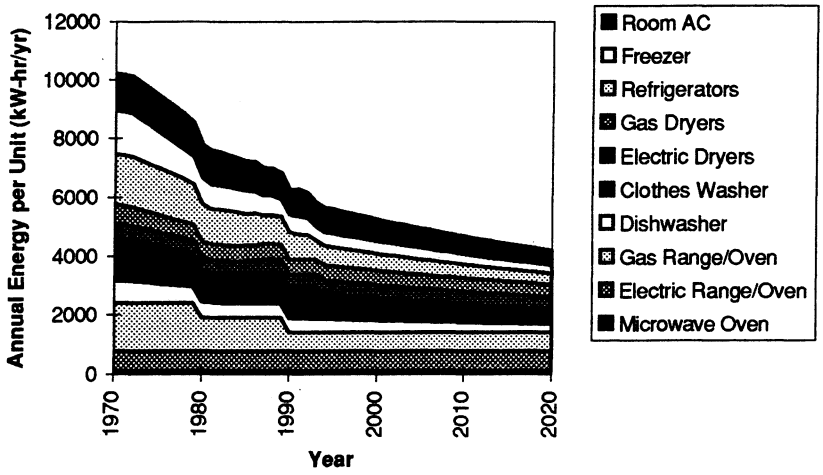


Figure 3 shows the effects of energy requirement changes on a per unit basis for appliances. Some appliances, such as electric ranges and microwave ovens, have not been changed over time because of scarcity of data available showing the trends in consumer use of these appliances. Other appliances, such as clothes washers and dishwashers that require hot water, could benefit from auxiliary equipment efficiency gains.

Figure 3 Annual energy requirement per appliance.



A Summary of Clothes Washer Global Warming Impact

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Clothes washers contribute to global warming by consumption of electrical power and energy required for heating water. Water is commonly heated by either electrical power or fuel combustion. The most common fuel is natural gas.

Figure 1 Plot of clothes washer factory shipments since 1970 (2% growth assumed after 1994).

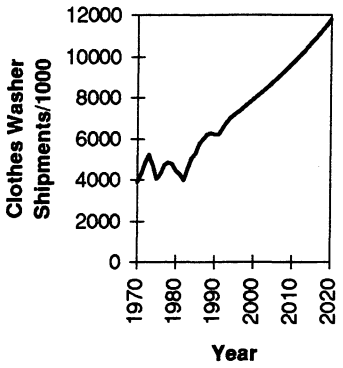

Figure 1 is a plot of clothes washer unit sales from 1970 extended through 2020. Historic sales have gone through significant cycles, but overall show a growth since 1980. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a dishwasher has been assumed to be 14 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 shows the energy per cycle requirements for each production year since 1970. A two percent decrease in required energy has been assumed for future years. Historically, the industry has been reducing energy consumption at a faster rate until 1980 when an increase in energy per cycle occurred. Reductions in energy requirements per cycle have occurred since 1990.

Figure 2 Energy per cycle requirement for clothes washers (includes water heating).

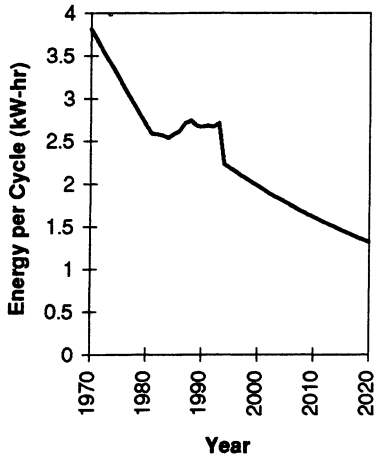

Figure 3 shows the amount of lifetime equivalent carbon dioxide output expected from each year's production volume. All TEWI contributions are from indirect sources. The primary source is the electrical power required by the clothes washer. The secondary source is water heating with similar amounts for gas water heating and

electric water heating. Gas water heaters are somewhat more popular than electric water heaters on a national basis (59% gas, 41% electric). Carbon output due to electric power has been determined by assuming a nationally averaged mix of utility power generation sources (coal, oil, gas, hydro, nuclear, solar). Electric water heating efficiency has been assumed to be 83%. Gas water heating assumes an average water heater efficiency of 51%.

Figure 3 Total carbon dioxide contribution for each production year.

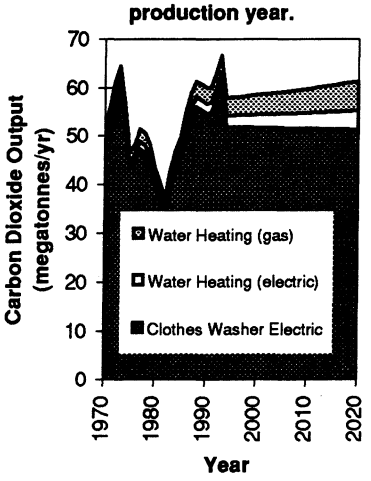

Figure 4 Lifetime carbon dioxide output per unit.

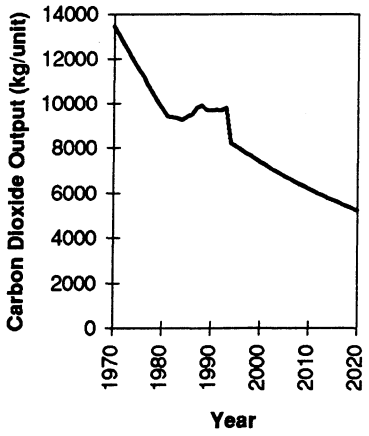

Figure 4 shows historic and projected lifetime carbon dioxide generation on a unit basis. Significant reductions in energy demand have been made until the mid-1980's. Beyond 1994, a two percent average energy reduction is estimated. These gains are assumed to be possible due to the introduction of higher efficiency motors, implementation of sensors for "dirt", and improvements in water heater efficiencies.

Figure 5 Integrated annual clothes washer carbon dioxide output.

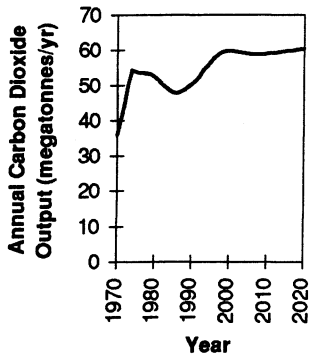

Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. Longterm increase in TEWI is due to the assumed growth in unit sales. The distribution is derived from AHAM's survey of home appliance owners. Average clothes washer lifetime is assumed to be 14 years. Significant scrapping of units begins at year 11. Most units have been scrapped after 17 years of operation. All TEWI contributions are assumed to occur in a distributed manner throughout the unit's lifetime. No significant carbon release is assumed to occur upon scrapping.

A Summary of Gas and Electric Dryer Global Warming Impact

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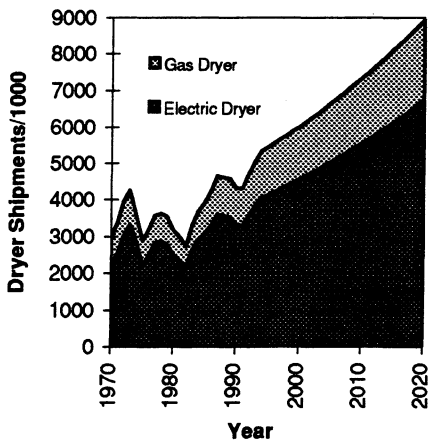
Electric and gas dryers contribute to global warming by consumption of either electrical power or fossil fuel. Clothes drying is a process in which heated air removes moisture from clothing. Electric dryers are the most popular type of unit. Gas heated dryers are the other common option. Figure 1 shows historic sales of dryers with a projected growth of 2 percent for future years.

Figure 1 Plot of gas and electric clothes dryer factory shipments since 1970 (2%growth assumed after 1994).



The average lifetime of an electric dryer has been assumed to be 13 years and the average lifetime of a gas dryer has been assumed to be 14 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 shows the historic change of energy demand per cycle for electric and gas dryers. From 1970 to 1994, energy requirements for electric dryers have dropped by 0.2 percent per year while gas dryer energy requirements have dropped by 0.8 percent per year. These values have been used to project future energy changes.

Figure 2 Energy per cycle for electric and gas dryers.

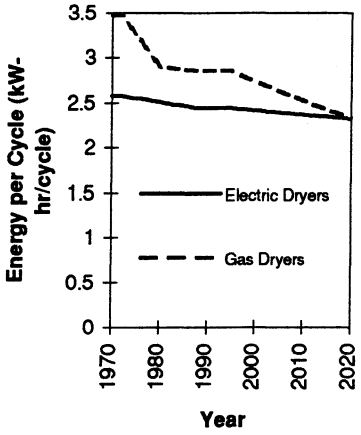


Figure 3 is a plot of the expected lifetime carbon dioxide generation for each production year of dryers. Gas ranges have significantly less carbon dioxide output due to lower carbon requirements per energy as well as the lower number of units manufactured. Figure 3 breaks gas dryer units into their electrically generated and gas generated carbon dioxide components.

Figure 4 shows the carbon dioxide production on a unit basis. Although

overall energy per unit is higher for gas dryers, the carbon dioxide generated from gas units tends to be significantly lower than electric units.

Figure 3 Total carbon dioxide contribution for each production year.

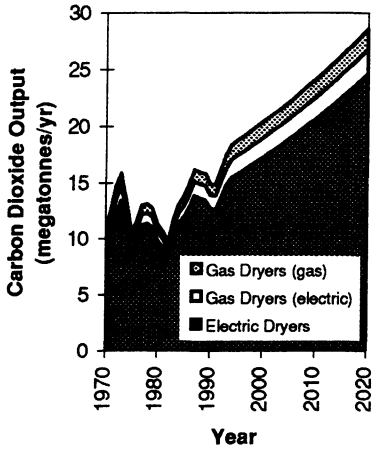


Figure 4 Lifetime carbon dioxide output per unit.

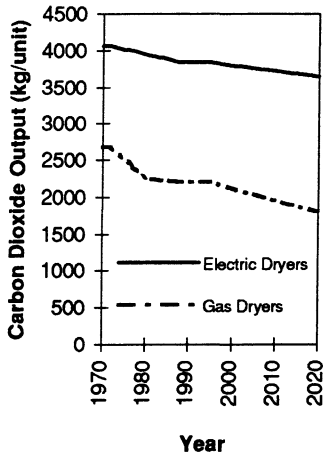
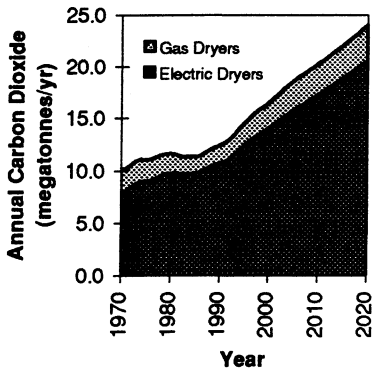


Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. Longterm increase in TEWI is due to the assumed growth in unit sales. The distribution is derived from AHAM's survey of home appliance owners. Average electric dryer lifetime is assumed to be 13 years. Significant scrapping of units begins at year 10. Most units have been scrapped after 16 years of operation. Average gas dryer lifetime is assumed to be 14 years with significant scrapping beginning in the year 11. All units are assumed to have been scrapped by the 17 year. All TEWI contributions are assumed to occur in a distributed manner throughout the unit's lifetime. No significant carbon release is assumed to occur upon scrapping.

Figure 5 Integrated annual equivalent dryer carbon dioxide output.



A Summary of Dishwasher Global Warming Impact

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Dishwashers contribute to global warming by consumption of electrical power and energy required for heating water. Water is commonly heated by either electrical power or fuel combustion. The most common fuel is natural gas.

Figure 1 Plot of dishwasher factory shipments since 1970 (2% growth assumed after 1994).

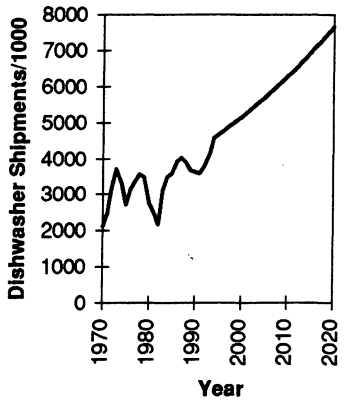

Figure 1 is a plot of dishwasher unit sales from 1970 extended through 2020. Historic sales have gone through significant cycles, but overall show a growth since 1980. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a dishwasher has been assumed to be 11 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 shows the energy per cycle requirements for each production year since 1970. A two percent decrease in required energy has been assumed for future years. Historically, the industry has been reducing energy consumption at a faster rate, although energy reductions have been level since the latter 1980's.

Figure 2 Energy per cycle requirement for dishwashers (includes water heating).

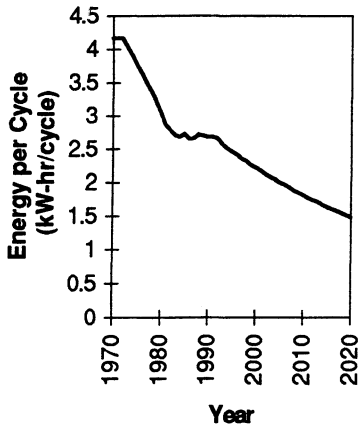

Figure 3 shows the amount of lifetime equivalent carbon dioxide output expected from each year's production volume. All TEWI contributions are from indirect sources. The primary source is the electrical power required by the dishwasher. The secondary source is water heating with similar amounts for gas water heating and electric water heating. Gas water heaters are somewhat more popular than electric water heaters

on a national basis (59% gas, 41% electric). Carbon output due to electric power has been determined by assuming a nationally averaged mix of utility power generation sources (coal, oil, gas, hydro, nuclear, solar). Electric water heating efficiency has been assumed to be 83%. Gas water heating assumes an average water heater efficiency of 51%.

Figure 3 Total carbon dioxide contribution for each production year.

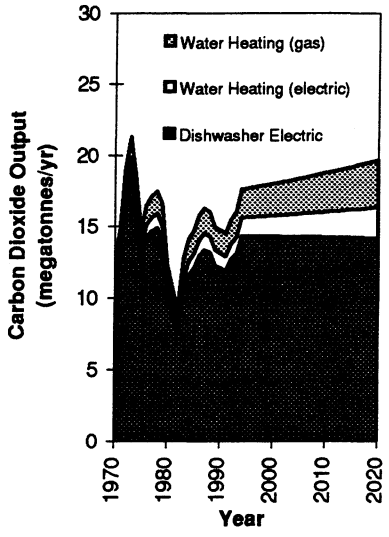

Figure 4 Lifetime carbon dioxide output per unit.

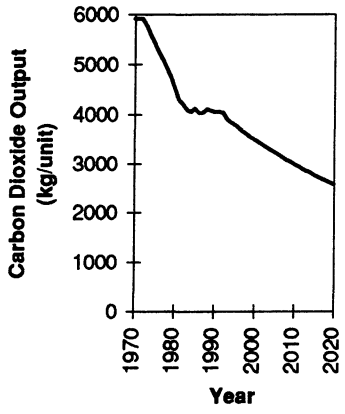

Figure 4 shows historic and projected lifetime carbon dioxide generation on a unit basis. Significant reductions in energy demand have been since 1970. Beyond 1994, a two percent average energy reduction is estimated. These gains are assumed to be possible due to the introduction of higher efficiency motors, implementation of sensors for "dirt", and improvements in water heater efficiencies.

Figure 5 Integrated annual dishwasher carbon dioxide output.

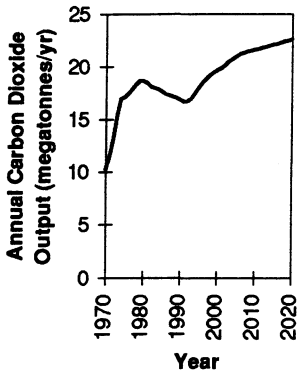

Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. Longterm increase in TEWI is due to the assumed growth in unit sales. The distribution is derived from AHAM's survey of home appliance owners. Average dishwasher lifetime is assumed to be 11 years. Significant scrapping of units begins at year 8. Most units have been scrapped after 14 years of operation. All TEWI contributions are assumed to occur in a distributed manner throughout the unit's lifetime. No significant carbon release is assumed to occur upon scrapping.

A Summary of Gas and Electric Range Global Warming Impact

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Electric and gas ranges contribute to global warming by consumption of either electrical power or fossil fuel. The process of cooking is complicated and does not leave many opportunities for reductions in energy consumption. Changes in the thermal mass of a range as well as insulation value of the oven compartment do not result in significant savings because energy requirements are dominated by convective heating and stove top cooking processes.

Figure 1 Plot of gas and electric range factory shipments since 1970 (2% growth assumed after 1994).

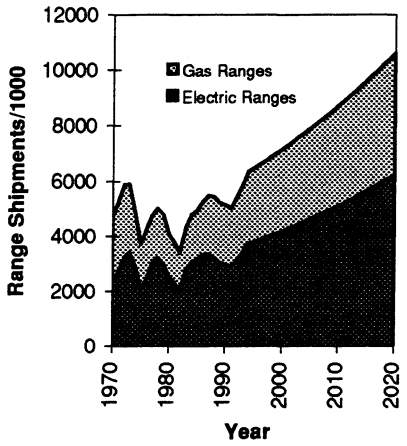


Figure 1 is a plot of electric and gas range unit sales from 1970 extended through 2020. Historic sales have gone through significant cycles, but overall show a growth since 1980. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of an electric range has been assumed to be 13 years and the average lifetime of a gas range has been assumed to be 14 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Electric range energy requirements on an annual basis are assumed to be 653 kW-hr per year. No variation in electric range energy requirements have been assumed over the 40 year time span. Gas ranges are assumed to have dropped in energy consumption from 56 therms per year to 22 therms per year due to implementation of electronic ignition. Electronic ignition has been assumed to have been phased in over the 1980's.

Figure 2 is a plot of the expected lifetime carbon dioxide generation for each production year of ranges. Electric and gas ranges had similar popularity during the early 1970's. Without electronic ignition, gas range carbon dioxide generation is similar in magnitude to the amount produced through electric range usage. A shift toward electric ranges along with implementation of electronic ignition has reduced gas range carbon dioxide generation relative to electric range carbon dioxide generation. On a per unit basis, electric ranges generate 5700 kg of carbon dioxide over a 13 year

lifetime. Gas ranges have changed from 4230 kg of carbon dioxide to 1660 kg of carbon dioxide generation over a 14 year lifespan due to electronic ignition.

Figure 2 Total carbon dioxide contribution for each production year.

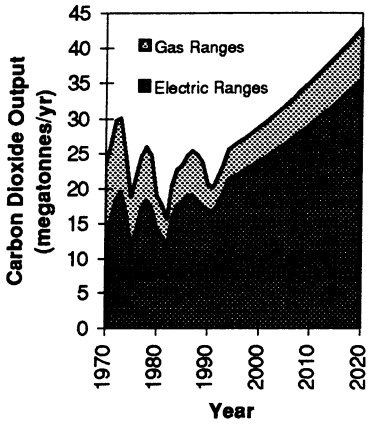
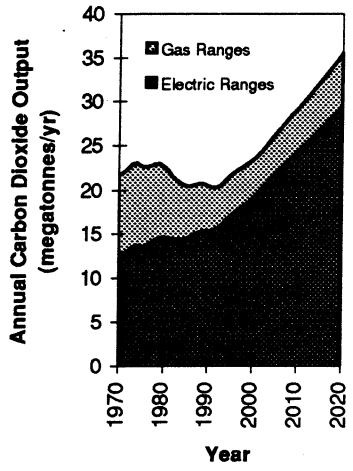


Figure 3 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. Longterm increase in TEWI is due to the assumed growth in unit sales. The distribution is derived from AHAM's survey of home appliance owners. Average electric oven lifetime is assumed to be 13 years. Significant scrapping of units begins at year 10. Most units have been scrapped after 16 years of operation. Average gas range lifetime is assumed to be 14 years with significant scrapping beginning in the year 11. All units are assumed to have been scrapped by the 17 year. All TEWI contributions are assumed to occur in a distributed manner throughout the unit's lifetime. No significant carbon release is assumed to occur upon scrapping.

Figure 3 Integrated annual gas and electric range carbon dioxide output.



A Summary of Microwave Oven Global Warming Impact

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Microwave ovens have become a commonplace appliance over the past twenty years. Rapid growth occurred throughout the 1970's and most of the 1980's. Many questions are unanswered and require investigations in order to accurately assess the impact of microwave ovens on both energy and global warming issues. For example, one of the most basic parameters, daily cooking time, is in wide disagreement among various sources due primarily to a lack of data. Additionally, little information is available that shows how microwave cooking time has affected conventional range cooking time.

Figure 1 Plot of microwave oven factory shipments since 1970 (2% growth assumed after 1994).

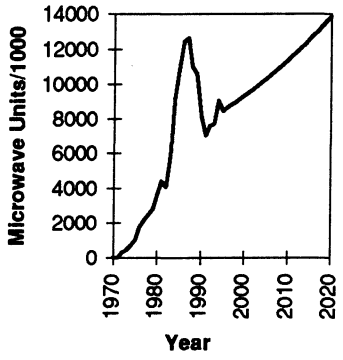


Figure 1 is a plot of microwave oven unit sales from 1970 extended through 2020. Rapid growth occurred until the mid-1980's. Sales dropped significantly until 1990 sales again increased. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a microwave oven has been assumed to be 10 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Microwave oven energy requirements have been assumed constant over the entire time frame at 1443 watts with an average daily cooking time of 11.4 minutes. Annual energy requirements are 100 kW-hr per year based on these values.

Recent discussions have occurred regarding methods for increasing microwave oven efficiency, however, there does not appear to be any easy technology path that can economically cause significant improvements to unit efficiencies. Current industry average efficiency is 56%.

Microwave ovens are approximately 15% of the total annual energy estimated for conventional gas/electric ranges. Reliable field data is needed in order to know how the two types of cooking appliances are used interactively. Microwave ovens would seem to have a much broader consumer base than conventional ranges, and therefore, a variety of usage patterns. Microwave

ovens are often found in offices, workshops, lunchrooms, and many other locations because of their compact size and convenience.

Figure 2 is a plot of the expected lifetime carbon dioxide generation for each production year of microwave ovens. On a per unit basis, microwave ovens are estimated to generate 672 kg of carbon dioxide over a 10 year lifetime. No variation of microwave oven efficiency or energy capacity has been assumed over the time period of interest.

Figure 2 Total carbon dioxide contribution for each production year.

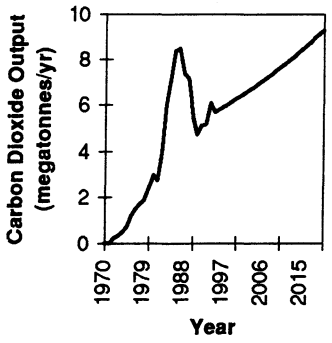
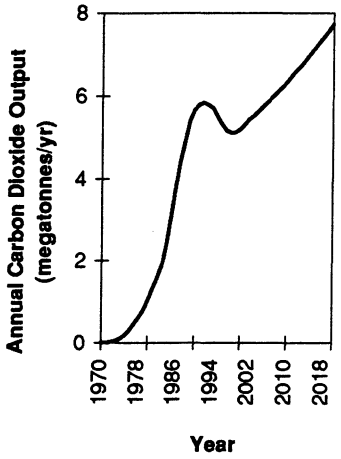


Figure 3 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. Long-term increase in TEWI is due to the assumed growth in unit sales. The distribution is derived from AHAM's survey of home appliance .. owners. Average microwave oven lifetime is assumed to be 10 years. Significant scrapping of units begins at year 7. All units are assumed scrapped after 13 years of operation. All TEWI contributions are assumed to occur in a distributed manner throughout the unit's lifetime. No significant carbon release is assumed to occur upon scrapping.

Although estimated microwave oven energy requirements are approximately 15% of conventional gas/electric oven units, the TEWI contribution is approximately 30% of conventional gas/electric ovens because of the relatively low TEWI contribution of gas ranges with electronic ignition.

Figure 3 Integrated annual microwave oven carbon dioxide output.



A Summary of Freezer Global Warming Impact

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Freezers, in a manner similar to refrigerators, impact global warming by three main mechanisms: energy consumption, refrigeration system refrigerant, and foam insulation blowing agent. Freezers have historically been similar to refrigerators in energy demand and overall lifetime carbon dioxide output on a unit basis. Improvements in energy efficiency and changes in refrigerants for both refrigeration and insulation systems will reduce total carbon output by almost 50% as older generation units are phased out.

Figure 1 Plot of freezer factory shipments since 1970 (2% growth assumed after 1994).

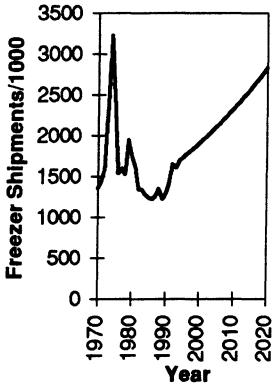

Figure 1 is a plot of overall freezer unit sales from 1970 extended through 2020. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a freezer has been assumed to be 16 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 shows the annual electric energy requirements for each production year since 1970. A two percent decrease in required energy has been assumed for future years. Historically, the industry has been reducing energy consumption at a faster rate.

Figure 2 Annual electric energy requirements for each production year.

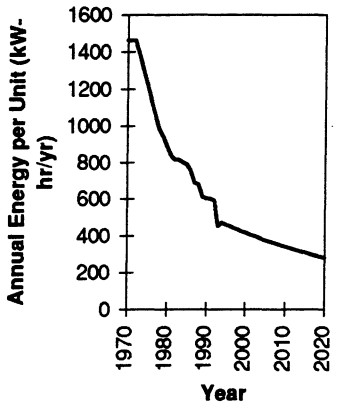

Figure 3 shows the amount of lifetime equivalent carbon dioxide output expected from each year's production volume. Indirect carbon dioxide output is due to the electric power consumption of the appliance. Refrigeration system refrigerant and foam insulation blowing agent are the components of the appliance's direct carbon contribution. A

100 year TEWI analysis has been assumed which more heavily weights the direct carbon contribution relative to the indirect. The indirect contribution has been determined by assuming a nationally averaged mix of utility power generation sources (coal, oil, gas, hydro, nuclear, solar). Lower unit sales of freezers results in a total carbon ouput that is less than half of that of refrigerators.

Figure 3 Total equivalent carbon dioxide contribution for each production year.

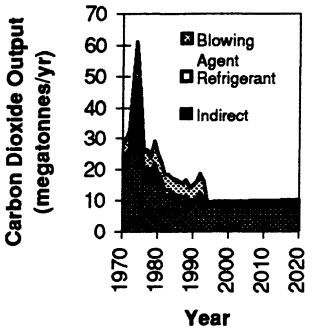

Figure 4 Lifetime carbon dioxide output per unit.

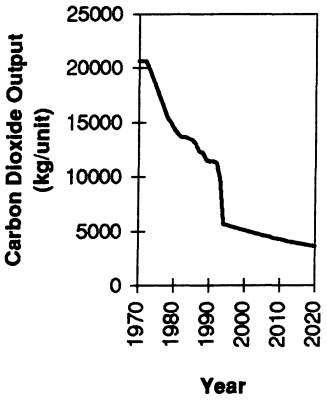

Figure 4 shows the significant change made in freezers on a unit basis. Significant reductions in equivalent carbon dioxide output have been made in all three categories. Energy efficiency improvements have been a major source of carbon reduction since 1970. Refrigerant and insulation blowing agent conversions in 1994 added to energy efficiency improvements. The conversion of refrigerant from R12 to R134a and insulation blowing agent from R11 to R141b reduced the direct carbon contribution to approximately 1/6 of its previous level. Advances made to refrigerators appear to be passed directly to freezers.

Figure 5 Integrated annual equivalent freezer carbon dioxide output.

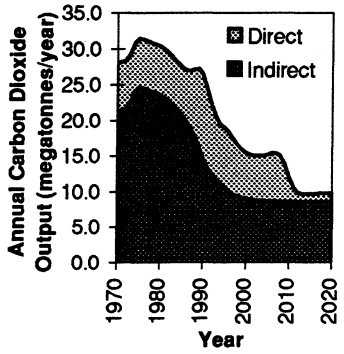

Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. The distribution is derived from AHAM's survey of home appliance owners. Average freezer lifetime is assumed to be 16 years, approximately 2 years longer than refrigerators. Significant scrapping of units begins at year 13. Most units have been scrapped after 20 years of operation. The direct carbon component due to refrigerant and blowing agent is assumed to occur at the end of a unit's lifetime. No recovery of refrigerant or blowing agent has been assumed. A large contribution to carbon production due to direct continues until the year 2010 when most units with R11 and R12 have been retired. Recovery during scrapping could significantly reduce these contributions.

A Summary of Refrigerator Global Warming Impact

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Today's refrigerators impact global warming by three main mechanisms: energy consumption, refrigeration system refrigerant, and foam insulation blowing agent. Refrigerators represent a significant fraction of the overall major appliance contribution to global warming. The primary reasons for refrigerators' global warming contribution are the large number of refrigerators, long operational lifetime, and relatively high energy requirement compared to other major appliances. Significant technological changes by the refrigeration industry has resulted in dramatic reductions in global warming factors. Improvements in energy efficiency and changes in refrigerants for both refrigeration and insulation systems will reduce total carbon output by almost 50% as older generation units are phased out.

Figure 1 Plot of refrigerator factory shipments since 1970 (2% growth assumed after 1994).

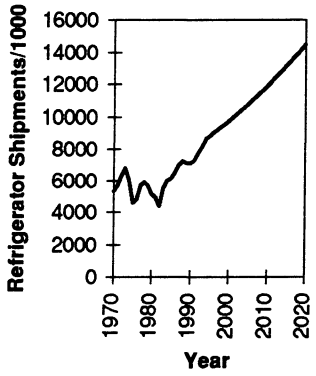

Figure 1 is a plot of overall refrigeration unit sales from 1970 extended through 2020. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a refrigerator has been assumed to be 14 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 Annual electric energy requirements for each production year.

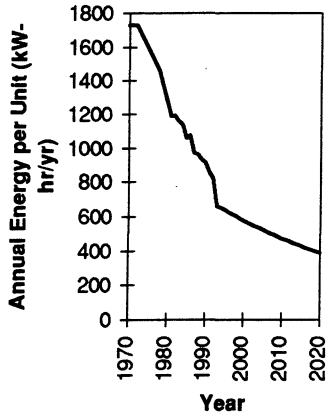

Figure 2 shows the annual electric energy requirements for each production year since 1970. A two percent decrease in required energy has been assumed for future years.

Figure 3 shows the amount of lifetime equivalent carbon dioxide output expected from each year's production volume. Indirect carbon dioxide output

is due to the electric power consumption of the appliance. Refrigeration system refrigerant and foam insulation blowing agent are the components of the appliance's direct carbon contribution. A 100 year TEWI analysis has been assumed which more heavily weights the direct carbon contribution relative to the indirect. The indirect contribution has been determined by assuming a nationally averaged mix of utility power generation sources (coal, oil, gas, hydro, nuclear, solar).

Figure 3 Total equivalent carbon dioxide contribution for each production year.

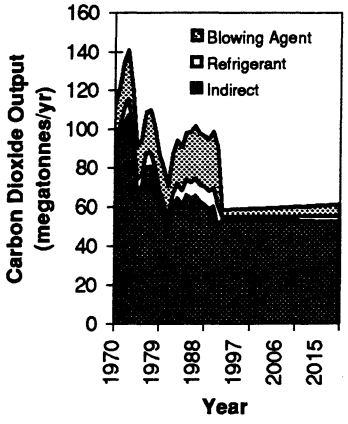

Figure 4 Lifetime carbon dioxide output per unit.

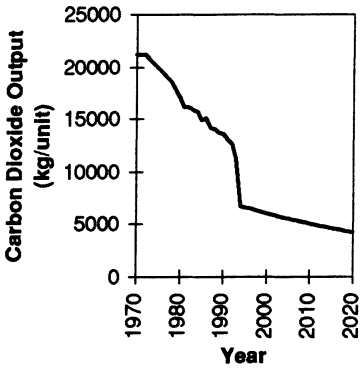

Figure 4 shows the significant change made in refrigerators on a unit basis. Significant reductions in equivalent carbon dioxide output have been made in all three categories. Energy efficiency improvements have been a major source of carbon reduction since 1970. Refrigerant and insulation blowing agent conversions in 1994 added to energy efficiency improvements. The conversion of refrigerant from R12 to R134a and insulation blowing agent from R11 to R141b reduced the direct carbon contribution to approximately 1/6 of its previous level.

Figure 5 Integrated annual equivalent refrigerator carbon dioxide output.

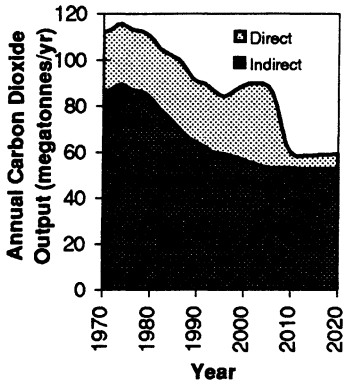

Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. The distribution is derived from AHAM's survey of home appliance owners. Average refrigerator lifetime is assumed to be 14 years. Significant scrapping of units begins at year 11. The direct carbon component due to refrigerant and blowing agent is assumed to occur at the end of a unit's lifetime. No recovery of refrigerant or blowing agent has been assumed. A large contribution to carbon production is seen to occur around the year 2000 due to the retirement of a large number of units with R12 and R11. Recovery during scrapping could significantly reduce these contributions. Beyond 2010, most R12/R11 units are retired and direct carbon contribution declines.

A Summary of Room Air Conditioner Global Warming Impact

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Room air conditioners impact global warming by two primary mechanisms: energy consumption and refrigeration system refrigerant. R22 is generally used as the refrigerant in room air conditioners. In terms of global warming potential, R22 is similar to R134a, the most common replacement for R12 systems.

Figure 1 Plot of room air conditioner factory shipments since 1970 (2% growth assumed after 1994).

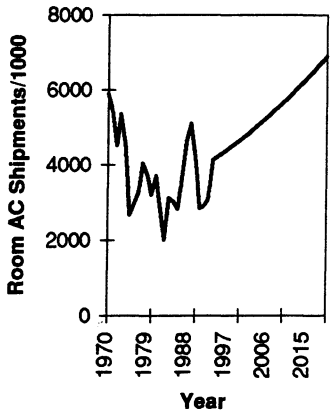

Figure 1 is a plot of overall room air conditioner (RAC) unit sales from 1970 extended through 2020. Shipment figures show wide variations on a year-by-year basis, possibly showing a correlation to summer weather as well as general business conditions. A 2 percent growth rate has been assumed for years beyond 1994. The average lifetime of a RAC has been assumed to be 9 years. Survey data from the Association of Home Appliance Manufacturer's (AHAM) indicates a distributed lifetime of approximately six years across the average lifetime.

Figure 2 Annual electric energy requirements for each production year (750 hours of operation assumed).

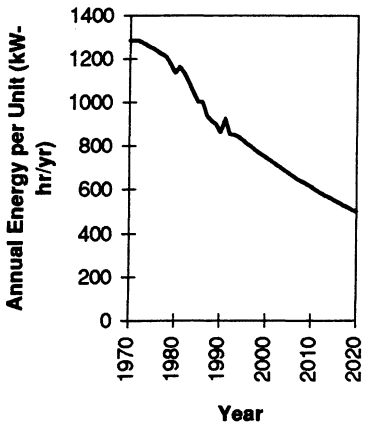

Figure 2 shows the annual electric energy requirements for each production year since 1970. A two percent decrease in required energy has been assumed for future years. This trend appears to be a reasonable extension of the significant energy improvements that have occurred over the past twenty five years.

Figure 3 shows the amount of lifetime equivalent carbon dioxide output expected from each year's production volume. Indirect carbon dioxide output is due to the electric power consumption of the appliance. RAC system refrigerant is the appliance's direct carbon contribution. A 100 year TEWI analysis has been assumed which more heavily

weights the direct carbon contribution relative to the indirect. The indirect contribution has been determined by assuming a nationally averaged mix of utility power generation sources (coal, oil, gas, hydro, nuclear, solar). No reduction in system charge has been predicted for future years which results in an increase in the direct component. Indirect contributions stay flat in the future because projected energy requirement reductions offset projected sales increases.

Figure 3 Total equivalent carbon dioxide contribution for each production year.

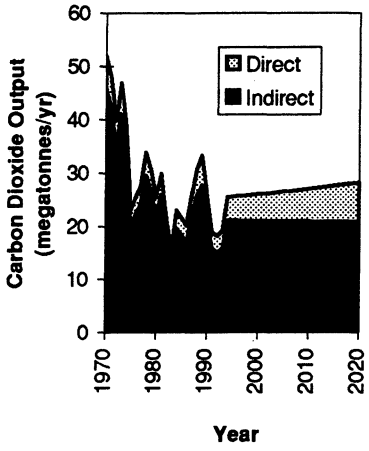

Figure 4 Lifetime carbon dioxide output per unit.

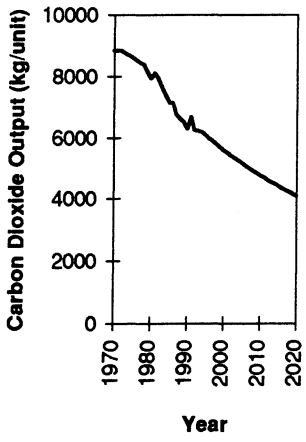

Figure 4 shows the significant change made in RACs on a unit basis. Energy efficiency improvements have been the major source of carbon reduction since 1970. Conversion from R22 to an alternative refrigerant will not result in as dramatic of a reduction as converted R12 systems because R22 is only 20 percent of R12 global warming potential.

Figure 5 Integrated annual equivalent room AC carbon dioxide output.

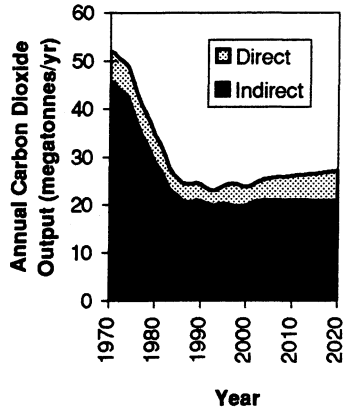

Figure 5 shows the annual equivalent carbon dioxide output from a distribution of previous years' production models. The distribution is derived from AHAM's survey of home appliance owners. Average RAC lifetime is assumed to be 9 years. Significant scrapping of units begins at year 6. Most units have been scrapped after 12 years of operation. The direct carbon component due to the refrigerant is assumed to occur at the end of a unit's lifetime. No recovery of refrigerant has been assumed.

Appendix B

The following Excel spreadsheets are listed in this appendix for the appliances listed below. Each spreadsheet is listed in a three page format. The first page lists basic data on unit production and energy demand. The second sheet determines global warming effects (TEWI) of each production year. The third sheet integrates the global warming data over the over an expected lifetime distribution of previous years production models.

Clothes Washers
Electric Dryers
Gas Dryers
Dishwashers
Electric Ranges
Gas Ranges
Microwave Ovens
Freezers (100 year GWI)
Freezers (500 year GWI)
Refrigerators (100 year GWI)
Refrigerators (500 year GWI)
Room Air Conditioners (100 year GWI)
Room Air Conditioners (500 year GWI)

APPLIANCE ENERGY ANALYSIS

Appliance Category | automatic washers

Elec/Gas Water Heat/Ave Water

	YEAR	UNITS (,000)	LIFE (years)	POWER (kW-hr/cycle)	HOT WATER (kg/cycle)	WATER(gas) therm/cycle	WATER(elec) kw-hr/cycle
	1970	3869	13	3.81	8.6	0.02	0.36
*	1971	4270	13	3.7	8.6	0.02	0.36
*	1972	4824	13	3.59	8.6	0.02	0.36
*	1973	5234	13	3.47	8.6	0.02	0.36
*	1974	4713	13	3.36	8.6	0.02	0.36
*	1975	4032	13	3.25	8.6	0.02	0.36
*	1976	4288	13	3.14	8.6	0.02	0.36
*	1977	4739	13	3.02	8.6	0.02	0.36
*	1978	4838	13	2.91	8.6	0.02	0.36
	1979	4779	13	2.8	8.6	0.02	0.36
*	1980	4426	13	2.7	8.6	0.02	0.36
	1981	4277	13	2.59	8.6	0.02	0.36
*	1982	3955	13	2.58	8.6	0.02	0.36
	1983	4546	13	2.57	8.6	0.02	0.36
	1984	5049	13	2.54	8.6	0.02	0.36
	1985	5279	13	2.58	8.6	0.02	0.36
	1986	5765	13	2.62	8.6	0.02	0.36
	1987	5998	13	2.71	8.6	0.02	0.36
	1988	6190	13	2.74	8.6	0.02	0.36
	1989	6252	13	2.68	8.6	0.02	0.36
	1990	6192	13	2.67	8.6	0.02	0.36
	1991	6197	13	2.68	8.6	0.02	0.36
	1992	6515	13	2.67	8.6	0.02	0.36
	1993	6793	13	2.71	8.6	0.02	0.36
	1994	7035	13	2.23	8.6	0.02	0.36
*	1995	7176	13	2.19	8.6	0.02	0.36
*	1996	7319	13	2.14	8.6	0.02	0.36
*	1997	7466	13	2.10	8.6	0.02	0.36
*	1998	7615	13	2.06	8.6	0.02	0.36
*	1999	7767	13	2.02	8.6	0.02	0.36
*	2000	7923	13	1.98	8.6	0.02	0.36
*	2001	8081	13	1.94	8.6	0.02	0.36
*	2002	8243	13	1.90	8.6	0.02	0.36
*	2003	8407	13	1.86	8.6	0.02	0.36
*	2004	8576	13	1.82	8.6	0.02	0.36
*	2005	8747	13	1.79	8.6	0.02	0.36
*	2006	8922	13	1.75	8.6	0.02	0.36
*	2007	9101	13	1.71	8.6	0.02	0.36
*	2008	9283	13	1.68	8.6	0.02	0.36
*	2009	9468	13	1.65	8.6	0.02	0.36
*	2010	9658	13	1.61	8.6	0.02	0.36
*	2011	9851	13	1.58	8.6	0.02	0.36
*	2012	10048	13	1.55	8.6	0.02	0.36
*	2013	10249	13	1.52	8.6	0.02	0.36
*	2014	10454	13	1.49	8.6	0.02	0.36
*	2015	10663	13	1.46	8.6	0.02	0.36
*	2016	10876	13	1.43	8.6	0.02	0.36
*	2017	11093	13	1.40	8.6	0.02	0.36
*	2018	11315	13	1.37	8.6	0.02	0.36
*	2019	11542	13	1.35	8.6	0.02	0.36
*	2020	11772	13	1.32	8.6	0.02	0.36

Note:
1) Water heated from 15C to 45C; heater efficiency, gas=51%; elec=83%
2) 400 wash cycles per year assumed, 33.5 gallon/cycle
3) Water heater population; gas=59%; elec=41%
4) 8.6kg hot water/cycle based on EIA data

APPLIANCE TEWI ANALYSIS

Appliance Category | automatic washers

Elec/Gas Water Heat/Ave Water

YEAR	UNITS (,000)	POWER ($MT-CO_2$)	WATER/GAS ($MT-CO_2$)	WATER/ELEC ($MT-CO_2$)	($MT-CO_2$) TEWI TOTAL	($kg-CO_2$) TEWI per UNIT
1970	3869	48.7	1.3	2.0	52.0	13440
1971	4270	52.2	1.4	2.2	55.8	13076
1972	4824	57.2	1.6	2.5	61.3	12713
1973	5234	60.0	1.8	2.7	64.5	12317
1974	4713	52.3	1.6	2.4	56.3	11953
1975	4032	43.3	1.3	2.1	46.7	11590
1976	4288	44.5	1.4	2.2	48.1	11227
1977	4739	47.3	1.6	2.5	51.3	10830
1978	4838	46.5	1.6	2.5	50.6	10467
1979	4779	44.2	1.6	2.5	48.3	10103
1980	4426	39.5	1.5	2.3	43.3	9773
1981	4277	36.6	1.4	2.2	40.2	9410
1982	3955	33.7	1.3	2.1	37.1	9377
1983	4546	38.6	1.5	2.4	42.5	9344
1984	5049	42.4	1.7	2.6	46.7	9245
1985	5279	45.0	1.8	2.7	49.5	9377
1986	5765	49.9	1.9	3.0	54.8	9509
1987	5998	53.7	2.0	3.1	58.8	9806
1988	6190	56.0	2.1	3.2	61.3	9905
1989	6252	55.3	2.1	3.2	60.7	9707
1990	6192	54.6	2.1	3.2	59.9	9674
1991	6197	54.9	2.1	3.2	60.2	9707
1992	6515	57.5	2.2	3.4	63.0	9674
1993	6793	60.8	2.3	3.5	66.6	9806
1994	7035	51.8	2.4	3.7	57.8	8221
1995	7176	51.8	2.4	3.7	57.9	8073
1996	7319	51.8	2.4	3.8	58.0	7929
1997	7466	51.8	2.5	3.9	58.1	7787
1998	7615	51.7	2.5	4.0	58.2	7649
1999	7767	51.7	2.6	4.0	58.4	7513
2000	7923	51.7	2.7	4.1	58.5	7380
2001	8081	51.7	2.7	4.2	58.6	7249
2002	8243	51.7	2.8	4.3	58.7	7121
2003	8407	51.6	2.8	4.4	58.8	6996
2004	8576	51.6	2.9	4.5	58.9	6873
2005	8747	51.6	2.9	4.5	59.1	6753
2006	8922	51.6	3.0	4.6	59.2	6635
2007	9101	51.6	3.0	4.7	59.3	6519
2008	9283	51.5	3.1	4.8	59.5	6406
2009	9468	51.5	3.2	4.9	59.6	6295
2010	9658	51.5	3.2	5.0	59.7	6186
2011	9851	51.5	3.3	5.1	59.9	6079
2012	10048	51.5	3.4	5.2	60.0	5975
2013	10249	51.4	3.4	5.3	60.2	5872
2014	10454	51.4	3.5	5.4	60.3	5772
2015	10663	51.4	3.6	5.5	60.5	5674
2016	10876	51.4	3.6	5.7	60.7	5577
2017	11093	51.3	3.7	5.8	60.8	5483
2018	11315	51.3	3.8	5.9	61.0	5390
2019	11542	51.3	3.9	6.0	61.2	5300
2020	11772	51.3	3.9	6.1	61.3	5211

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr15
/10%yr16/5%yr17

YEAR	(MT-CO_2) TEWI TOTAL
1970	36.0
1971	40.3
1972	45.0
1973	50.0
1974	54.3
1975	53.9
1976	53.6
1977	53.6
1978	53.4
1979	53.2
1980	52.5
1981	51.6
1982	50.4
1983	49.4
1984	48.7
1985	48.0
1986	47.8
1987	48.0
1988	48.7
1989	49.5
1990	50.3
1991	51.2
1992	52.5
1993	54.2
1994	55.4
1995	56.7
1996	57.8
1997	58.7
1998	59.3
1999	59.6
2000	59.7
2001	59.7
2002	59.6
2003	59.4
2004	59.2
2005	59.0
2006	58.8
2007	58.7
2008	58.7
2009	58.8
2010	59.0
2011	59.1
2012	59.2
2013	59.3
2014	59.5
2015	59.6
2016	59.8
2017	59.9
2018	60.0
2019	60.2
2020	60.4

APPLIANCE ENERGY ANALYSIS

Appliance Category clothes dryer

Electric Dryer

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/cycle)	GAS (therm/cycle)
*	1970	2129	13	2.58	0
*	1971	2527	13	2.58	0
	1972	2989	13	2.58	0
*	1973	3330	13	2.57	0
*	1974	2845	13	2.56	0
*	1975	2198	13	2.55	0
*	1976	2466	13	2.55	0
*	1977	2817	13	2.54	0
*	1978	2865	13	2.53	0
*	1979	2783	13	2.52	0
	1980	2494	13	2.51	0
*	1981	2337	13	2.5	0
*	1982	2143	13	2.49	0
*	1983	2622	13	2.48	0
*	1984	2931	13	2.48	0
*	1985	3080	13	2.47	0
*	1986	3309	13	2.46	0
*	1987	3600	13	2.45	0
	1988	3554	13	2.44	0
*	1989	3522	13	2.44	0
*	1990	3318	13	2.44	0
*	1991	3295	13	2.44	0
*	1992	3563	13	2.44	0
*	1993	3853	13	2.44	0
*	1994	4036	13	2.44	0
*	1995	4117	13	2.44	0
*	1996	4199	13	2.44	0
*	1997	4283	13	2.43	0
*	1998	4369	13	2.43	0
*	1999	4456	13	2.42	0
*	2000	4545	13	2.42	0
*	2001	4636	13	2.41	0
*	2002	4729	13	2.41	0
*	2003	4823	13	2.40	0
*	2004	4920	13	2.40	0
*	2005	5018	13	2.39	0
*	2006	5119	13	2.39	0
*	2007	5221	13	2.38	0
*	2008	5325	13	2.38	0
*	2009	5432	13	2.37	0
*	2010	5541	13	2.37	0
*	2011	5651	13	2.36	0
*	2012	5764	13	2.36	0
*	2013	5880	13	2.35	0
*	2014	5997	13	2.35	0
*	2015	6117	13	2.34	0
*	2016	6240	13	2.34	0
*	2017	6364	13	2.33	0
*	2018	6492	13	2.33	0
*	2019	6621	13	2.33	0
*	2020	6754	13	2.32	0

Note: 1) 180 dryer cycles per year assumed
2) Estimated energy reduction of 0.2% after 1996 assumed.

APPLIANCE TEWI ANALYSIS

Appliance Category clothes dryer

Electric Dryer

YEAR	UNITS (,000)	ELEC ($MT\text{-}CO_2$)	GAS ($MT\text{-}CO_2$)	($MT\text{-}CO_2$) **TEWI TOTAL**	($kg\text{-}CO_2$) **TEWI per UNIT**
1970	2129	8.6	0.0	8.6	4057
1971	2527	10.3	0.0	10.3	4057
1972	2989	12.1	0.0	12.1	4057
1973	3330	13.5	0.0	13.5	4041
1974	2845	11.5	0.0	11.5	4026
1975	2198	8.8	0.0	8.8	4010
1976	2466	9.9	0.0	9.9	4010
1977	2817	11.3	0.0	11.3	3994
1978	2865	11.4	0.0	11.4	3978
1979	2783	11.0	0.0	11.0	3963
1980	2494	9.8	0.0	9.8	3947
1981	2337	9.2	0.0	9.2	3931
1982	2143	8.4	0.0	8.4	3915
1983	2622	10.2	0.0	10.2	3900
1984	2931	11.4	0.0	11.4	3900
1985	3080	12.0	0.0	12.0	3884
1986	3309	12.8	0.0	12.8	3868
1987	3600	13.9	0.0	13.9	3853
1988	3554	13.6	0.0	13.6	3837
1989	3522	13.5	0.0	13.5	3837
1990	3318	12.7	0.0	12.7	3837
1991	3295	12.6	0.0	12.6	3837
1992	3563	13.7	0.0	13.7	3837
1993	3853	14.8	0.0	14.8	3837
1994	4036	15.5	0.0	15.5	3837
1995	4117	15.8	0.0	15.8	3837
1996	4199	16.1	0.0	16.1	3829
1997	4283	16.4	0.0	16.4	3822
1998	4369	16.7	0.0	16.7	3814
1999	4456	17.0	0.0	17.0	3806
2000	4545	17.3	0.0	17.3	3799
2001	4636	17.6	0.0	17.6	3791
2002	4729	17.9	0.0	17.9	3783
2003	4823	18.2	0.0	18.2	3776
2004	4920	18.5	0.0	18.5	3768
2005	5018	18.9	0.0	18.9	3761
2006	5119	19.2	0.0	19.2	3753
2007	5221	19.6	0.0	19.6	3746
2008	5325	19.9	0.0	19.9	3738
2009	5432	20.3	0.0	20.3	3731
2010	5541	20.6	0.0	20.6	3723
2011	5651	21.0	0.0	21.0	3716
2012	5764	21.4	0.0	21.4	3708
2013	5880	21.8	0.0	21.8	3701
2014	5997	22.2	0.0	22.2	3694
2015	6117	22.5	0.0	22.5	3686
2016	6240	23.0	0.0	23.0	3679
2017	6364	23.4	0.0	23.4	3672
2018	6492	23.8	0.0	23.8	3664
2019	6621	24.2	0.0	24.2	3657
2020	6754	24.6	0.0	24.6	3650

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr10/10%yr11/20%yr12/30%yr13/20%yr14
/10%yr15/5%yr16

YEAR	(MT-CO_2) TEWI TOTAL
1970	8.0
1971	8.1
1972	8.4
1973	8.7
1974	9.0
1975	9.0
1976	9.1
1977	9.3
1978	9.5
1979	9.7
1980	9.7
1981	9.8
1982	9.7
1983	9.7
1984	9.7
1985	9.7
1986	9.8
1987	10.1
1988	10.3
1989	10.5
1990	10.7
1991	10.9
1992	11.1
1993	11.5
1994	12.0
1995	12.4
1996	12.8
1997	13.1
1998	13.4
1999	13.7
2000	14.0
2001	14.3
2002	14.7
2003	15.1
2004	15.4
2005	15.8
2006	16.1
2007	16.4
2008	16.7
2009	17.0
2010	17.3
2011	17.6
2012	17.9
2013	18.2
2014	18.5
2015	18.9
2016	19.2
2017	19.6
2018	19.9
2019	20.3
2020	20.6

APPLIANCE ENERGY ANALYSIS

Appliance Category | clothes dryer

Gas Dryer

	YEAR	UNITS (,000)	LIFE (years)	TOT ENERGY (kW-hr/cycle)	ELEC (kW-hr/cycle)	GAS (therm/cycle)
*	1970	851	14	3.47	0.868	0.089
*	1971	850	14	3.47	0.868	0.089
	1972	936	14	3.47	0.868	0.089
*	1973	926	14	3.4	0.850	0.087
*	1974	739	14	3.33	0.833	0.086
*	1975	672	14	3.26	0.815	0.084
*	1976	708	14	3.19	0.798	0.082
*	1977	736	14	3.11	0.778	0.080
*	1978	757	14	3.04	0.760	0.078
*	1979	768	14	2.97	0.743	0.076
	1980	682	14	2.9	0.725	0.075
*	1981	640	14	2.89	0.723	0.074
*	1982	584	14	2.89	0.723	0.074
*	1983	672	14	2.88	0.720	0.074
*	1984	754	14	2.87	0.718	0.074
*	1985	834	14	2.87	0.718	0.074
*	1986	936	14	2.86	0.715	0.074
*	1987	1037	14	2.86	0.715	0.074
	1988	1047	14	2.85	0.713	0.073
*	1989	1052	14	2.85	0.713	0.073
*	1990	1002	14	2.85	0.713	0.073
*	1991	1018	14	2.85	0.713	0.073
*	1992	1154	14	2.85	0.713	0.073
*	1993	1221	14	2.85	0.713	0.073
*	1994	1303	14	2.85	0.713	0.073
*	1995	1329	14	2.85	0.713	0.073
*	1996	1356	14	2.83	0.707	0.073
*	1997	1383	14	2.80	0.701	0.072
*	1998	1410	14	2.78	0.696	0.072
*	1999	1439	14	2.76	0.690	0.071
*	2000	1467	14	2.74	0.684	0.070
*	2001	1497	14	2.72	0.679	0.070
*	2002	1527	14	2.69	0.674	0.069
*	2003	1557	14	2.67	0.668	0.069
*	2004	1588	14	2.65	0.663	0.068
*	2005	1620	14	2.63	0.658	0.068
*	2006	1653	14	2.61	0.652	0.067
*	2007	1686	14	2.59	0.647	0.067
*	2008	1719	14	2.57	0.642	0.066
*	2009	1754	14	2.55	0.637	0.065
*	2010	1789	14	2.53	0.632	0.065
*	2011	1825	14	2.51	0.627	0.064
*	2012	1861	14	2.49	0.622	0.064
*	2013	1898	14	2.47	0.617	0.063
*	2014	1936	14	2.45	0.612	0.063
*	2015	1975	14	2.43	0.607	0.062
*	2016	2014	14	2.41	0.602	0.062
*	2017	2055	14	2.39	0.597	0.061
*	2018	2096	14	2.37	0.592	0.061
*	2019	2138	14	2.35	0.588	0.060
*	2020	2180	14	2.33	0.583	0.060

Note: 1) 180 dryer cycles per year assumed
2) Electric = 25% total energy assumed; Gas = 75% total energy assumed
3) Future energy reductions assumed to be 0.8% per year after 1996.

* Estimated data

APPLIANCE TEWI ANALYSIS

Appliance Category clothes dryer

Gas Dryer

YEAR	UNITS (,000)	ELEC ($MT\text{-}CO_2$)	GAS ($MT\text{-}CO_2$)	($MT\text{-}CO_2$) TEWI TOTAL	($kg\text{-}CO_2$) TEWI per UNIT
1970	851	1.3	1.0	2.3	2681
1971	850	1.2	1.0	2.3	2681
1972	936	1.4	1.1	2.5	2681
1973	926	1.3	1.1	2.4	2627
1974	739	1.0	0.9	1.9	2573
1975	672	0.9	0.8	1.7	2519
1976	708	1.0	0.8	1.7	2465
1977	736	1.0	0.8	1.8	2403
1978	757	1.0	0.8	1.8	2349
1979	768	1.0	0.8	1.8	2295
1980	682	0.8	0.7	1.5	2241
1981	640	0.8	0.6	1.4	2233
1982	584	0.7	0.6	1.3	2233
1983	672	0.8	0.7	1.5	2225
1984	754	0.9	0.8	1.7	2217
1985	834	1.0	0.8	1.8	2217
1986	936	1.1	0.9	2.1	2210
1987	1037	1.3	1.0	2.3	2210
1988	1047	1.3	1.0	2.3	2202
1989	1052	1.3	1.0	2.3	2202
1990	1002	1.2	1.0	2.2	2202
1991	1018	1.2	1.0	2.2	2202
1992	1154	1.4	1.1	2.5	2202
1993	1221	1.5	1.2	2.7	2202
1994	1303	1.6	1.3	2.9	2202
1995	1329	1.6	1.3	2.9	2202
1996	1356	1.6	1.3	3.0	2184
1997	1383	1.6	1.4	3.0	2167
1998	1410	1.7	1.4	3.0	2150
1999	1439	1.7	1.4	3.1	2132
2000	1467	1.7	1.4	3.1	2115
2001	1497	1.7	1.4	3.1	2098
2002	1527	1.7	1.4	3.2	2082
2003	1557	1.8	1.5	3.2	2065
2004	1588	1.8	1.5	3.3	2048
2005	1620	1.8	1.5	3.3	2032
2006	1653	1.8	1.5	3.3	2016
2007	1686	1.8	1.5	3.4	2000
2008	1719	1.9	1.5	3.4	1984
2009	1754	1.9	1.6	3.5	1968
2010	1789	1.9	1.6	3.5	1952
2011	1825	1.9	1.6	3.5	1936
2012	1861	2.0	1.6	3.6	1921
2013	1898	2.0	1.6	3.6	1906
2014	1936	2.0	1.7	3.7	1890
2015	1975	2.0	1.7	3.7	1875
2016	2014	2.1	1.7	3.7	1860
2017	2055	2.1	1.7	3.8	1845
2018	2096	2.1	1.7	3.8	1831
2019	2138	2.1	1.8	3.9	1816
2020	2180	2.2	1.8	3.9	1801

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr15
/10%yr16/5%yr17

YEAR	(MT-CO_2) TEWI TOTAL
1970	2.1
1971	2.1
1972	2.1
1973	2.1
1974	2.1
1975	2.1
1976	2.0
1977	2.0
1978	2.0
1979	1.9
1980	1.9
1981	1.8
1982	1.7
1983	1.7
1984	1.6
1985	1.6
1986	1.6
1987	1.6
1988	1.6
1989	1.7
1990	1.7
1991	1.8
1992	1.8
1993	1.9
1994	2.0
1995	2.1
1996	2.2
1997	2.3
1998	2.4
1999	2.4
2000	2.5
2001	2.6
2002	2.6
2003	2.7
2004	2.8
2005	2.8
2006	2.9
2007	2.9
2008	3.0
2009	3.0
2010	3.0
2011	3.1
2012	3.1
2013	3.1
2014	3.2
2015	3.2
2016	3.2
2017	3.3
2018	3.3
2019	3.4
2020	3.4

APPLIANCE ENERGY ANALYSIS

Appliance Category dishwashers

Elec/Gas Water Heat/Ave Water

	YEAR	UNITS (,000)	LIFE (years)	POWER (kW-hr/cycle)	HOT WATER (kg/cycle)	WATER(gas) therm/cycle	WATER(elec) kw-hr/cycle
*	1970	2116	11	4.17	8.6	0.02	0.36
*	1971	2477	11	4.17	8.6	0.02	0.36
	1972	3199	11	4.17	8.6	0.02	0.36
*	1973	3702	11	4.04	8.6	0.02	0.36
*	1974	3320	11	3.9	8.6	0.02	0.36
*	1975	2702	11	3.77	8.6	0.02	0.36
*	1976	3140	11	3.63	8.6	0.02	0.36
*	1977	3356	11	3.5	8.6	0.02	0.36
*	1978	3557	11	3.36	8.6	0.02	0.36
	1979	3488	11	3.23	8.6	0.02	0.36
*	1980	2738	11	3.05	8.6	0.02	0.36
	1981	2484	11	2.87	8.6	0.02	0.36
*	1982	2170	11	2.79	8.6	0.02	0.36
	1983	3121	11	2.7	8.6	0.02	0.36
	1984	3491	11	2.67	8.6	0.02	0.36
	1985	3575	11	2.72	8.6	0.02	0.36
	1986	3918	11	2.65	8.6	0.02	0.36
	1987	4032	11	2.66	8.6	0.02	0.36
	1988	3907	11	2.71	8.6	0.02	0.36
	1989	3668	11	2.69	8.6	0.02	0.36
	1990	3637	11	2.67	8.6	0.02	0.36
	1991	3571	11	2.67	8.6	0.02	0.36
	1992	3820	11	2.66	8.6	0.02	0.36
	1993	4099	11	2.56	8.6	0.02	0.36
*	1994	4580	11	2.51	8.6	0.02	0.36
*	1995	4672	11	2.46	8.6	0.02	0.36
*	1996	4765	11	2.41	8.6	0.02	0.36
*	1997	4860	11	2.36	8.6	0.02	0.36
*	1998	4958	11	2.31	8.6	0.02	0.36
*	1999	5057	11	2.27	8.6	0.02	0.36
*	2000	5158	11	2.22	8.6	0.02	0.36
*	2001	5261	11	2.18	8.6	0.02	0.36
*	2002	5366	11	2.13	8.6	0.02	0.36
*	2003	5474	11	2.09	8.6	0.02	0.36
*	2004	5583	11	2.05	8.6	0.02	0.36
*	2005	5695	11	2.01	8.6	0.02	0.36
*	2006	5809	11	1.97	8.6	0.02	0.36
*	2007	5925	11	1.93	8.6	0.02	0.36
*	2008	6043	11	1.89	8.6	0.02	0.36
*	2009	6164	11	1.85	8.6	0.02	0.36
*	2010	6287	11	1.82	8.6	0.02	0.36
*	2011	6413	11	1.78	8.6	0.02	0.36
*	2012	6541	11	1.74	8.6	0.02	0.36
*	2013	6672	11	1.71	8.6	0.02	0.36
*	2014	6806	11	1.67	8.6	0.02	0.36
*	2015	6942	11	1.64	8.6	0.02	0.36
*	2016	7081	11	1.61	8.6	0.02	0.36
*	2017	7222	11	1.58	8.6	0.02	0.36
*	2018	7367	11	1.54	8.6	0.02	0.36
*	2019	7514	11	1.51	8.6	0.02	0.36
*	2020	7664	11	1.48	8.6	0.02	0.36

Note:
1) Water heated from 15C to 45C; heater efficiency, gas=51%; elec=83%
2) 180 wash cycles per year assumed, 33.5 gallon/cycle
3) Water heater population; gas=59%; elec=41%
4) 8.6kg hot water/cycle

APPLIANCE TEWI ANALYSIS

Appliance Category dishwashers

Elec/Gas Water Heat/Ave Water

YEAR	UNITS (,000)	POWER (MT-CO_2)	WATER/GAS (MT-CO_2)	WATER/ELEC (MT-CO_2)	(MT-CO_2) TEWI TOTAL	(kg-CO_2) TEWI per UNIT
1970	2116	11.0	0.6	0.9	12.5	5913
1971	2477	12.9	0.7	1.1	14.6	5913
1972	3199	16.6	0.9	1.4	18.9	5913
1973	3702	18.6	1.0	1.6	21.3	5751
1974	3320	16.1	0.9	1.5	18.5	5577
1975	2702	12.7	0.8	1.2	14.6	5415
1976	3140	14.2	0.9	1.4	16.5	5241
1977	3356	14.6	1.0	1.5	17.0	5079
1978	3557	14.9	1.0	1.6	17.4	4905
1979	3488	14.0	1.0	1.5	16.5	4743
1980	2738	10.4	0.8	1.2	12.4	4519
1981	2484	8.9	0.7	1.1	10.7	4295
1982	2170	7.5	0.6	1.0	9.1	4195
1983	3121	10.5	0.9	1.4	12.7	4083
1984	3491	11.6	1.0	1.5	14.1	4046
1985	3575	12.1	1.0	1.6	14.7	4108
1986	3918	12.9	1.1	1.7	15.8	4021
1987	4032	13.3	1.1	1.8	16.3	4033
1988	3907	13.2	1.1	1.7	16.0	4096
1989	3668	12.3	1.0	1.6	14.9	4071
1990	3637	12.1	1.0	1.6	14.7	4046
1991	3571	11.9	1.0	1.6	14.4	4046
1992	3820	12.6	1.1	1.7	15.4	4033
1993	4099	13.1	1.2	1.8	16.0	3909
1994	4580	14.3	1.3	2.0	17.6	3845
1995	4672	14.3	1.3	2.1	17.7	3783
1996	4765	14.3	1.3	2.1	17.7	3722
1997	4860	14.3	1.4	2.1	17.8	3662
1998	4958	14.3	1.4	2.2	17.9	3603
1999	5057	14.3	1.4	2.2	17.9	3545
2000	5158	14.3	1.5	2.3	18.0	3489
2001	5261	14.3	1.5	2.3	18.1	3433
2002	5366	14.3	1.5	2.4	18.1	3379
2003	5474	14.2	1.5	2.4	18.2	3326
2004	5583	14.2	1.6	2.5	18.3	3274
2005	5695	14.2	1.6	2.5	18.4	3223
2006	5809	14.2	1.6	2.6	18.4	3173
2007	5925	14.2	1.7	2.6	18.5	3124
2008	6043	14.2	1.7	2.7	18.6	3076
2009	6164	14.2	1.7	2.7	18.7	3029
2010	6287	14.2	1.8	2.8	18.8	2983
2011	6413	14.2	1.8	2.8	18.8	2938
2012	6541	14.2	1.9	2.9	18.9	2893
2013	6672	14.2	1.9	2.9	19.0	2850
2014	6806	14.2	1.9	3.0	19.1	2807
2015	6942	14.2	2.0	3.1	19.2	2766
2016	7081	14.2	2.0	3.1	19.3	2725
2017	7222	14.2	2.0	3.2	19.4	2685
2018	7367	14.2	2.1	3.2	19.5	2645
2019	7514	14.2	2.1	3.3	19.6	2607
2020	7664	14.2	2.2	3.4	19.7	2569

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr15/10%yr16/5%yr17

YEAR	(MT-CO_2) TEWI TOTAL
1970	10.2
1971	11.6
1972	13.3
1973	15.2
1974	16.9
1975	17.1
1976	17.5
1977	17.9
1978	18.3
1979	18.7
1980	18.7
1981	18.5
1982	18.1
1983	18.0
1984	17.9
1985	17.6
1986	17.4
1987	17.3
1988	17.2
1989	17.0
1990	16.8
1991	16.7
1992	16.7
1993	17.0
1994	17.5
1995	18.0
1996	18.5
1997	18.9
1998	19.2
1999	19.5
2000	19.7
2001	19.9
2002	20.2
2003	20.4
2004	20.7
2005	21.0
2006	21.2
2007	21.3
2008	21.4
2009	21.5
2010	21.6
2011	21.7
2012	21.8
2013	21.9
2014	22.0
2015	22.1
2016	22.2
2017	22.3
2018	22.4
2019	22.5
2020	22.6

APPLIANCE ENERGY ANALYSIS

Appliance Category oven

Electric Oven

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)
*	1970	2362	13	653
*	1971	2714	13	653
	1972	3232	13	653
*	1973	3430	13	653
*	1974	2925	13	653
*	1975	2082	13	653
*	1976	2463	13	653
*	1977	3011	13	653
*	1978	3217	13	653
*	1979	3000	13	653
	1980	2530	13	653
*	1981	2328	13	653
*	1982	2036	13	653
*	1983	2754	13	653
*	1984	3074	13	653
*	1985	3142	13	653
*	1986	3318	13	653
*	1987	3346	13	653
	1988	3202	13	653
*	1989	3049	13	653
*	1990	2989	13	653
*	1991	2901	13	653
*	1992	3132	13	653
*	1993	3390	13	653
*	1994	3724	13	653
*	1995	3798	13	653
*	1996	3874	13	653
*	1997	3952	13	653
*	1998	4031	13	653
*	1999	4112	13	653
*	2000	4194	13	653
*	2001	4278	13	653
*	2002	4363	13	653
*	2003	4451	13	653
*	2004	4540	13	653
*	2005	4630	13	653
*	2006	4723	13	653
*	2007	4817	13	653
*	2008	4914	13	653
*	2009	5012	13	653
*	2010	5112	13	653
*	2011	5214	13	653
*	2012	5319	13	653
*	2013	5425	13	653
*	2014	5534	13	653
*	2015	5644	13	653
*	2016	5757	13	653
*	2017	5872	13	653
*	2018	5990	13	653
*	2019	6110	13	653
*	2020	6232	13	653

* Estimated data

APPLIANCE TEWI ANALYSIS

Appliance Category oven

Electric Oven

YEAR	UNITS (,000)	ELEC ($MT\text{-}CO_2$)	GAS ($MT\text{-}CO_2$)	($MT\text{-}CO_2$) **TEWI TOTAL**	($kg\text{-}CO_2$) **TEWI per UNIT**
1970	2362	13.5	0.0	13.5	5705
1971	2714	15.5	0.0	15.5	5705
1972	3232	18.4	0.0	18.4	5705
1973	3430	19.6	0.0	19.6	5705
1974	2925	16.7	0.0	16.7	5705
1975	2082	11.9	0.0	11.9	5705
1976	2463	14.1	0.0	14.1	5705
1977	3011	17.2	0.0	17.2	5705
1978	3217	18.4	0.0	18.4	5705
1979	3000	17.1	0.0	17.1	5705
1980	2530	14.4	0.0	14.4	5705
1981	2328	13.3	0.0	13.3	5705
1982	2036	11.6	0.0	11.6	5705
1983	2754	15.7	0.0	15.7	5705
1984	3074	17.5	0.0	17.5	5705
1985	3142	17.9	0.0	17.9	5705
1986	3318	18.9	0.0	18.9	5705
1987	3346	19.1	0.0	19.1	5705
1988	3202	18.3	0.0	18.3	5705
1989	3049	17.4	0.0	17.4	5705
1990	2989	17.1	0.0	17.1	5705
1991	2901	16.5	0.0	16.5	5705
1992	3132	17.9	0.0	17.9	5705
1993	3390	19.3	0.0	19.3	5705
1994	3724	21.2	0.0	21.2	5705
1995	3798	21.7	0.0	21.7	5705
1996	3874	22.1	0.0	22.1	5705
1997	3952	22.5	0.0	22.5	5705
1998	4031	23.0	0.0	23.0	5705
1999	4112	23.5	0.0	23.5	5705
2000	4194	23.9	0.0	23.9	5705
2001	4278	24.4	0.0	24.4	5705
2002	4363	24.9	0.0	24.9	5705
2003	4451	25.4	0.0	25.4	5705
2004	4540	25.9	0.0	25.9	5705
2005	4630	26.4	0.0	26.4	5705
2006	4723	26.9	0.0	26.9	5705
2007	4817	27.5	0.0	27.5	5705
2008	4914	28.0	0.0	28.0	5705
2009	5012	28.6	0.0	28.6	5705
2010	5112	29.2	0.0	29.2	5705
2011	5214	29.7	0.0	29.7	5705
2012	5319	30.3	0.0	30.3	5705
2013	5425	30.9	0.0	30.9	5705
2014	5534	31.6	0.0	31.6	5705
2015	5644	32.2	0.0	32.2	5705
2016	5757	32.8	0.0	32.8	5705
2017	5872	33.5	0.0	33.5	5705
2018	5990	34.2	0.0	34.2	5705
2019	6110	34.9	0.0	34.9	5705
2020	6232	35.6	0.0	35.6	5705

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr10/10%yr11/20%yr12/30%yr13/20%yr14
/10%yr15/5%yr16

YEAR	(MT-CO_2) TEWI TOTAL
1970	12.4
1971	12.6
1972	13.0
1973	13.4
1974	13.7
1975	13.6
1976	13.6
1977	13.9
1978	14.3
1979	14.6
1980	14.6
1981	14.6
1982	14.3
1983	14.3
1984	14.4
1985	14.4
1986	14.7
1987	15.0
1988	15.2
1989	15.3
1990	15.3
1991	15.4
1992	15.6
1993	16.0
1994	16.5
1995	17.0
1996	17.4
1997	17.8
1998	18.2
1999	18.5
2000	19.0
2001	19.5
2002	20.1
2003	20.7
2004	21.3
2005	21.8
2006	22.3
2007	22.8
2008	23.2
2009	23.7
2010	24.2
2011	24.6
2012	25.1
2013	25.6
2014	26.2
2015	26.7
2016	27.2
2017	27.8
2018	28.3
2019	28.9
2020	29.5

APPLIANCE ENERGY ANALYSIS

Appliance Category oven

Gas Oven

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/cycle)	GAS (therm/yr)
*	1970	2362	14	0.000	56.000
*	1971	2549	14	0.000	56.000
	1972	2661	14	0.000	56.000
*	1973	2481	14	0.000	56.000
*	1974	1950	14	0.000	56.000
*	1975	1618	14	0.000	56.000
*	1976	1824	14	0.000	56.000
*	1977	1746	14	0.000	56.000
*	1978	1794	14	0.000	56.000
*	1979	1799	14	0.000	56.000
	1980	1539	14	0.000	39.000
*	1981	1496	14	0.000	39.000
*	1982	1368	14	0.000	39.000
*	1983	1573	14	0.000	39.000
*	1984	1732	14	0.000	39.000
*	1985	1814	14	0.000	39.000
*	1986	1940	14	0.000	39.000
*	1987	2143	14	0.000	39.000
	1988	2227	14	0.000	39.000
*	1989	2167	14	0.000	39.000
*	1990	2167	14	0.000	22.000
*	1991	2131	14	0.000	22.000
*	1992	2312	14	0.000	22.000
*	1993	2433	14	0.000	22.000
*	1994	2622	14	0.000	22.000
*	1995	2674	14	0.000	22.000
*	1996	2728	14	0.000	22.000
*	1997	2782	14	0.000	22.000
*	1998	2838	14	0.000	22.000
*	1999	2895	14	0.000	22.000
*	2000	2953	14	0.000	22.000
*	2001	3012	14	0.000	22.000
*	2002	3072	14	0.000	22.000
*	2003	3134	14	0.000	22.000
*	2004	3196	14	0.000	22.000
*	2005	3260	14	0.000	22.000
*	2006	3325	14	0.000	22.000
*	2007	3392	14	0.000	22.000
*	2008	3460	14	0.000	22.000
*	2009	3529	14	0.000	22.000
*	2010	3599	14	0.000	22.000
*	2011	3671	14	0.000	22.000
*	2012	3745	14	0.000	22.000
*	2013	3820	14	0.000	22.000
*	2014	3896	14	0.000	22.000
*	2015	3974	14	0.000	22.000
*	2016	4054	14	0.000	22.000
*	2017	4135	14	0.000	22.000
*	2018	4217	14	0.000	22.000
*	2019	4302	14	0.000	22.000
*	2020	4388	14	0.000	22.000

Note: 1970-1979; no electronic ignition
1980-1989; 50% electronic pilot
1990-2020; 100% electronic pilot

* Estimated data

APPLIANCE TEWI ANALYSIS

Appliance Category oven

Gas Oven

YEAR	UNITS (,000)	ELEC ($MT\text{-}CO_2$)	GAS ($MT\text{-}CO_2$)	($MT\text{-}CO_2$) TEWI TOTAL	($kg\text{-}CO_2$) TEWI per UNIT
1970	2362	0.0	10.0	10.0	4226
1971	2549	0.0	10.8	10.8	4226
1972	2661	0.0	11.2	11.2	4226
1973	2481	0.0	10.5	10.5	4226
1974	1950	0.0	8.2	8.2	4226
1975	1618	0.0	6.8	6.8	4226
1976	1824	0.0	7.7	7.7	4226
1977	1746	0.0	7.4	7.4	4226
1978	1794	0.0	7.6	7.6	4226
1979	1799	0.0	7.6	7.6	4226
1980	1539	0.0	4.5	4.5	2943
1981	1496	0.0	4.4	4.4	2943
1982	1368	0.0	4.0	4.0	2943
1983	1573	0.0	4.6	4.6	2943
1984	1732	0.0	5.1	5.1	2943
1985	1814	0.0	5.3	5.3	2943
1986	1940	0.0	5.7	5.7	2943
1987	2143	0.0	6.3	6.3	2943
1988	2227	0.0	6.6	6.6	2943
1989	2167	0.0	6.4	6.4	2943
1990	2167	0.0	3.6	3.6	1660
1991	2131	0.0	3.5	3.5	1660
1992	2312	0.0	3.8	3.8	1660
1993	2433	0.0	4.0	4.0	1660
1994	2622	0.0	4.4	4.4	1660
1995	2674	0.0	4.4	4.4	1660
1996	2728	0.0	4.5	4.5	1660
1997	2782	0.0	4.6	4.6	1660
1998	2838	0.0	4.7	4.7	1660
1999	2895	0.0	4.8	4.8	1660
2000	2953	0.0	4.9	4.9	1660
2001	3012	0.0	5.0	5.0	1660
2002	3072	0.0	5.1	5.1	1660
2003	3134	0.0	5.2	5.2	1660
2004	3196	0.0	5.3	5.3	1660
2005	3260	0.0	5.4	5.4	1660
2006	3325	0.0	5.5	5.5	1660
2007	3392	0.0	5.6	5.6	1660
2008	3460	0.0	5.7	5.7	1660
2009	3529	0.0	5.9	5.9	1660
2010	3599	0.0	6.0	6.0	1660
2011	3671	0.0	6.1	6.1	1660
2012	3745	0.0	6.2	6.2	1660
2013	3820	0.0	6.3	6.3	1660
2014	3896	0.0	6.5	6.5	1660
2015	3974	0.0	6.6	6.6	1660
2016	4054	0.0	6.7	6.7	1660
2017	4135	0.0	6.9	6.9	1660
2018	4217	0.0	7.0	7.0	1660
2019	4302	0.0	7.1	7.1	1660
2020	4388	0.0	7.3	7.3	1660

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr15
/10%yr16/5%yr17

YEAR	(MT-CO_2) TEWI TOTAL
1970	9.3
1971	9.3
1972	9.4
1973	9.5
1974	9.3
1975	9.1
1976	8.9
1977	8.8
1978	8.6
1979	8.4
1980	8.0
1981	7.6
1982	7.2
1983	6.8
1984	6.4
1985	6.0
1986	5.8
1987	5.6
1988	5.5
1989	5.4
1990	5.1
1991	4.9
1992	4.7
1993	4.6
1994	4.5
1995	4.5
1996	4.5
1997	4.5
1998	4.4
1999	4.4
2000	4.3
2001	4.2
2002	4.2
2003	4.3
2004	4.3
2005	4.4
2006	4.5
2007	4.6
2008	4.7
2009	4.8
2010	4.9
2011	5.0
2012	5.1
2013	5.2
2014	5.3
2015	5.4
2016	5.6
2017	5.7
2018	5.8
2019	5.9
2020	6.0

APPLIANCE ENERGY ANALYSIS

Appliance Category microwave

Microwave Oven

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)
*	1970	0	10	100
*	1971	0	10	100
*	1972	314	10	100
*	1973	445	10	100
*	1974	713	10	100
*	1975	1052	10	100
*	1976	1749	10	100
*	1977	2157	10	100
*	1978	2501	10	100
*	1979	2807	10	100
*	1980	3608	10	100
*	1981	4422	10	100
*	1982	4071	10	100
*	1983	5933	10	100
*	1984	9132	10	100
*	1985	10883	10	100
*	1986	12444	10	100
*	1987	12610	10	100
*	1988	10987	10	100
*	1989	10598	10	100
*	1990	8126	10	100
*	1991	7012	10	100
*	1992	7588	10	100
*	1993	7703	10	100
*	1994	9032	10	100
*	1995	8436	10	100
*	1996	8612	10	100
*	1997	8784	10	100
*	1998	8960	10	100
*	1999	9139	10	100
*	2000	9322	10	100
*	2001	9508	10	100
*	2002	9699	10	100
*	2003	9892	10	100
*	2004	10090	10	100
*	2005	10292	10	100
*	2006	10498	10	100
*	2007	10708	10	100
*	2008	10922	10	100
*	2009	11141	10	100
*	2010	11363	10	100
*	2011	11591	10	100
*	2012	11822	10	100
*	2013	12059	10	100
*	2014	12300	10	100
*	2015	12546	10	100
*	2016	12797	10	100
*	2017	13053	10	100
*	2018	13314	10	100
*	2019	13580	10	100
*	2020	13852	10	100

* Estimated data

APPLIANCE TEWI ANALYSIS

Appliance Category | microwav e

Microwave Oven

YEAR	UNITS (,000)	ELEC (MT-CO_2)	GAS (MT-CO_2)	(MT-CO_2) **TEWI TOTAL**	(kg-CO_2) **TEWI per UNIT**
1970	0	0.0	0.0	0.0	0
1971	0	0.0	0.0	0.0	0
1972	314	0.2	0.0	0.2	672
1973	445	0.3	0.0	0.3	672
1974	713	0.5	0.0	0.5	672
1975	1052	0.7	0.0	0.7	672
1976	1749	1.2	0.0	1.2	672
1977	2157	1.4	0.0	1.4	672
1978	2501	1.7	0.0	1.7	672
1979	2807	1.9	0.0	1.9	672
1980	3608	2.4	0.0	2.4	672
1981	4422	3.0	0.0	3.0	672
1982	4071	2.7	0.0	2.7	672
1983	5933	4.0	0.0	4.0	672
1984	9132	6.1	0.0	6.1	672
1985	10883	7.3	0.0	7.3	672
1986	12444	8.4	0.0	8.4	672
1987	12610	8.5	0.0	8.5	672
1988	10987	7.4	0.0	7.4	672
1989	10598	7.1	0.0	7.1	672
1990	8126	5.5	0.0	5.5	672
1991	7012	4.7	0.0	4.7	672
1992	7588	5.1	0.0	5.1	672
1993	7703	5.2	0.0	5.2	672
1994	9032	6.1	0.0	6.1	672
1995	8436	5.7	0.0	5.7	672
1996	8612	5.8	0.0	5.8	672
1997	8784	5.9	0.0	5.9	672
1998	8960	6.0	0.0	6.0	672
1999	9139	6.1	0.0	6.1	672
2000	9322	6.3	0.0	6.3	672
2001	9508	6.4	0.0	6.4	672
2002	9699	6.5	0.0	6.5	672
2003	9892	6.6	0.0	6.6	672
2004	10090	6.8	0.0	6.8	672
2005	10292	6.9	0.0	6.9	672
2006	10498	7.1	0.0	7.1	672
2007	10708	7.2	0.0	7.2	672
2008	10922	7.3	0.0	7.3	672
2009	11141	7.5	0.0	7.5	672
2010	11363	7.6	0.0	7.6	672
2011	11591	7.8	0.0	7.8	672
2012	11822	7.9	0.0	7.9	672
2013	12059	8.1	0.0	8.1	672
2014	12300	8.3	0.0	8.3	672
2015	12546	8.4	0.0	8.4	672
2016	12797	8.6	0.0	8.6	672
2017	13053	8.8	0.0	8.8	672
2018	13314	8.9	0.0	8.9	672
2019	13580	9.1	0.0	9.1	672
2020	13852	9.3	0.0	9.3	672

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr7/10%yr8/20%yr9/30%yr10/20%yr11/10%yr12/5%yr13

YEAR	TEWI TOTAL (MT-CO_2)
1970	0.0
1971	0.0
1972	0.0
1973	0.1
1974	0.1
1975	0.2
1976	0.3
1977	0.4
1978	0.6
1979	0.8
1980	1.0
1981	1.3
1982	1.5
1983	1.9
1984	2.4
1985	3.0
1986	3.7
1987	4.4
1988	4.9
1989	5.4
1990	5.7
1991	5.8
1992	5.8
1993	5.8
1994	5.7
1995	5.5
1996	5.3
1997	5.2
1998	5.1
1999	5.1
2000	5.2
2001	5.3
2002	5.4
2003	5.5
2004	5.6
2005	5.7
2006	5.9
2007	6.0
2008	6.1
2009	6.2
2010	6.3
2011	6.5
2012	6.6
2013	6.7
2014	6.9
2015	7.0
2016	7.1
2017	7.3
2018	7.4
2019	7.6
2020	7.7

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category freezers

TEWI Basis = 100 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	REFRIG* (kg/unit)	INSUL* (kg/unit)
*	1970	1359	16	1460	0.17	1.06
*	1971	1436	16	1460	0.17	1.06
	1972	1577	16	1460	0.17	1.06
*	1973	2415	16	1381	0.17	1.06
*	1974	3219	16	1302	0.17	1.06
*	1975	2457	16	1223	0.17	1.06
*	1976	1541	16	1143	0.17	1.06
*	1977	1598	16	1064	0.17	1.06
	1978	1521	16	985	0.17	1.06
*	1979	1941	16	934	0.17	1.06
	1980	1757	16	883	0.17	1.06
	1981	1605	16	837	0.17	1.06
	1982	1340	16	813	0.17	1.06
	1983	1341	16	813	0.17	1.06
	1984	1281	16	799	0.17	1.06
	1985	1236	16	787	0.17	1.06
	1986	1222	16	754	0.17	1.06
	1987	1260	16	685	0.17	1.06
	1988	1349	16	677	0.17	1.06
	1989	1219	16	611	0.17	1.06
	1990	1296	16	600	0.17	1.06
	1991	1414	16	600	0.17	1.06
	1992	1639	16	590	0.17	1.06
	1993	1606	16	453	0.17	1.06
	1994	1692	16	471	0.155	0.905
*	1995	1726	16	462	0.155	0.905
*	1996	1760	16	452	0.155	0.905
*	1997	1796	16	443	0.155	0.905
*	1998	1831	16	434	0.155	0.905
*	1999	1868	16	426	0.155	0.905
*	2000	1905	16	417	0.155	0.905
*	2001	1944	16	409	0.155	0.905
*	2002	1982	16	401	0.155	0.905
*	2003	2022	16	393	0.155	0.905
*	2004	2063	16	385	0.155	0.905
*	2005	2104	16	377	0.155	0.905
*	2006	2146	16	370	0.155	0.905
*	2007	2189	16	362	0.155	0.905
*	2008	2233	16	355	0.155	0.905
*	2009	2277	16	348	0.155	0.905
*	2010	2323	16	341	0.155	0.905
*	2011	2369	16	334	0.155	0.905
*	2012	2417	16	327	0.155	0.905
*	2013	2465	16	321	0.155	0.905
*	2014	2514	16	314	0.155	0.905
*	2015	2565	16	308	0.155	0.905
*	2016	2616	16	302	0.155	0.905
*	2017	2668	16	296	0.155	0.905
*	2018	2721	16	290	0.155	0.905
*	2019	2776	16	284	0.155	0.905
*	2020	2831	16	279	0.155	0.905

0.17 kg R12 for refrigeration system (AFEAS, 1991); 100year GWP = 7300

1.06 kg R11 for insulation system (AFEAS, 1991); 100year GWP = 3500

0.155 kg R134a for refrigeration system (AFEAS, 1991); 100year GWP = 1200

0.905 kg R141b for insulation system (AFEAS, 1991); 100 year GWP = 440

R141b and R134a assumed to replace R11 and R12 in 1994

* estimated data, 2% growth per year

APPLIANCE TEWI ANALYSIS

Appliance Category freezers

TEWI Basis = 100 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)	GAS (MT-CO_2)	**INDIRECT TEWI**	REFRIG* (MT-CO_2)	INSUL* (MT-CO_2)	(MT-CO_2) **DIRECT TEWI**	(MT-CO_2) **TOTAL TEWI**	(kg-CO_2) **TEWI per UNIT**
1970	1359	21.3	0.0	21.3	1.7	5.0	6.7	28.1	20649
1971	1436	22.5	0.0	22.5	1.8	5.3	7.1	29.7	20649
1972	1577	24.8	0.0	24.8	2.0	5.9	7.8	32.6	20649
1973	2415	35.9	0.0	35.9	3.0	9.0	12.0	47.8	19799
1974	3219	45.1	0.0	45.1	4.0	11.9	15.9	61.0	18950
1975	2457	32.3	0.0	32.3	3.0	9.1	12.2	44.5	18101
1976	1541	18.9	0.0	18.9	1.9	5.7	7.6	26.6	17240
1977	1598	18.3	0.0	18.3	2.0	5.9	7.9	26.2	16391
1978	1521	16.1	0.0	16.1	1.9	5.6	7.5	23.6	15542
1979	1941	19.5	0.0	19.5	2.4	7.2	9.6	29.1	14993
1980	1757	16.7	0.0	16.7	2.2	6.5	8.7	25.4	14445
1981	1605	14.4	0.0	14.4	2.0	6.0	7.9	22.4	13950
1982	1340	11.7	0.0	11.7	1.7	5.0	6.6	18.3	13692
1983	1341	11.7	0.0	11.7	1.7	5.0	6.6	18.4	13692
1984	1281	11.0	0.0	11.0	1.6	4.8	6.3	17.3	13542
1985	1236	10.5	0.0	10.5	1.5	4.6	6.1	16.6	13413
1986	1222	9.9	0.0	9.9	1.5	4.5	6.1	16.0	13058
1987	1260	9.3	0.0	9.3	1.6	4.7	6.2	15.5	12316
1988	1349	9.8	0.0	9.8	1.7	5.0	6.7	16.5	12230
1989	1219	8.0	0.0	8.0	1.5	4.5	6.0	14.0	11520
1990	1296	8.4	0.0	8.4	1.6	4.8	6.4	14.8	11402
1991	1414	9.1	0.0	9.1	1.8	5.2	7.0	16.1	11402
1992	1639	10.4	0.0	10.4	2.0	6.1	8.1	18.5	11295
1993	1606	7.8	0.0	7.8	2.0	6.0	8.0	15.8	9822
1994	1692	8.6	0.0	8.6	0.3	0.7	1.0	9.6	5648
1995	1726	8.6	0.0	8.6	0.3	0.7	1.0	9.6	5547
1996	1760	8.6	0.0	8.6	0.3	0.7	1.0	9.6	5448
1997	1796	8.6	0.0	8.6	0.3	0.7	1.0	9.6	5351
1998	1831	8.6	0.0	8.6	0.3	0.7	1.1	9.6	5255
1999	1868	8.6	0.0	8.6	0.3	0.7	1.1	9.6	5162
2000	1905	8.5	0.0	8.5	0.4	0.8	1.1	9.7	5070
2001	1944	8.5	0.0	8.5	0.4	0.8	1.1	9.7	4981
2002	1982	8.5	0.0	8.5	0.4	0.8	1.2	9.7	4893
2003	2022	8.5	0.0	8.5	0.4	0.8	1.2	9.7	4806
2004	2063	8.5	0.0	8.5	0.4	0.8	1.2	9.7	4722
2005	2104	8.5	0.0	8.5	0.4	0.8	1.2	9.8	4639
2006	2146	8.5	0.0	8.5	0.4	0.9	1.3	9.8	4558
2007	2189	8.5	0.0	8.5	0.4	0.9	1.3	9.8	4479
2008	2233	8.5	0.0	8.5	0.4	0.9	1.3	9.8	4401
2009	2277	8.5	0.0	8.5	0.4	0.9	1.3	9.8	4324
2010	2323	8.5	0.0	8.5	0.4	0.9	1.4	9.9	4250
2011	2369	8.5	0.0	8.5	0.4	0.9	1.4	9.9	4176
2012	2417	8.5	0.0	8.5	0.4	1.0	1.4	9.9	4104
2013	2465	8.5	0.0	8.5	0.5	1.0	1.4	9.9	4034
2014	2514	8.5	0.0	8.5	0.5	1.0	1.5	10.0	3965
2015	2565	8.5	0.0	8.5	0.5	1.0	1.5	10.0	3897
2016	2616	8.5	0.0	8.5	0.5	1.0	1.5	10.0	3831
2017	2668	8.5	0.0	8.5	0.5	1.1	1.6	10.0	3766
2018	2721	8.5	0.0	8.5	0.5	1.1	1.6	10.1	3703
2019	2776	8.5	0.0	8.5	0.5	1.1	1.6	10.1	3640
2020	2831	8.5	0.0	8.5	0.5	1.1	1.7	10.1	3579

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr13/10%yr14/20%yr15/30%yr16/20%yr17/10%yr18/5%yr19

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	21.3	6.7	28.1
1971	21.4	6.7	28.1
1972	21.6	6.7	28.4
1973	22.5	6.7	29.3
1974	24.0	6.7	30.7
1975	24.7	6.7	31.4
1976	24.6	6.7	31.3
1977	24.4	6.7	31.1
1978	24.0	6.7	30.8
1979	23.9	6.7	30.6
1980	23.6	6.7	30.4
1981	23.2	6.7	29.9
1982	22.6	6.7	29.3
1983	22.0	6.7	28.7
1984	21.3	6.7	28.1
1985	20.6	6.8	27.5
1986	19.9	7.2	27.0
1987	18.9	8.0	26.9
1988	17.7	9.4	27.1
1989	16.2	11.0	27.2
1990	14.6	11.9	26.5
1991	13.3	11.1	24.4
1992	12.4	9.7	22.2
1993	11.6	8.8	20.4
1994	11.0	8.4	19.4
1995	10.5	8.4	18.9
1996	10.0	8.3	18.3
1997	9.6	7.8	17.4
1998	9.3	7.2	16.5
1999	9.1	6.7	15.9
2000	9.0	6.4	15.4
2001	8.9	6.3	15.1
2002	8.8	6.2	15.0
2003	8.7	6.3	15.0
2004	8.7	6.4	15.0
2005	8.6	6.5	15.1
2006	8.6	6.7	15.3
2007	8.6	6.8	15.4
2008	8.6	6.5	15.1
2009	8.5	5.4	13.9
2010	8.5	3.4	11.9
2011	8.5	2.1	10.6
2012	8.5	1.4	9.9
2013	8.5	1.0	9.6
2014	8.5	1.1	9.6
2015	8.5	1.1	9.6
2016	8.5	1.1	9.6
2017	8.5	1.1	9.7
2018	8.5	1.2	9.7
2019	8.5	1.2	9.7
2020	8.5	1.2	9.7

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category freezers

TEWI Basis = 500 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	GAS (therms/yr)	REFRIG* (kg/unit)	INSUL* (kg/unit)
*	1970	1359	16	1460		0.17	1.06
*	1971	1436	16	1460		0.17	1.06
	1972	1577	16	1460		0.17	1.06
*	1973	2415	16	1381		0.17	1.06
*	1974	3219	16	1302		0.17	1.06
*	1975	2457	16	1223		0.17	1.06
*	1976	1541	16	1143		0.17	1.06
*	1977	1598	16	1064		0.17	1.06
	1978	1521	16	985		0.17	1.06
*	1979	1941	16	934		0.17	1.06
	1980	1757	16	883		0.17	1.06
	1981	1605	16	837		0.17	1.06
	1982	1340	16	813		0.17	1.06
	1983	1341	16	813		0.17	1.06
	1984	1281	16	799		0.17	1.06
	1985	1236	16	787		0.17	1.06
	1986	1222	16	754		0.17	1.06
	1987	1260	16	685		0.17	1.06
	1988	1349	16	677		0.17	1.06
	1989	1219	16	611		0.17	1.06
	1990	1296	16	600		0.17	1.06
	1991	1414	16	600		0.17	1.06
	1992	1639	16	590		0.17	1.06
	1993	1606	16	453		0.17	1.06
	1994	1692	16	471		0.155	0.905
*	1995	1726	16	462		0.155	0.905
*	1996	1760	16	452		0.155	0.905
*	1997	1796	16	443		0.155	0.905
*	1998	1831	16	434		0.155	0.905
*	1999	1868	16	426		0.155	0.905
*	2000	1905	16	417		0.155	0.905
*	2001	1944	16	409		0.155	0.905
*	2002	1982	16	401		0.155	0.905
*	2003	2022	16	393		0.155	0.905
*	2004	2063	16	385		0.155	0.905
*	2005	2104	16	377		0.155	0.905
*	2006	2146	16	370		0.155	0.905
*	2007	2189	16	362		0.155	0.905
*	2008	2233	16	355		0.155	0.905
*	2009	2277	16	348		0.155	0.905
*	2010	2323	16	341		0.155	0.905
*	2011	2369	16	334		0.155	0.905
*	2012	2417	16	327		0.155	0.905
*	2013	2465	16	321		0.155	0.905
*	2014	2514	16	314		0.155	0.905
*	2015	2565	16	308		0.155	0.905
*	2016	2616	16	302		0.155	0.905
*	2017	2668	16	296		0.155	0.905
*	2018	2721	16	290		0.155	0.905
*	2019	2776	16	284		0.155	0.905
*	2020	2831	16	279		0.155	0.905

0.17 kg R12 for refrigeration system (AFEAS, 1991); 500year GWP = 4500

1.06 kg R11 for insulation system (AFEAS, 1991); 500year GWP = 1500

0.155 kg R134a for refrigeration system (AFEAS, 1991); 500year GWP = 420

0.905 kg R141b for insulation system (AFEAS, 1991); 500 year GWP =150

R141b and R134a assumed to replace R11 and R12 in 1994

* estimated data, 2% growth per year

APPLIANCE TEWI ANALYSIS

Appliance Category freezers

TEWI Basis = 500 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)	GAS (MT-CO_2)	**INDIRECT TEWI**	REFRIG* (MT-CO_2)	INSUL* (MT-CO_2)	(MT-CO_2) **DIRECT TEWI**	(MT-CO_2) **TOTAL TEWI**	(kg-CO_2) **TEWI per UNIT**
1970	1359	21.3	0.0	21.3	1.0	2.2	3.2	24.5	18053
1971	1436	22.5	0.0	22.5	1.1	2.3	3.4	25.9	18053
1972	1577	24.8	0.0	24.8	1.2	2.5	3.7	28.5	18053
1973	2415	35.9	0.0	35.9	1.8	3.8	5.7	41.5	17203
1974	3219	45.1	0.0	45.1	2.5	5.1	7.6	52.6	16354
1975	2457	32.3	0.0	32.3	1.9	3.9	5.8	38.1	15505
1976	1541	18.9	0.0	18.9	1.2	2.5	3.6	22.6	14644
1977	1598	18.3	0.0	18.3	1.2	2.5	3.8	22.0	13795
1978	1521	16.1	0.0	16.1	1.2	2.4	3.6	19.7	12946
1979	1941	19.5	0.0	19.5	1.5	3.1	4.6	24.1	12397
1980	1757	16.7	0.0	16.7	1.3	2.8	4.1	20.8	11849
1981	1605	14.4	0.0	14.4	1.2	2.6	3.8	18.2	11354
1982	1340	11.7	0.0	11.7	1.0	2.1	3.2	14.9	11096
1983	1341	11.7	0.0	11.7	1.0	2.1	3.2	14.9	11096
1984	1281	11.0	0.0	11.0	1.0	2.0	3.0	14.0	10946
1985	1236	10.5	0.0	10.5	0.9	2.0	2.9	13.4	10817
1986	1222	9.9	0.0	9.9	0.9	1.9	2.9	12.8	10462
1987	1260	9.3	0.0	9.3	1.0	2.0	3.0	12.2	9720
1988	1349	9.8	0.0	9.8	1.0	2.1	3.2	13.0	9634
1989	1219	8.0	0.0	8.0	0.9	1.9	2.9	10.9	8924
1990	1296	8.4	0.0	8.4	1.0	2.1	3.1	11.4	8806
1991	1414	9.1	0.0	9.1	1.1	2.2	3.3	12.5	8806
1992	1639	10.4	0.0	10.4	1.3	2.6	3.9	14.3	8699
1993	1606	7.8	0.0	7.8	1.2	2.6	3.8	11.6	7226
1994	1692	8.6	0.0	8.6	0.1	0.2	0.3	8.9	5265
1995	1726	8.6	0.0	8.6	0.1	0.2	0.3	8.9	5164
1996	1760	8.6	0.0	8.6	0.1	0.2	0.4	8.9	5064
1997	1796	8.6	0.0	8.6	0.1	0.2	0.4	8.9	4967
1998	1831	8.6	0.0	8.6	0.1	0.2	0.4	8.9	4872
1999	1868	8.6	0.0	8.6	0.1	0.3	0.4	8.9	4778
2000	1905	8.5	0.0	8.5	0.1	0.3	0.4	8.9	4687
2001	1944	8.5	0.0	8.5	0.1	0.3	0.4	8.9	4597
2002	1982	8.5	0.0	8.5	0.1	0.3	0.4	8.9	4509
2003	2022	8.5	0.0	8.5	0.1	0.3	0.4	8.9	4423
2004	2063	8.5	0.0	8.5	0.1	0.3	0.4	8.9	4339
2005	2104	8.5	0.0	8.5	0.1	0.3	0.4	9.0	4256
2006	2146	8.5	0.0	8.5	0.1	0.3	0.4	9.0	4175
2007	2189	8.5	0.0	8.5	0.1	0.3	0.4	9.0	4095
2008	2233	8.5	0.0	8.5	0.1	0.3	0.4	9.0	4017
2009	2277	8.5	0.0	8.5	0.1	0.3	0.5	9.0	3941
2010	2323	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3866
2011	2369	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3793
2012	2417	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3721
2013	2465	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3651
2014	2514	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3582
2015	2565	8.5	0.0	8.5	0.2	0.3	0.5	9.0	3514
2016	2616	8.5	0.0	8.5	0.2	0.4	0.5	9.0	3448
2017	2668	8.5	0.0	8.5	0.2	0.4	0.5	9.0	3383
2018	2721	8.5	0.0	8.5	0.2	0.4	0.5	9.0	3319
2019	2776	8.5	0.0	8.5	0.2	0.4	0.6	9.0	3257
2020	2831	8.5	0.0	8.5	0.2	0.4	0.6	9.0	3196

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr13/10%yr14/20%yr15/30%yr16/20%yr17/10%yr18/5%yr19

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	21.3	3.2	24.5
1971	21.4	3.2	24.6
1972	21.6	3.2	24.8
1973	22.5	3.2	25.7
1974	24.0	3.2	27.2
1975	24.7	3.2	27.9
1976	24.6	3.2	27.8
1977	24.4	3.2	27.6
1978	24.0	3.2	27.2
1979	23.9	3.2	27.1
1980	23.6	3.2	26.8
1981	23.2	3.2	26.4
1982	22.6	3.2	25.8
1983	22.0	3.2	25.2
1984	21.3	3.2	24.6
1985	20.6	3.2	23.9
1986	19.9	3.4	23.3
1987	18.9	3.8	22.7
1988	17.7	4.5	22.2
1989	16.2	5.2	21.4
1990	14.6	5.7	20.3
1991	13.3	5.3	18.6
1992	12.4	4.6	17.0
1993	11.6	4.2	15.8
1994	11.0	4.0	15.0
1995	10.5	4.0	14.5
1996	10.0	3.9	13.9
1997	9.6	3.7	13.3
1998	9.3	3.4	12.8
1999	9.1	3.2	12.3
2000	9.0	3.1	12.0
2001	8.9	3.0	11.8
2002	8.8	3.0	11.7
2003	8.7	3.0	11.7
2004	8.7	3.0	11.7
2005	8.6	3.1	11.7
2006	8.6	3.2	11.8
2007	8.6	3.2	11.8
2008	8.6	3.1	11.6
2009	8.5	2.5	11.1
2010	8.5	1.5	10.1
2011	8.5	0.9	9.4
2012	8.5	0.5	9.1
2013	8.5	0.4	8.9
2014	8.5	0.4	8.9
2015	8.5	0.4	8.9
2016	8.5	0.4	8.9
2017	8.5	0.4	8.9
2018	8.5	0.4	8.9
2019	8.5	0.4	8.9
2020	8.5	0.4	8.9

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category | refrigerators

TEWI Basis = 100 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	REFRIG* (kg/unit)	INSUL* (kg/unit)
*	1970	5286	14	1726	0.17	1.06
*	1971	5691	14	1726	0.17	1.06
	1972	6315	14	1726	0.17	1.06
*	1973	6774	14	1681	0.17	1.06
*	1974	5982	14	1635	0.17	1.06
*	1975	4577	14	1590	0.17	1.06
*	1976	4817	14	1544	0.17	1.06
*	1977	5707	14	1499	0.17	1.06
	1978	5890	14	1453	0.17	1.06
*	1979	5701	14	1366	0.17	1.06
	1980	5124	14	1278	0.17	1.06
	1981	4944	14	1190	0.17	1.06
	1982	4364	14	1191	0.17	1.06
	1983	5477	14	1160	0.17	1.06
	1984	5994	14	1139	0.17	1.06
	1985	6081	14	1058	0.17	1.06
	1986	6510	14	1074	0.17	1.06
	1987	6972	14	974	0.17	1.06
	1988	7227	14	964	0.17	1.06
	1989	7099	14	934	0.17	1.06
	1990	7101	14	916	0.17	1.06
	1991	7273	14	857	0.17	1.06
	1992	7761	14	821	0.17	1.06
	1993	8109	14	660	0.17	1.06
	1994	8652	14	653	0.155	0.905
*	1995	8825	14	640	0.155	0.905
*	1996	9002	14	627	0.155	0.905
*	1997	9182	14	615	0.155	0.905
*	1998	9365	14	602	0.155	0.905
*	1999	9553	14	590	0.155	0.905
*	2000	9744	14	578	0.155	0.905
*	2001	9938	14	567	0.155	0.905
*	2002	10137	14	556	0.155	0.905
*	2003	10340	14	544	0.155	0.905
*	2004	10547	14	534	0.155	0.905
*	2005	10758	14	523	0.155	0.905
*	2006	10973	14	512	0.155	0.905
*	2007	11192	14	502	0.155	0.905
*	2008	11416	14	492	0.155	0.905
*	2009	11644	14	482	0.155	0.905
*	2010	11877	14	473	0.155	0.905
*	2011	12115	14	463	0.155	0.905
*	2012	12357	14	454	0.155	0.905
*	2013	12604	14	445	0.155	0.905
*	2014	12856	14	436	0.155	0.905
*	2015	13114	14	427	0.155	0.905
*	2016	13376	14	419	0.155	0.905
*	2017	13643	14	410	0.155	0.905
*	2018	13916	14	402	0.155	0.905
*	2019	14195	14	394	0.155	0.905
*	2020	14478	14	386	0.155	0.905

0.17 kg R12 for refrigeration system (AFEAS, 1991); 100year GWP = 7300

1.06 kg R11 for insulation system (AFEAS, 1991); 100year GWP = 3500

0.155 kg R134a for refrigeration system (AFEAS, 1991); 100year GWP = 1200

0.905 kg R141b for insulation system (AFEAS, 1991); 100 year GWP = 440

R141b and R134a assumed to replace R11 and R12 in 1994

* estimated data, 2% growth in sales and 2%reduction in energy beyond 1994

APPLIANCE TEWI ANALYSIS

Appliance Category refrigerators

TEWI Basis = 100 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)		(MT-CO_2) **INDIRECT TEWI**	REFRIG* (MT-CO_2)	INSUL* (MT-CO_2)	(MT-CO_2) **DIRECT TEWI**	(MT-CO_2) **TOTAL TEWI**	(kg-CO_2) **TEWI per UNIT**
1970	5286	85.8	0.0	85.8	6.6	19.6	26.2	112.0	21189
1971	5691	92.4	0.0	92.4	7.1	21.1	28.2	120.6	21189
1972	6315	102.5	0.0	102.5	7.8	23.4	31.3	133.8	21189
1973	6774	107.1	0.0	107.1	8.4	25.1	33.5	140.7	20766
1974	5982	92.0	0.0	92.0	7.4	22.2	29.6	121.6	20333
1975	4577	68.5	0.0	68.5	5.7	17.0	22.7	91.1	19910
1976	4817	70.0	0.0	70.0	6.0	17.9	23.8	93.8	19477
1977	5707	80.5	0.0	80.5	7.1	21.2	28.3	108.7	19054
1978	5890	80.5	0.0	80.5	7.3	21.9	29.2	109.7	18621
1979	5701	73.3	0.0	73.3	7.1	21.2	28.2	101.5	17802
1980	5124	61.6	0.0	61.6	6.4	19.0	25.4	87.0	16974
1981	4944	55.4	0.0	55.4	6.1	18.3	24.5	79.8	16146
1982	4364	48.9	0.0	48.9	5.4	16.2	21.6	70.5	16156
1983	5477	59.8	0.0	59.8	6.8	20.3	27.1	86.9	15864
1984	5994	64.2	0.0	64.2	7.4	22.2	29.7	93.9	15667
1985	6081	60.5	0.0	60.5	7.5	22.6	30.1	90.6	14905
1986	6510	65.8	0.0	65.8	8.1	24.2	32.2	98.0	15055
1987	6972	63.9	0.0	63.9	8.7	25.9	34.5	98.4	14114
1988	7227	65.5	0.0	65.5	9.0	26.8	35.8	101.3	14020
1989	7099	62.4	0.0	62.4	8.8	26.3	35.1	97.5	13738
1990	7101	61.2	0.0	61.2	8.8	26.3	35.2	96.4	13569
1991	7273	58.6	0.0	58.6	9.0	27.0	36.0	94.6	13014
1992	7761	59.9	0.0	59.9	9.6	28.8	38.4	98.4	12675
1993	8109	50.4	0.0	50.4	10.1	30.1	40.1	90.5	11160
1994	8652	53.2	0.0	53.2	1.6	3.4	5.1	58.2	6728
1995	8825	53.1	0.0	53.1	1.6	3.5	5.2	58.3	6605
1996	9002	53.1	0.0	53.1	1.7	3.6	5.3	58.4	6484
1997	9182	53.1	0.0	53.1	1.7	3.7	5.4	58.5	6366
1998	9365	53.1	0.0	53.1	1.7	3.7	5.5	58.5	6251
1999	9553	53.0	0.0	53.0	1.8	3.8	5.6	58.6	6137
2000	9744	53.0	0.0	53.0	1.8	3.9	5.7	58.7	6026
2001	9938	53.0	0.0	53.0	1.8	4.0	5.8	58.8	5917
2002	10137	53.0	0.0	53.0	1.9	4.0	5.9	58.9	5811
2003	10340	53.0	0.0	53.0	1.9	4.1	6.0	59.0	5706
2004	10547	52.9	0.0	52.9	2.0	4.2	6.2	59.1	5604
2005	10758	52.9	0.0	52.9	2.0	4.3	6.3	59.2	5503
2006	10973	52.9	0.0	52.9	2.0	4.4	6.4	59.3	5405
2007	11192	52.9	0.0	52.9	2.1	4.5	6.5	59.4	5309
2008	11416	52.9	0.0	52.9	2.1	4.5	6.7	59.5	5214
2009	11644	52.8	0.0	52.8	2.2	4.6	6.8	59.6	5122
2010	11877	52.8	0.0	52.8	2.2	4.7	6.9	59.8	5031
2011	12115	52.8	0.0	52.8	2.3	4.8	7.1	59.9	4942
2012	12357	52.8	0.0	52.8	2.3	4.9	7.2	60.0	4855
2013	12604	52.8	0.0	52.8	2.3	5.0	7.4	60.1	4769
2014	12856	52.7	0.0	52.7	2.4	5.1	7.5	60.2	4686
2015	13114	52.7	0.0	52.7	2.4	5.2	7.7	60.4	4604
2016	13376	52.7	0.0	52.7	2.5	5.3	7.8	60.5	4523
2017	13643	52.7	0.0	52.7	2.5	5.4	8.0	60.6	4444
2018	13916	52.6	0.0	52.6	2.6	5.5	8.1	60.8	4367
2019	14195	52.6	0.0	52.6	2.6	5.7	8.3	60.9	4292
2020	14478	52.6	0.0	52.6	2.7	5.8	8.5	61.1	4217

MT-CO2 = MEGATONNES OF CARBON DIOXIDE

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr15/10%yr16/5%yr17

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	85.8	26.2	112.0
1971	86.3	26.2	112.5
1972	87.5	26.2	113.7
1973	89.0	26.2	115.2
1974	89.5	26.2	115.6
1975	88.2	26.2	114.4
1976	87.1	26.2	113.3
1977	86.7	26.2	112.9
1978	86.3	26.2	112.5
1979	85.4	26.2	111.6
1980	83.7	26.2	109.9
1981	81.5	26.2	107.7
1982	78.9	26.3	105.1
1983	76.9	26.6	103.5
1984	75.1	27.4	102.5
1985	72.7	28.7	101.4
1986	70.5	29.7	100.3
1987	68.3	29.8	98.1
1988	66.7	28.5	95.1
1989	65.3	26.7	92.0
1990	64.2	26.3	90.5
1991	63.0	26.9	89.9
1992	61.9	27.3	89.3
1993	60.5	26.9	87.5
1994	59.8	26.0	85.7
1995	59.3	25.2	84.5
1996	59.0	25.2	84.3
1997	58.7	26.7	85.4
1998	58.1	28.7	86.8
1999	57.4	30.4	87.9
2000	56.7	32.3	88.9
2001	55.9	33.7	89.6
2002	55.1	34.7	89.9
2003	54.5	35.3	89.8
2004	53.9	35.9	89.8
2005	53.5	35.1	88.5
2006	53.2	32.8	86.0
2007	53.0	26.9	79.9
2008	53.0	17.0	70.0
2009	53.0	10.4	63.3
2010	53.0	7.0	60.0
2011	52.9	5.4	58.3
2012	52.9	5.5	58.4
2013	52.9	5.6	58.5
2014	52.9	5.7	58.6
2015	52.8	5.8	58.7
2016	52.8	5.9	58.8
2017	52.8	6.0	58.8
2018	52.8	6.2	58.9
2019	52.8	6.3	59.0
2020	52.7	6.4	59.2

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category refrigerators

TEWI Basis = 500 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	REFRIG* (kg/unit)	INSUL* (kg/unit)
*	1970	5286	14	1726	0.17	1.06
*	1971	5691	14	1726	0.17	1.06
	1972	6315	14	1726	0.17	1.06
*	1973	6774	14	1681	0.17	1.06
*	1974	5982	14	1635	0.17	1.06
*	1975	4577	14	1590	0.17	1.06
*	1976	4817	14	1544	0.17	1.06
*	1977	5707	14	1499	0.17	1.06
	1978	5890	14	1453	0.17	1.06
*	1979	5701	14	1366	0.17	1.06
	1980	5124	14	1278	0.17	1.06
	1981	4944	14	1190	0.17	1.06
	1982	4364	14	1191	0.17	1.06
	1983	5477	14	1160	0.17	1.06
	1984	5994	14	1139	0.17	1.06
	1985	6081	14	1058	0.17	1.06
	1986	6510	14	1074	0.17	1.06
	1987	6972	14	974	0.17	1.06
	1988	7227	14	964	0.17	1.06
	1989	7099	14	934	0.17	1.06
	1990	7101	14	916	0.17	1.06
	1991	7273	14	857	0.17	1.06
	1992	7761	14	821	0.17	1.06
	1993	8109	14	660	0.17	1.06
	1994	8652	14	653	0.155	0.905
*	1995	8825	14	640	0.155	0.905
*	1996	9002	14	627	0.155	0.905
*	1997	9182	14	615	0.155	0.905
*	1998	9365	14	602	0.155	0.905
*	1999	9553	14	590	0.155	0.905
*	2000	9744	14	578	0.155	0.905
*	2001	9938	14	567	0.155	0.905
*	2002	10137	14	556	0.155	0.905
*	2003	10340	14	544	0.155	0.905
*	2004	10547	14	534	0.155	0.905
*	2005	10758	14	523	0.155	0.905
*	2006	10973	14	512	0.155	0.905
*	2007	11192	14	502	0.155	0.905
*	2008	11416	14	492	0.155	0.905
*	2009	11644	14	482	0.155	0.905
*	2010	11877	14	473	0.155	0.905
*	2011	12115	14	463	0.155	0.905
*	2012	12357	14	454	0.155	0.905
*	2013	12604	14	445	0.155	0.905
*	2014	12856	14	436	0.155	0.905
*	2015	13114	14	427	0.155	0.905
*	2016	13376	14	419	0.155	0.905
*	2017	13643	14	410	0.155	0.905
*	2018	13916	14	402	0.155	0.905
*	2019	14195	14	394	0.155	0.905
*	2020	14478	14	386	0.155	0.905

0.17 kg R12 for refrigeration system (AFEAS, 1991); 500year GWP = 4500
1.06 kg R11 for insulation system (AFEAS, 1991); 500year GWP = 1500
0.155 kg R134a for refrigeration system (AFEAS, 1991); 500year GWP = 420
0.905 kg R141b for insulation system (AFEAS, 1991); 500 year GWP =150

R141b and R134a assumed to replace R11 and R12 in 1994
* estimated data, 2% growth in sales and 2%reduction in energy beyond 1994

APPLIANCE TEWI ANALYSIS

Appliance Category refrigerators

TEWI Basis = 500 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)		(MT-CO_2) INDIRECT TEWI	REFRIG* (MT-CO_2)	INSUL* (MT-CO_2)	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI	(kg-CO_2) TEWI per UNIT
1970	5286	85.8	0.0	85.8	4.0	8.4	12.4	98.3	18593
1971	5691	92.4	0.0	92.4	4.4	9.0	13.4	105.8	18593
1972	6315	102.5	0.0	102.5	4.8	10.0	14.9	117.4	18593
1973	6774	107.1	0.0	107.1	5.2	10.8	16.0	123.1	18170
1974	5982	92.0	0.0	92.0	4.6	9.5	14.1	106.1	17737
1975	4577	68.5	0.0	68.5	3.5	7.3	10.8	79.2	17314
1976	4817	70.0	0.0	70.0	3.7	7.7	11.3	81.3	16881
1977	5707	80.5	0.0	80.5	4.4	9.1	13.4	93.9	16458
1978	5890	80.5	0.0	80.5	4.5	9.4	13.9	94.4	16025
1979	5701	73.3	0.0	73.3	4.4	9.1	13.4	86.7	15206
1980	5124	61.6	0.0	61.6	3.9	8.1	12.1	73.7	14378
1981	4944	55.4	0.0	55.4	3.8	7.9	11.6	67.0	13550
1982	4364	48.9	0.0	48.9	3.3	6.9	10.3	59.2	13560
1983	5477	59.8	0.0	59.8	4.2	8.7	12.9	72.7	13268
1984	5994	64.2	0.0	64.2	4.6	9.5	14.1	78.3	13071
1985	6081	60.5	0.0	60.5	4.7	9.7	14.3	74.8	12309
1986	6510	65.8	0.0	65.8	5.0	10.4	15.3	81.1	12459
1987	6972	63.9	0.0	63.9	5.3	11.1	16.4	80.3	11518
1988	7227	65.5	0.0	65.5	5.5	11.5	17.0	82.6	11424
1989	7099	62.4	0.0	62.4	5.4	11.3	16.7	79.1	11142
1990	7101	61.2	0.0	61.2	5.4	11.3	16.7	77.9	10973
1991	7273	58.6	0.0	58.6	5.6	11.6	17.1	75.8	10418
1992	7761	59.9	0.0	59.9	5.9	12.3	18.3	78.2	10079
1993	8109	50.4	0.0	50.4	6.2	12.9	19.1	69.4	8564
1994	8652	53.2	0.0	53.2	0.6	1.2	1.7	54.9	6344
1995	8825	53.1	0.0	53.1	0.6	1.2	1.8	54.9	6221
1996	9002	53.1	0.0	53.1	0.6	1.2	1.8	54.9	6101
1997	9182	53.1	0.0	53.1	0.6	1.2	1.8	54.9	5983
1998	9365	53.1	0.0	53.1	0.6	1.3	1.9	54.9	5867
1999	9553	53.0	0.0	53.0	0.6	1.3	1.9	55.0	5754
2000	9744	53.0	0.0	53.0	0.6	1.3	2.0	55.0	5643
2001	9938	53.0	0.0	53.0	0.6	1.3	2.0	55.0	5534
2002	10137	53.0	0.0	53.0	0.7	1.4	2.0	55.0	5427
2003	10340	53.0	0.0	53.0	0.7	1.4	2.1	55.0	5323
2004	10547	52.9	0.0	52.9	0.7	1.4	2.1	55.1	5220
2005	10758	52.9	0.0	52.9	0.7	1.5	2.2	55.1	5120
2006	10973	52.9	0.0	52.9	0.7	1.5	2.2	55.1	5022
2007	11192	52.9	0.0	52.9	0.7	1.5	2.2	55.1	4925
2008	11416	52.9	0.0	52.9	0.7	1.5	2.3	55.1	4831
2009	11644	52.8	0.0	52.8	0.8	1.6	2.3	55.2	4738
2010	11877	52.8	0.0	52.8	0.8	1.6	2.4	55.2	4647
2011	12115	52.8	0.0	52.8	0.8	1.6	2.4	55.2	4559
2012	12357	52.8	0.0	52.8	0.8	1.7	2.5	55.3	4471
2013	12604	52.8	0.0	52.8	0.8	1.7	2.5	55.3	4386
2014	12856	52.7	0.0	52.7	0.8	1.7	2.6	55.3	4302
2015	13114	52.7	0.0	52.7	0.9	1.8	2.6	55.3	4220
2016	13376	52.7	0.0	52.7	0.9	1.8	2.7	55.4	4140
2017	13643	52.7	0.0	52.7	0.9	1.9	2.7	55.4	4061
2018	13916	52.6	0.0	52.6	0.9	1.9	2.8	55.4	3984
2019	14195	52.6	0.0	52.6	0.9	1.9	2.9	55.5	3908
2020	14478	52.6	0.0	52.6	0.9	2.0	2.9	55.5	3834

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr11/10%yr12/20%yr13/30%yr14/20%yr
15/10%yr16/5%yr17

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	85.8	12.4	98.3
1971	86.3	12.4	98.8
1972	87.5	12.4	99.9
1973	89.0	12.4	101.5
1974	89.5	12.4	101.9
1975	88.2	12.4	100.7
1976	87.1	12.4	99.5
1977	86.7	12.4	99.2
1978	86.3	12.4	98.8
1979	85.4	12.4	97.9
1980	83.7	12.4	96.1
1981	81.5	12.4	94.0
1982	78.9	12.5	91.4
1983	76.9	12.7	89.6
1984	75.1	13.1	88.1
1985	72.7	13.7	86.3
1986	70.5	14.1	84.7
1987	68.3	14.2	82.5
1988	66.7	13.5	80.2
1989	65.3	12.7	78.0
1990	64.2	12.5	76.7
1991	63.0	12.8	75.8
1992	61.9	13.0	74.9
1993	60.5	12.8	73.3
1994	59.8	12.4	72.1
1995	59.3	12.0	71.3
1996	59.0	12.0	71.0
1997	58.7	12.7	71.4
1998	58.1	13.6	71.7
1999	57.4	14.5	71.9
2000	56.7	15.3	72.0
2001	55.9	16.0	71.9
2002	55.1	16.5	71.7
2003	54.5	16.8	71.3
2004	53.9	17.1	71.0
2005	53.5	16.7	70.1
2006	53.2	15.5	68.7
2007	53.0	12.5	65.6
2008	53.0	7.7	60.6
2009	53.0	4.3	57.3
2010	53.0	2.7	55.6
2011	52.9	1.8	54.8
2012	52.9	1.9	54.8
2013	52.9	1.9	54.8
2014	52.9	2.0	54.8
2015	52.8	2.0	54.8
2016	52.8	2.0	54.9
2017	52.8	2.1	54.9
2018	52.8	2.1	54.9
2019	52.8	2.2	54.9
2020	52.7	2.2	54.9

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category | room air conditioners

TEWI Basis = 100 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	REFRIG* (kg/unit)
*	1970	5886	9	1282	0.72
*	1971	5438	9	1282	0.72
	1972	4508	9	1282	0.72
*	1973	5346	9	1270	0.72
*	1974	4564	9	1258	0.72
*	1975	2670	9	1245	0.72
*	1976	2961	9	1233	0.72
*	1977	3270	9	1221	0.72
	1978	4037	9	1209	0.72
*	1979	3749	9	1172	0.72
	1980	3203	9	1134	0.72
	1981	3693	9	1161	0.72
	1982	2761	9	1135	0.72
	1983	2002	9	1088	0.72
	1984	3103	9	1044	0.72
	1985	3022	9	1002	0.72
	1986	2816	9	1000	0.72
	1987	3798	9	938	0.72
	1988	4637	9	915	0.72
	1989	5091	9	900	0.72
	1990	4150	9	862	0.72
	1991	2834	9	925	0.72
	1992	2910	9	853	0.72
	1993	3076	9	851	0.72
	1994	4120	9	843	0.72
*	1995	4202	9	826	0.72
*	1996	4286	9	810	0.72
*	1997	4372	9	793	0.72
*	1998	4460	9	778	0.72
*	1999	4549	9	762	0.72
*	2000	4640	9	747	0.72
*	2001	4733	9	732	0.72
*	2002	4827	9	717	0.72
*	2003	4924	9	703	0.72
*	2004	5022	9	689	0.72
*	2005	5123	9	675	0.72
*	2006	5225	9	662	0.72
*	2007	5330	9	648	0.72
*	2008	5436	9	635	0.72
*	2009	5545	9	623	0.72
*	2010	5656	9	610	0.72
*	2011	5769	9	598	0.72
*	2012	5884	9	586	0.72
*	2013	6002	9	574	0.72
*	2014	6122	9	563	0.72
*	2015	6245	9	552	0.72
*	2016	6369	9	541	0.72
*	2017	6497	9	530	0.72
*	2018	6627	9	519	0.72
*	2019	6759	9	509	0.72
*	2020	6894	9	499	0.72

100year GWP = 1500 (AFEAS, 1991)

0.72 kg R22 (25.4 oz.) estimated refrigerant capacity

* estimated data, 2% growth in sales and 2%reduction in energy beyond 1994

APPLIANCE TEWI ANALYSIS

Appliance Category | room air conditioners

TEWI Basis = 100 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)	(MT-CO_2) **INDIRECT TEWI**	REFRIG* (MT-CO_2)	(MT-CO_2) **DIRECT TEWI**	(MT-CO_2) **TOTAL TEWI**	(kg-CO_2) **TEWI per UNIT**
1970	5886	45.6	45.6	6.4	6.4	52.0	8834
1971	5438	42.2	42.2	5.9	5.9	48.0	8834
1972	4508	35.0	35.0	4.9	4.9	39.8	8834
1973	5346	41.1	41.1	5.8	5.8	46.8	8761
1974	4564	34.7	34.7	4.9	4.9	39.7	8688
1975	2670	20.1	20.1	2.9	2.9	23.0	8610
1976	2961	22.1	22.1	3.2	3.2	25.3	8537
1977	3270	24.1	24.1	3.5	3.5	27.7	8465
1978	4037	29.5	29.5	4.4	4.4	33.9	8392
1979	3749	26.6	26.6	4.0	4.0	30.6	8168
1980	3203	22.0	22.0	3.5	3.5	25.4	7938
1981	3693	25.9	25.9	4.0	4.0	29.9	8102
1982	2761	19.0	19.0	3.0	3.0	21.9	7944
1983	2002	13.2	13.2	2.2	2.2	15.3	7660
1984	3103	19.6	19.6	3.4	3.4	22.9	7394
1985	3022	18.3	18.3	3.3	3.3	21.6	7140
1986	2816	17.0	17.0	3.0	3.0	20.1	7128
1987	3798	21.5	21.5	4.1	4.1	25.6	6753
1988	4637	25.7	25.7	5.0	5.0	30.7	6614
1989	5091	27.7	27.7	5.5	5.5	33.2	6523
1990	4150	21.6	21.6	4.5	4.5	26.1	6293
1991	2834	15.9	15.9	3.1	3.1	18.9	6674
1992	2910	15.0	15.0	3.1	3.1	18.2	6239
1993	3076	15.8	15.8	3.3	3.3	19.2	6227
1994	4120	21.0	21.0	4.4	4.4	25.5	6178
1995	4202	21.0	21.0	4.5	4.5	25.5	6076
1996	4286	21.0	21.0	4.6	4.6	25.6	5977
1997	4372	21.0	21.0	4.7	4.7	25.7	5879
1998	4460	21.0	21.0	4.8	4.8	25.8	5783
1999	4549	21.0	21.0	4.9	4.9	25.9	5689
2000	4640	21.0	21.0	5.0	5.0	26.0	5596
2001	4733	20.9	20.9	5.1	5.1	26.1	5506
2002	4827	20.9	20.9	5.2	5.2	26.2	5418
2003	4924	20.9	20.9	5.3	5.3	26.2	5331
2004	5022	20.9	20.9	5.4	5.4	26.3	5246
2005	5123	20.9	20.9	5.5	5.5	26.4	5162
2006	5225	20.9	20.9	5.6	5.6	26.5	5081
2007	5330	20.9	20.9	5.8	5.8	26.7	5001
2008	5436	20.9	20.9	5.9	5.9	26.8	4922
2009	5545	20.9	20.9	6.0	6.0	26.9	4846
2010	5656	20.9	20.9	6.1	6.1	27.0	4770
2011	5769	20.9	20.9	6.2	6.2	27.1	4696
2012	5884	20.9	20.9	6.4	6.4	27.2	4624
2013	6002	20.8	20.8	6.5	6.5	27.3	4553
2014	6122	20.8	20.8	6.6	6.6	27.5	4484
2015	6245	20.8	20.8	6.7	6.7	27.6	4416
2016	6369	20.8	20.8	6.9	6.9	27.7	4349
2017	6497	20.8	20.8	7.0	7.0	27.8	4284
2018	6627	20.8	20.8	7.2	7.2	28.0	4220
2019	6759	20.8	20.8	7.3	7.3	28.1	4157
2020	6894	20.8	20.8	7.4	7.4	28.2	4095

MT-CO2 = MEGATONNES OF CARBON DIOXIDE

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr6/10%yr7/20%yr8/30%yr9/20%yr10/10%yr11/5%yr12

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	45.6	6.4	52.0
1971	45.3	6.4	51.6
1972	44.1	6.4	50.4
1973	43.6	6.4	49.9
1974	42.3	6.4	48.7
1975	39.5	6.4	45.9
1976	36.9	6.4	43.2
1977	34.5	6.3	40.9
1978	32.8	6.2	39.1
1979	30.9	6.1	37.0
1980	28.8	5.8	34.5
1981	27.4	5.4	32.8
1982	25.5	5.0	30.5
1983	23.4	4.5	27.9
1984	22.6	3.9	26.5
1985	21.8	3.7	25.5
1986	20.9	3.7	24.6
1987	20.5	3.8	24.3
1988	20.5	3.8	24.3
1989	20.9	3.7	24.6
1990	20.9	3.5	24.4
1991	20.4	3.2	23.6
1992	20.1	3.0	23.0
1993	19.8	3.1	22.9
1994	20.1	3.3	23.4
1995	20.2	3.6	23.8
1996	20.2	4.1	24.3
1997	19.9	4.5	24.4
1998	19.7	4.6	24.3
1999	19.7	4.2	23.9
2000	19.9	3.8	23.7
2001	20.3	3.6	23.9
2002	20.6	3.7	24.4
2003	20.8	4.1	24.9
2004	20.9	4.4	25.3
2005	20.9	4.6	25.5
2006	20.9	4.7	25.7
2007	20.9	4.8	25.7
2008	20.9	4.9	25.8
2009	20.9	5.0	25.9
2010	20.9	5.1	26.0
2011	20.9	5.2	26.1
2012	20.9	5.3	26.2
2013	20.9	5.4	26.3
2014	20.9	5.5	26.4
2015	20.9	5.6	26.5
2016	20.9	5.8	26.6
2017	20.8	5.9	26.7
2018	20.8	6.0	26.8
2019	20.8	6.1	26.9
2020	20.8	6.2	27.1

APPLIANCE ENERGY/REFRIGERANT ANALYSIS

Appliance Category room air conditioners

TEWI Basis = 500 years

	YEAR	UNITS (,000)	LIFE (years)	ELEC (kW-hr/yr)	REFRIG* (kg/unit)
*	1970	5886	9	1282	0.72
*	1971	5438	9	1282	0.72
	1972	4508	9	1282	0.72
*	1973	5346	9	1270	0.72
*	1974	4564	9	1258	0.72
*	1975	2670	9	1245	0.72
*	1976	2961	9	1233	0.72
*	1977	3270	9	1221	0.72
	1978	4037	9	1209	0.72
*	1979	3749	9	1172	0.72
	1980	3203	9	1134	0.72
	1981	3693	9	1161	0.72
	1982	2761	9	1135	0.72
	1983	2002	9	1088	0.72
	1984	3103	9	1044	0.72
	1985	3022	9	1002	0.72
	1986	2816	9	1000	0.72
	1987	3798	9	938	0.72
	1988	4637	9	915	0.72
	1989	5091	9	900	0.72
	1990	4150	9	862	0.72
	1991	2834	9	925	0.72
	1992	2910	9	853	0.72
	1993	3076	9	851	0.72
	1994	4120	9	843	0.72
*	1995	4202	9	826	0.72
*	1996	4286	9	810	0.72
*	1997	4372	9	793	0.72
*	1998	4460	9	778	0.72
*	1999	4549	9	762	0.72
*	2000	4640	9	747	0.72
*	2001	4733	9	732	0.72
*	2002	4827	9	717	0.72
*	2003	4924	9	703	0.72
*	2004	5022	9	689	0.72
*	2005	5123	9	675	0.72
*	2006	5225	9	662	0.72
*	2007	5330	9	648	0.72
*	2008	5436	9	635	0.72
*	2009	5545	9	623	0.72
*	2010	5656	9	610	0.72
*	2011	5769	9	598	0.72
*	2012	5884	9	586	0.72
*	2013	6002	9	574	0.72
*	2014	6122	9	563	0.72
*	2015	6245	9	552	0.72
*	2016	6369	9	541	0.72
*	2017	6497	9	530	0.72
*	2018	6627	9	519	0.72
*	2019	6759	9	509	0.72
*	2020	6894	9	499	0.72

500year GWP = 510 (AFEAS, 1991)

0.72 kg R22 (25.4 oz.) estimated refrigerant capacity

* estimated data, 2% growth in sales and 2%reduction in energy beyond 1994

APPLIANCE TEWI ANALYSIS

Appliance Category | room air conditioners

TEWI Basis = 500 years

YEAR	UNITS (,000)	ELEC (MT-CO_2)	(MT-CO_2) **INDIRECT TEWI**	REFRIG* (MT-CO_2)	(MT-CO_2) **DIRECT TEWI**	(MT-CO_2) **TOTAL TEWI**	(kg-CO_2) **TEWI per UNIT**
1970	5886	45.6	45.6	2.2	2.2	47.8	8121
1971	5438	42.2	42.2	2.0	2.0	44.2	8121
1972	4508	35.0	35.0	1.7	1.7	36.6	8121
1973	5346	41.1	41.1	2.0	2.0	43.0	8048
1974	4564	34.7	34.7	1.7	1.7	36.4	7976
1975	2670	20.1	20.1	1.0	1.0	21.1	7897
1976	2961	22.1	22.1	1.1	1.1	23.2	7824
1977	3270	24.1	24.1	1.2	1.2	25.3	7752
1978	4037	29.5	29.5	1.5	1.5	31.0	7679
1979	3749	26.6	26.6	1.4	1.4	28.0	7455
1980	3203	22.0	22.0	1.2	1.2	23.1	7226
1981	3693	25.9	25.9	1.4	1.4	27.3	7389
1982	2761	19.0	19.0	1.0	1.0	20.0	7232
1983	2002	13.2	13.2	0.7	0.7	13.9	6947
1984	3103	19.6	19.6	1.1	1.1	20.7	6681
1985	3022	18.3	18.3	1.1	1.1	19.4	6427
1986	2816	17.0	17.0	1.0	1.0	18.1	6415
1987	3798	21.5	21.5	1.4	1.4	22.9	6040
1988	4637	25.7	25.7	1.7	1.7	27.4	5901
1989	5091	27.7	27.7	1.9	1.9	29.6	5810
1990	4150	21.6	21.6	1.5	1.5	23.2	5581
1991	2834	15.9	15.9	1.0	1.0	16.9	5962
1992	2910	15.0	15.0	1.1	1.1	16.1	5526
1993	3076	15.8	15.8	1.1	1.1	17.0	5514
1994	4120	21.0	21.0	1.5	1.5	22.5	5466
1995	4202	21.0	21.0	1.5	1.5	22.5	5364
1996	4286	21.0	21.0	1.6	1.6	22.6	5264
1997	4372	21.0	21.0	1.6	1.6	22.6	5166
1998	4460	21.0	21.0	1.6	1.6	22.6	5070
1999	4549	21.0	21.0	1.7	1.7	22.6	4976
2000	4640	21.0	21.0	1.7	1.7	22.7	4884
2001	4733	20.9	20.9	1.7	1.7	22.7	4793
2002	4827	20.9	20.9	1.8	1.8	22.7	4705
2003	4924	20.9	20.9	1.8	1.8	22.7	4618
2004	5022	20.9	20.9	1.8	1.8	22.8	4533
2005	5123	20.9	20.9	1.9	1.9	22.8	4450
2006	5225	20.9	20.9	1.9	1.9	22.8	4368
2007	5330	20.9	20.9	2.0	2.0	22.9	4288
2008	5436	20.9	20.9	2.0	2.0	22.9	4210
2009	5545	20.9	20.9	2.0	2.0	22.9	4133
2010	5656	20.9	20.9	2.1	2.1	22.9	4057
2011	5769	20.9	20.9	2.1	2.1	23.0	3984
2012	5884	20.9	20.9	2.2	2.2	23.0	3911
2013	6002	20.8	20.8	2.2	2.2	23.1	3840
2014	6122	20.8	20.8	2.2	2.2	23.1	3771
2015	6245	20.8	20.8	2.3	2.3	23.1	3703
2016	6369	20.8	20.8	2.3	2.3	23.2	3636
2017	6497	20.8	20.8	2.4	2.4	23.2	3571
2018	6627	20.8	20.8	2.4	2.4	23.2	3507
2019	6759	20.8	20.8	2.5	2.5	23.3	3444
2020	6894	20.8	20.8	2.5	2.5	23.3	3382

MT-CO2 = MEGATONNES OF CARBON DIOXIDE

DISTRIBUTED LIFETIME TEWI ANALYSIS

5%yr6/10%yr7/20%yr8/30%yr9/20%yr10/10%yr11/5%yr12

YEAR	(MT-CO_2) INDIRECT TEWI	(MT-CO_2) DIRECT TEWI	(MT-CO_2) TOTAL TEWI
1970	45.6	2.2	47.8
1971	45.3	2.2	47.4
1972	44.1	2.2	46.2
1973	43.6	2.2	45.7
1974	42.3	2.2	44.5
1975	39.5	2.2	41.7
1976	36.9	2.2	39.1
1977	34.5	2.2	36.7
1978	32.8	2.1	34.9
1979	30.9	2.1	33.0
1980	28.8	2.0	30.7
1981	27.4	1.8	29.2
1982	25.5	1.7	27.2
1983	23.4	1.5	25.0
1984	22.6	1.3	23.9
1985	21.8	1.2	23.1
1986	20.9	1.3	22.2
1987	20.5	1.3	21.8
1988	20.5	1.3	21.8
1989	20.9	1.2	22.2
1990	20.9	1.2	22.0
1991	20.4	1.1	21.5
1992	20.1	1.0	21.1
1993	19.8	1.1	20.9
1994	20.1	1.1	21.2
1995	20.2	1.2	21.5
1996	20.2	1.4	21.6
1997	19.9	1.5	21.5
1998	19.7	1.6	21.2
1999	19.7	1.4	21.1
2000	19.9	1.3	21.2
2001	20.3	1.2	21.5
2002	20.6	1.3	21.9
2003	20.8	1.4	22.2
2004	20.9	1.5	22.4
2005	20.9	1.6	22.5
2006	20.9	1.6	22.5
2007	20.9	1.6	22.6
2008	20.9	1.7	22.6
2009	20.9	1.7	22.6
2010	20.9	1.7	22.6
2011	20.9	1.8	22.7
2012	20.9	1.8	22.7
2013	20.9	1.8	22.7
2014	20.9	1.9	22.8
2015	20.9	1.9	22.8
2016	20.9	2.0	22.8
2017	20.8	2.0	22.8
2018	20.8	2.0	22.9
2019	20.8	2.1	22.9
2020	20.8	2.1	22.9