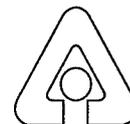

**Energy Consumption and Expenditure Projections
by Population Group on the Basis of the *Annual
Energy Outlook 1999* Forecast**

**Decision and Information
Sciences Division
Argonne National Laboratory**



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by D.A. Poyer and J.H. Balsley

Decision and Information Sciences Division,
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September 1999



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ENERGY CONSUMPTION AND EXPENDITURE PROJECTIONS BY POPULATION GROUP ON THE BASIS OF THE ANNUAL ENERGY OUTLOOK 1999 FORECAST

by

D.A. Poyer and J.H. Balsley

ABSTRACT

This report presents an analysis of the relative impacts of the base-case scenario used in *Annual Energy Outlook 1999* on different population groups. Projections of energy consumption and expenditures, as well as energy expenditures as a share of income, from 1996 to 2020 are given. The projected consumption of electricity, natural gas, distillate fuel, and liquefied petroleum gas during this period is also reported for each population group. In addition, this report compares the findings of the *Annual Energy Outlook 1999* report with the 1998 report. Changes in certain indicators and information affect energy use forecasts, and these effects are analyzed and discussed.

SUMMARY

This study provides a disaggregated analysis by household population type of the *Annual Energy Outlook 1999* forecast. Energy consumption and expenditure estimates and forecasts from 1996 through 2020 are provided for Hispanic, non-Hispanic black, and non-Hispanic white households. The analysis uses the Socio-Economic and Research and Analysis Program's Distributive Impact and Assessment Model, an econometric model that uses population-specific energy demand systems. These systems were estimated from a series of Residential Energy Consumption Surveys produced by the U.S. Department of Energy, Energy Information Administration.

Projections show that residential energy use during the specified time frame will shift substantially from distillate fuels, natural gas, and liquefied petroleum gas to electricity. On average, real household energy expenditures are projected to fall as well. Minority groups are projected to experience the largest changes in residential patterns of energy use. Some highlights of the forecast are listed below:

- Electricity
 - Of the major sources of energy for residential use, only average household electricity consumption is projected to increase for each population group.

- The increase in average household electricity consumption is projected to be highest for Hispanic and non-Hispanic black groups, growing at an annual rate of about 0.7% per year during the forecast period.
- Minority households are expected to increase their share of electricity consumed relative to that of non-Hispanic white households.
- Natural Gas
 - Natural gas consumption is projected to decrease over the forecast period. The decline is projected to be slowest for Hispanic households; consumption by non-Hispanic white and non-Hispanic black households is projected to decrease at similar rates.
 - The Hispanic household share of natural gas consumption is expected to double during the forecast period.
- Distillate Fuel
 - Distillate fuel usage is projected to sharply decrease from 1996 to 2020, declining by more than 2.5% per year. Consumption is projected to decrease slightly faster in non-Hispanic black and Hispanic households.
 - The Hispanic household share of distillate fuel consumption is projected to double by 2020.
- Liquefied petroleum gas (LPG)
 - LPG consumption is projected to fall, with the slowest decrease occurring in non-Hispanic black households.
 - Hispanic and non-Hispanic black household LPG shares are projected to increase by 40% between 1996 and 2020.
- Energy Expenditures
 - Real household energy expenditures are projected to decline for each income group during the forecast period. The largest decline is projected to occur for white households.
 - The electricity share of total energy expenditures is projected to increase from 67% to 71% by 2020. This increase is projected to occur for all population groups but grow fastest in minority households.
 - Expenditures for natural gas, distillate fuel, and LPG are projected to fall for each population group.

- Total residential energy expenditures are projected to fall for each population group. The largest decline is projected to occur for non-Hispanic white households, and the smallest decline is projected for Hispanic households.
- The energy expenditure share of household income is projected to decline for each population group. The decline is projected to be approximately the same for each group.

1 INTRODUCTION

Energy consumption and expenditures differ among population groups for many reasons. Such factors as geographic location, home type, socioeconomic status, and personal or cultural preference create observable variations in the type and amount of energy consumed. As a result, the effects of changing energy markets on the economic welfare of various population groups are likely to be disproportionate (Poyer and Allison 1998).

The U.S. Department of Energy (DOE), Office of Economic Impact and Diversity, supports research to create analytical tools, models, and other methods to produce disaggregated forecasts of energy consumption and expenditure, including residential energy usage. The aggregated forecasts for each residential energy source and population group are benchmarked to the aggregated forecast developed by DOE's Energy Information Administration (EIA). This research is important because differences in energy consumption and expenditure are found across population groups. These differences occur because the population groups considered are distributed differently across energy-related variables, such as home type and location. Consequently, these groups have diverse degrees of vulnerability to changing energy prices, and this diversity generally creates disparate economic outcomes for these groups (Poyer and Williams 1993; Poyer et al. 1997; Poyer and Allison 1998).

2 ENERGY CONSUMPTION AND POPULATION GROUP

This study presents an assessment and a disaggregated analysis of the 1999 *Annual Energy Outlook* AEO residential energy consumption and expenditure forecast (DOE 1998) across three population groups: Hispanic, non-Hispanic black, and non-Hispanic white households.

The Residential Energy Consumption Survey (RECS) data — which are published by the DOE/EIA — indicate that a very strong relationship exists between energy use patterns and geographic location and home type. Section 2.1 presents a forecast of energy consumption and expenditures over the 1996 to 2020 period. Section 2.2 describes energy use across population groups, Census region locations, and home types for 1996 — the base year of the forecast period.

2.1 ENERGY CONSUMPTION AND EXPENDITURES FOR 1996

Tables 1 and 2 provide data on energy consumption and expenditures, respectively, for 1996 for the four major residential energy sources for each population group. The 1996 estimates for total energy expenditure are highest for non-Hispanic white households. The electricity, liquefied petroleum gas (LPG) and distillate fuel consumption and expenditure levels are also estimated to be highest for non-Hispanic white households.

TABLE 1 1996 Average Household Energy Consumption by Population Group (10⁶ Btu/yr per household)

Population Group	Electricity	Natural Gas	Distillate	LPG	Total
Hispanic	28.61	45.04	8.90	1.66	84.21
Non-Hispanic black	32.37	70.75	6.13	1.51	110.76
Non-Hispanic white	39.19	53.51	11.01	5.03	108.74
U.S. average	37.50	54.66	10.29	4.35	106.80

**TABLE 2 1996 Average Household Energy Expenditures by Population Group
(\$/year per household)**

Population Group	Electricity	Natural Gas	Distillate	LPG	Total
Hispanic	713	283	64	20	1,079
Non-Hispanic black	806	445	44	18	1,313
Non-Hispanic white	976	336	79	59	1,451
U.S. average	934	344	74	51	1,403

The average non-Hispanic black household is estimated to spend almost \$110/yr more on natural gas than the average non-Hispanic white household. Conversely, the average non-Hispanic white household is estimated to spend \$170/yr more on electricity than a non-Hispanic black family and over \$260/yr more than a Hispanic family. Total energy expenditures of non-Hispanic white households are nearly 25% higher than the expenditures of Hispanic households and 10% higher than those of non-Hispanic black households.

Estimates of the energy expenditure burden, however, are highest for non-Hispanic blacks. As shown in Figure 1, total residential energy expenditures for non-Hispanic black households account for nearly 5% of their household income, compared with 3.5% for non-Hispanic white households —about a 40% difference. Blacks also spend a larger share of their income on electricity and natural gas. Surprisingly, the share of black income spent on natural gas is nearly twice the share of income spent by non-Hispanic white households. Hispanics and non-Hispanic whites spend about the same share of income on energy. The electricity expenditure share is slightly higher for white households than for Hispanics, and the natural gas expenditure share is slightly higher for Hispanics.

The relative differences in fuel-type expenditure shares across population groups reflect a different energy-source mix among these households. Figures 2–4 show the residential energy source shares of total energy expenditure for each of the three population groups. The largest difference occurs in the energy consumption mix in white and black households. For their total residential energy expenditures, non-Hispanic white households spend nearly 70% on electricity and 23% on natural gas, whereas non-Hispanic black households spend about 60% on electricity and about 35% on natural gas.

Furthermore, it has been argued that differences among population groups continue to prevail even after considering differences in income (Poyer and Williams 1993, Poyer et al. 1997). While the reasons for these differences are not clearly evident, the relationships among energy-related variables and income — and the quality and nature of these variables — probably differ among these population groups.

The distribution of energy-related variables by population type differs for many reasons. Minorities are less likely to live in single-family detached homes and more likely to live in smaller, older homes. They are also more likely to have more household members, to live in urban areas, and to be disproportionately located in the South and West. These variables account for some of the differences observed and the types of residential energy demanded.

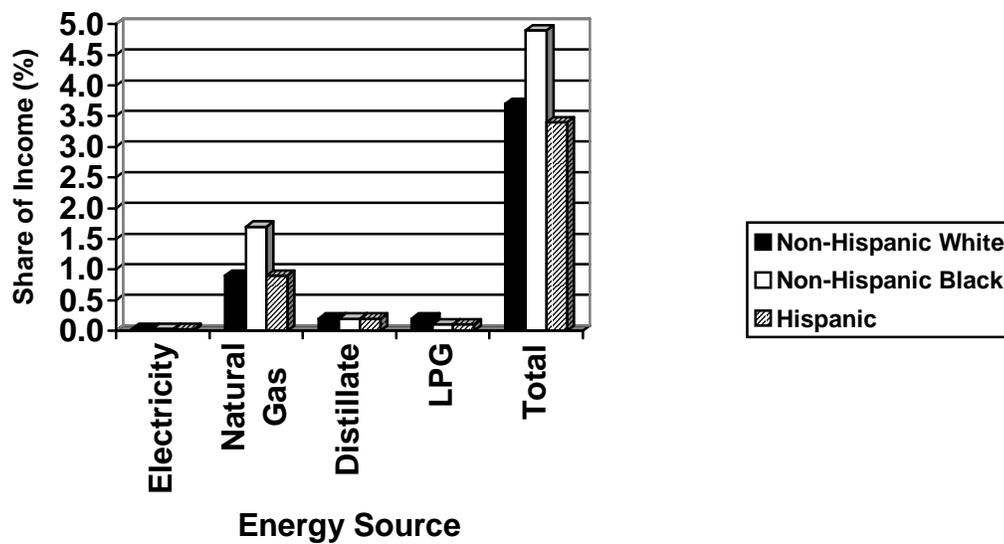


FIGURE 1 1996 Energy Expenditure Shares of Income by Population Group

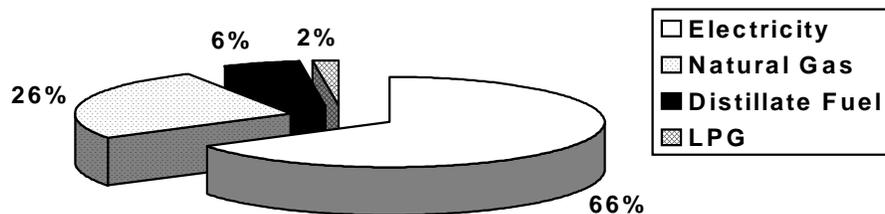


FIGURE 2 1996 Energy Expenditure Shares for Hispanic Households

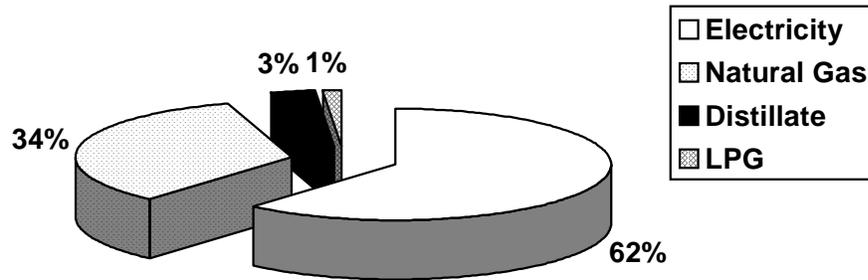


FIGURE 3 1996 Energy Expenditure Shares for Non-Hispanic Black Households

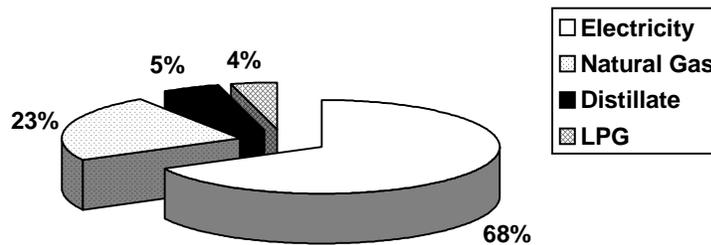


FIGURE 4 1996 Energy-Expenditure Shares for Non-Hispanic White Households

2.2 HOME TYPE, GEOGRAPHIC LOCATION, AND ENERGY CONSUMPTION

Sections 2.2.1 and 2.2.2 discuss the 1993 statistics from RECS on the interrelationships among energy consumption, regional location, home type, and population group.¹

2.2.1 Home Type and Energy Consumption

The AEO energy consumption forecasts are dependent on home type forecasts, because energy consumption and home-type characteristics are closely related (DOE 1999). Residents of detached single-family homes, on average, consume more energy and incur higher energy expenditures, whereas energy consumption and expenditures are lowest, on average, for residents of multifamily homes. Differences in fuel consumption mix among home types are also apparent. For example, electricity consumption is highest in single-family homes, whereas LPG consumption is highest in mobile homes. Because of these striking patterns, it is important to establish controls for home type when evaluating consumption among different income and

¹ Tables 3–6 and accompanying analysis are from Poyer and Allison (1998).

socioeconomic groups. Table 3 provides 1993 RECS data that show the percentage of households living in different types of housing by income quintile and socioeconomic group (Poyer and Allison 1998).

As reported by Poyer and Allison (1998), in general, the type of housing people occupy is related to their household income; it is not surprising that higher-income households typically live in detached single-family homes. This fact strongly contributes to the growth in energy consumption as household income increases. Figure 5 illustrates the consumption of energy by energy source and home type. The consumption of each residential energy source, with the exception of LPG, was higher in single-family homes in 1993. The consumption of natural gas was particularly higher in single-family housing. In 1993, the consumption of natural gas was more than 55% greater in single-family homes than in multifamily housing.

More important, the RECS data show that in general, higher-income households are more likely to live in single-family housing, but the pattern of this relationship differs among population groups. Table 3 indicates that Hispanic and non-Hispanic black households are more likely to live in multifamily housing than are non-Hispanic white households within the same income quintile. Moreover, non-Hispanic white households are the most likely to live in mobile homes for all income quintiles except the third. These differences are probably due to the disproportionate concentration of minority groups in urban areas (Poyer and Allison 1998).

TABLE 3 1993 Household Percentages by Home Type

Income Quintile and Socioeconomic Group	Detached Single-Family	Attached Single-Family	Mobile Home	Small ^a Multifamily	Large ^a Multifamily
First Quintile	43	7	8	12	30
Non-Hispanic white	36	6	10	11	26
Non-Hispanic black	41	9	2	14	35
Hispanic	31	8	7	16	39
Second Quintile	54	7	9	11	18
Non-Hispanic white	59	5	10	10	15
Non-Hispanic black	43	13	4	17	23
Hispanic	41	8	8	18	25
Third Quintile	63	7	7	7	16
Non-Hispanic white	67	7	7	7	12
Non-Hispanic black	42	11	4	10	33
Hispanic	41	7	10	6	36
Fourth Quintile	69	9	4	7	12
Non-Hispanic white	72	8	4	6	10
Non-Hispanic black	47	10	2	22	20
Hispanic	59	9	8	7	18
Fifth Quintile	80	8	1	4	7
Non-Hispanic white	84	7	2	3	5
Non-Hispanic black	53	21	0	9	17
Hispanic	63	10	1	9	17
U.S. average	62	8	6	8	17

^a Multifamily households are considered small when four or fewer units make up the residential structure and large when more than four units make up the residential structure.

Source: DOE (1995).

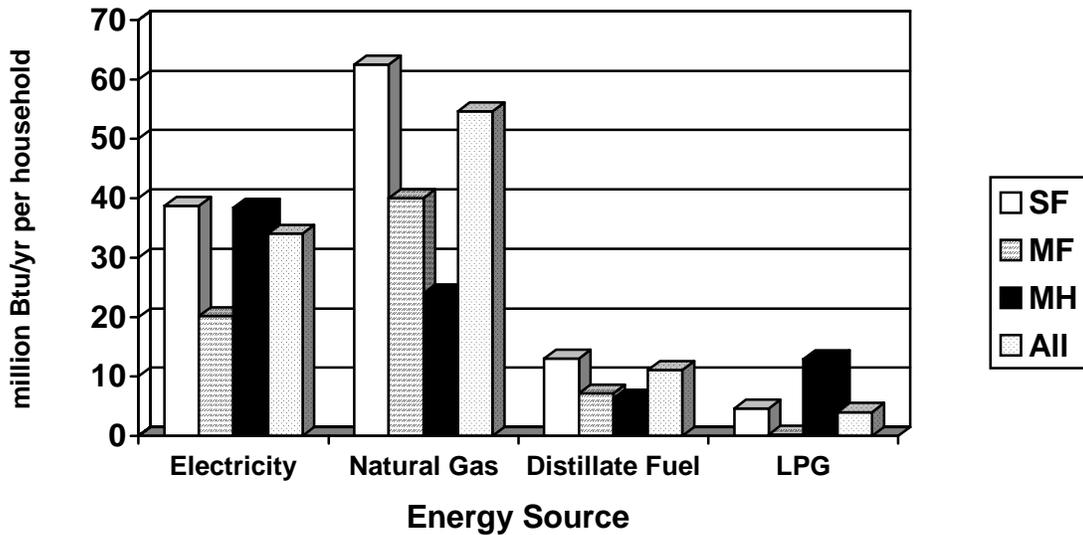


FIGURE 5 1996 Average Household Energy Consumption by Home Type
(SF = single family; MF = multifamily; MH = mobile home)

2.2.2 Geographic Location and Energy Consumption

Table 4 shows the average household energy consumption in 1993 by energy source and Census region. Patterns and amounts of energy consumption vary greatly by region. More electricity is consumed in the South; natural gas consumption is heavily concentrated in the Northeast and Midwest Census regions; and distillate fuel consumption occurs almost exclusively in the Northeast. Overall, the West is the least-energy-dependent region, consuming less than the national average of each major residential energy source.

Table 5 shows the average household energy expenditures in 1993 by energy source and Census region. The expenditures for energy, as is consumption of energy, is lowest in the West overall but highest in the Northeast — approximately 60% higher than in the West. Energy expenditures in the Midwest and South are slightly higher than the U.S. average (about \$1,300/yr per household).

Expenditures for different energy sources vary highly by region. In 1993, expenditures for electricity were highest in the South. Natural gas expenditures were highest in the Midwest and Northeast, each averaging around \$450/yr per household — nearly twice the levels in the South and West. Distillate fuel expenditures were highest in the Northeast, dwarfing expenditures for this energy source in the other regions. Finally, LPG expenditures were the highest in the Midwest, at \$68/year per household.

TABLE 4 1993 Average Household Energy Consumption by Energy Source and Census Region (10⁶ Btu/yr per household)

Census Region	Electricity	Natural Gas	Distillate Fuel	LPG	All
Northeast	24	57	40	1	122
Midwest	32	89	6	8	134
South	45	35	4	4	88
West	28	45	2	2	76
U.S. average	34	55	11	4	104

TABLE 5 1993 Average Household Energy Expenditures by Energy Source and Census Region (\$/yr per household)

Census Region	Electricity	Natural Gas	Distillate Fuel	LPG	All
Northeast	809	441	257	18	1,526
Midwest	753	488	36	68	1,336
South	1,017	216	27	43	1,304
West	667	250	12	21	953
U.S. average	839	332	40	73	1,283

The 1993 RECS data indicate that the distribution of minority households by Census region varies from that of non-Hispanic white households. Table 6 shows the 1993 household population distributions by Census region. Non-Hispanic white populations are slightly more concentrated in the Northeast and Midwest regions than are non-Hispanic black or Hispanic populations. Non-Hispanic blacks are concentrated in the South. More than 50% of the non-Hispanic black households are located in the South, compared with 33% of the non-Hispanic white household population. Hispanic households are more heavily concentrated in the West; that is, 37% of Hispanic households compared with 19% of non-Hispanic white households are in the West.

The housing and regional data alone indicate that electricity consumption would be relatively higher in minority households and that natural gas consumption, particularly among non-Hispanic blacks, would be relatively lower.² However, the 1993 RECS data reveal a different reality: electricity use is relatively higher in non-Hispanic white households, and average natural gas use is not only relatively higher but is also absolutely higher in non-Hispanic black households.

As a result of divergent patterns of energy use among different population groups, it is likely that changing energy markets, precipitated as a result of either public policy or technological changes, will affect the economic welfare of these population groups in various ways. This concern is the rationale for determining whether energy policies have disparate impacts across population groups.

² Analyses of the RECS 1993 data indicate that the difference in electricity consumption narrows when income and regional location are controlled; however, the average electricity consumption in non-Hispanic white households still exceeds that of black households. For natural gas, the circumstances are different. After controlling for income and regional location, the difference in natural gas consumption between non-Hispanic whites and blacks actually increases.

TABLE 6 1993 Household Percentages by Census Region

Income Quintile and Socioeconomic Group	Northeast	Midwest	South	West
First Quintile	21	21	40	18
Non-Hispanic white	21	25	37	18
Non-Hispanic black	17	19	59	5
Hispanic	31	9	21	40
Second Quintile	17	27	33	23
Non-Hispanic white	18	31	31	18
Non-Hispanic black	20	22	47	11
Hispanic	12	11	33	44
Third Quintile	18	26	36	20
Non-Hispanic white	18	28	35	19
Non-Hispanic black	16	12	55	17
Hispanic	22	18	31	29
Fourth Quintile	22	25	34	19
Non-Hispanic white	22	27	33	19
Non-Hispanic black	20	26	49	5
Hispanic	22	13	29	36
Fifth Quintile	24	22	32	23
Non-Hispanic white	24	23	32	21
Non-Hispanic black	27	18	41	14
Hispanic	24	12	32	32
U.S. Average	20	24	35	21
Non-Hispanic white	21	27	33	19
Non-Hispanic black	19	19	53	9
Hispanic	22	12	29	37

3 PROJECTIONS FOR ENERGY CONSUMPTION AND EXPENDITURES

Section 3 discusses the potential impact of the energy policy future underlying the 1999 AEO on energy consumption and expenditure patterns in minority households.

3.1 ECONOMIC ASSUMPTIONS IN THE ANNUAL ENERGY OUTLOOK 1999

The Socio-Economic Research and Analysis Program's Distributive Impact Assessment Model (DIAM) was developed to generate disaggregated forecasts of DOE/EIA's AEO forecast. DIAM can provide a disaggregated forecast either by income class or by population group. The model is primarily driven by changes in household income, energy price forecasts, and group-specific demand elasticities (see Poyer et al. 1997).

Changes in average real energy prices are expected to be modest over the forecast period, but as indicated in Figure 6, they are expected to be uneven. For example, a spike is projected in the real price of distillate fuels and LPG in the 2002–2008 time frame. Overall, projections indicate that LPG and distillate prices will rise in the long term, after dropping in price in the near term (1996–2002). Conversely, natural gas prices will rise and then fall after 2002. Real electricity prices are expected to fall throughout this period.

Residential energy consumption is expected to rise, but at a slightly lower rate than predicted in the 1998 AEO — to 22.9 quadrillion Btu (quads) in 2020 as opposed to 23.2 quads — because of increased efficiency in new construction, which offsets growth in the housing stock (DOE 1998, p. 3). The National Energy Modeling System (NEMS) model (used to generate the AEO report) recognizes strong growth in household income and modest energy prices but also accounts for nonmarket factors that affect energy consumption. The other major factors that distinguish this AEO report from previous reports are discussed in detail in the following sections.

3.2 ELECTRICITY CONSUMPTION AND EXPENDITURES

3.2.1 Electricity Consumption

Table 7 shows the forecast for electricity consumption by population group. Electricity consumption increases the most for Hispanic and non-Hispanic black households. During the forecast period, projections indicate that electricity consumption in Hispanic and black households will increase at annual rates of 0.80% and 0.64%, respectively, whereas white household electricity consumption is projected to increase at 0.36% per year. As a consequence, the overall minority share of aggregate electricity consumption is projected to increase rather dramatically in 2020. In 1996, white households accounted for 84% of all electricity consumption, but this amount is projected to fall to 76% by 2020.

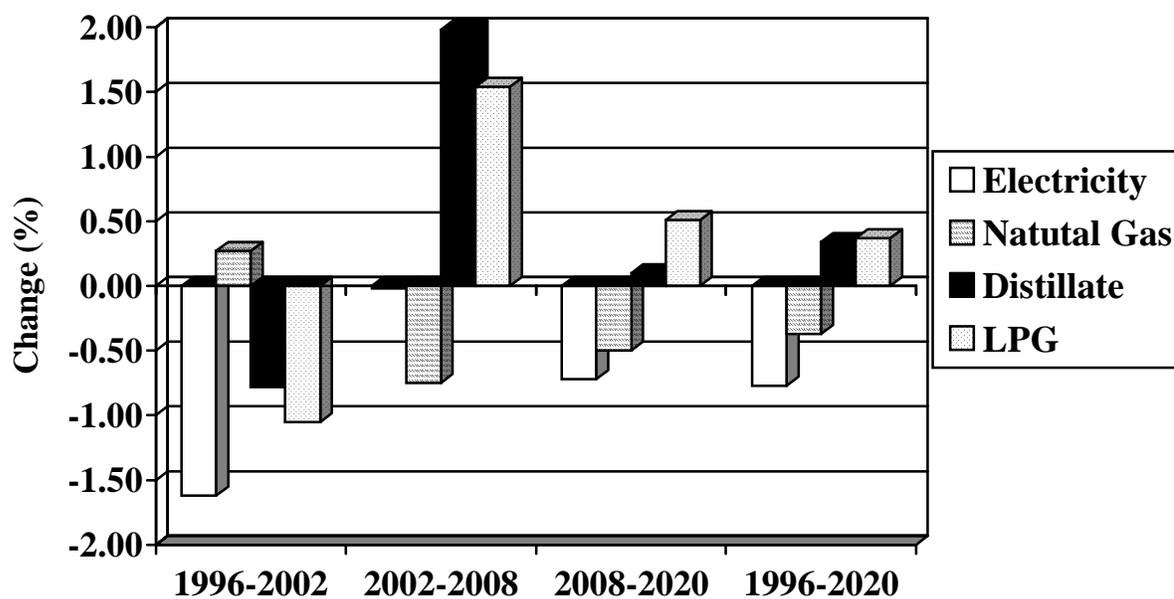


FIGURE 6 Projected Rates of Change in Real Energy Prices between 1996 and 2020
(Source: DOE 1998)

TABLE 7 Projected Average Household Electricity Consumption by Population Group for 1996, 2005, and 2020 (10^6 Btu/yr per household)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	28.61	31.94	34.61	0.80
Non-Hispanic black	32.37	35.67	37.71	0.64
Non-Hispanic white	39.19	41.84	42.67	0.36
U.S. average	37.50	40.05	40.81	0.35

Very little difference occurs in the projected change in the population group shares of aggregate electricity consumption between the 1998 and 1999 AEO reference cases. In 2020, the white household share of aggregate electricity consumption is slightly lower in the 1999 AEO case than it is in the 1998 AEO case. However, the average electricity consumption in white households is slightly higher than it is in the 1998 AEO case.

3.2.2 Electricity Expenditures

Table 8 shows the expenditure forecasts for electricity. With the exception of Hispanic households, real electricity expenditures decrease for each population group during the forecast

period. The rate of decrease differs between population groups; non-Hispanic whites decrease their electricity expenditures by about 0.34% per year during the forecast period, while electricity expenditures for non-Hispanic blacks decrease minimally — an average of 0.06% per year. Conversely, Hispanic household electricity expenditures are projected to increase at an annual rate of 0.10%.

3.3 NATURAL GAS CONSUMPTION AND EXPENDITURES

3.3.1 Natural Gas Consumption

Table 9 shows the forecasts for natural gas consumption for all population groups. Overall, the consumption of natural gas declines during the forecast period; the decrease is the least for Hispanics and about the same rate for non-Hispanic blacks and whites.

As occurred for electricity consumption, the minority household share of aggregate natural gas consumption increases dramatically. The non-Hispanic white household share of natural gas consumption is projected to fall over the forecast period, from about 79% in 1996 to 70% by 2020.

The projection of aggregate natural gas consumption is nearly identical in the 1998 and 1999 AEO forecasts — 5.9 quads. The overall differences between the 1998 and 1999 AEO forecasts in the rates of consumption and shares of aggregate natural gas consumption among the population groups are imperceptible.

TABLE 8 Projected Electricity Expenditures by Population Group for 1996, 2005, and 2020 (\$/yr per household, 1996 dollars)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	710	730	730	0.10
Non-Hispanic black	810	810	795	-0.06
Non-Hispanic white	980	950	900	-0.34
U.S. average	930	910	860	-0.34

TABLE 9 Projected Average Household Natural Gas Consumption by Population Group for 1996, 2005, and 2020 (10⁶ Btu/yr per household)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	45.04	42.17	40.87	-0.40
Non-Hispanic black	70.75	64.80	59.38	-0.73
Non-Hispanic white	53.51	48.13	44.31	-0.78
U.S. average	54.66	49.39	45.63	-0.75

3.3.2 Natural Gas Expenditures

Table 10 shows the forecasts for natural gas expenditures by population group. Expenditures are expected to decrease for natural gas by about 1.10% per year overall; Hispanics are projected to experience the smallest decline (about 0.75% per year), while non-Hispanic whites are projected to reduce their average household expenditures for natural gas by about 1.13% per year. The decline for non-Hispanic black households is projected to be comparable to that of white households (approximately 1.07% per year).

3.4 DISTILLATE FUEL CONSUMPTION AND EXPENDITURES

3.4.1 Distillate Fuel Consumption

Table 11 shows that distillate fuel consumption is projected to fall dramatically. Overall, consumption of this fuel is projected to decrease by more than 2.5% per year during the forecast period. The annual rate of change in distillate fuel consumption is similar among the three population groups. The rate of decline in consumption is slightly faster for minority households, where it is projected to decline by 2.71% and 2.50% for non-Hispanic black and Hispanic households, respectively. Non-Hispanic white household consumption is projected to decline by 2.43% per year.

TABLE 10 Projected Natural Gas Expenditures by Population Group for 1996, 2005, and 2020 (\$/yr per household, 1996 dollars)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	280	270	240	-0.75
Non-Hispanic black	440	410	340	-1.07
Non-Hispanic white	340	300	260	-1.13
U.S. average	340	310	260	-1.10

TABLE 11 Projected Average Household Distillate Fuel Consumption by Population Group for 1996, 2005, and 2020 (10^6 Btu/yr per household)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	8.90	6.91	4.84	-2.50
Non-Hispanic black	6.13	4.80	3.17	-2.71
Non-Hispanic white	11.01	8.58	6.10	-2.43
U.S. average	10.29	7.97	5.54	-2.54

Despite the relatively similar rate of decline in distillate consumption for each household category, the Hispanic households' share of aggregate distillate fuel consumption is projected to double during the forecast period, that is, increase from 7% in 1996 to about 14% by 2020.³

The overall decline in distillate fuel consumption under the 1999 AEO scenario was substantially larger than projected under the 1998 AEO scenario. In 1998, distillate fuel consumption was projected to decline at 1.84% per year compared to the 1999 AEO projection of 2.54% per year.

³ Its growing share of the household population explains the relative increase in the Hispanic share of total distillate fuel consumption.

3.4.2 Distillate Fuel Expenditures

Table 12 provides the projections for distillate fuel expenditures for each population group. The average decline in distillate fuel expenditures in the United States is projected to be 2.19% per year. This rate translates into a very large drop in real distillate fuel expenditures. For the average household, this change amounts to a decline of more than 40% in real distillate fuel expenditures during the forecast period.

As projected for distillate fuel consumption, the change in distillate fuel expenditures is projected to be about the same for the population groups. Expenditures are projected to decline slightly faster for non-Hispanic black households, at 2.35% per year. They are projected to decline at 2.08% and 2.15% per year for white and Hispanic households, respectively. By 2020, the typical household will spend less than \$4/mo on distillate fuel; the average non-Hispanic black households will spend a little more than \$2/mo.

TABLE 12 Projected Distillate Fuel Expenditures by Population Group for 1996, 2005, and 2020 (\$/yr per household, 1996 dollars)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	64	49	38	-2.15
Non-Hispanic black	44	34	25	-2.35
Non-Hispanic white	79	61	48	-2.08
U.S. average	74	56	43	-2.19

3.5 LPG CONSUMPTION AND EXPENDITURES

3.5.1 LPG Consumption

Table 13 shows the LPG consumption forecasts. The relative differences in the projected consumption of LPG among the different population groups are very large.⁴ Although LPG consumption declines for each population group, the relative magnitudes in the rates of change differ considerably. Hispanic households are projected to decrease LPG consumption an average

⁴ These differences are driven primarily by differences in geographic and metropolitan location of the three population groups and the assumptions made in regard to changes in their home-type mix over the forecast period. Our housing forecast scenario shows a disproportionate growth in minority households living in mobile homes.

of 1.96% per year during the forecast period, while non-Hispanic black households are projected to decrease consumption by only 0.12% per year. White households are projected to decrease consumption by 1.15% per year.

The 1999 AEO LPG projections differ the most from the 1998 AEO forecasts. The rather dramatic declines in the 1999 forecast contrast sharply with the modest declines and increase reported in the 1998 forecast. The 1998 AEO scenario projects a very moderate decline in overall LPG consumption during the 1993–2020 time frame, and an actual increase in LPG consumption is projected for non-Hispanic white (0.11% per year) and non-Hispanic black (0.91% per year) households in the 1998 forecast.

TABLE 13 Projected Average Household LPG Consumption by Population Group for 1996, 2005, and 2020 (10^6 Btu/yr per household)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	1.66	1.55	1.03	-1.96
Non-Hispanic black	1.51	1.57	1.47	-0.12
Non-Hispanic white	5.03	4.78	3.81	-1.15
U.S. average	4.35	4.06	3.09	-1.41

3.5.2 LPG Expenditures

Table 14 shows the projected LPG expenditures. On average, LPG expenditures are projected to decrease by about 20% by the end of the forecast period. The changes in LPG expenditure are neither uniform during the forecast period nor uniform by population group. Except for Hispanic households, the annual rate of change in LPG expenditures is projected to increase — or decrease more slowly — in the latter half of the forecast period (2005–2020).

By population group, expenditures also differ. LPG expenditures are projected to increase 0.22% per year for black households and 1.63% per year for Hispanic households. For white households, the annual rate of change in LPG expenditures falls between that of non-Hispanic black and Hispanic households — decreasing by 0.82% per year.

TABLE 14 Projected LPG Expenditures by Population Group for 1996, 2005, and 2020 (\$/yr per household, 1996 dollars)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	20	18	13	-1.63
Non-Hispanic black	18	18	19	0.22
Non-Hispanic white	59	54	49	-0.82
U.S. average	51	46	39	-1.08

3.6 PROJECTED RESIDENTIAL ENERGY EXPENDITURES

Annual residential energy expenditures per household are projected to decline during the entire forecast period. Real residential energy expenditures for each household are projected to decline by nearly \$200/yr between 1996 and 2020. This decline is driven by improvements in residential energy efficiency and a fall in real energy prices. However, the changes in expenditures across population categories are uneven.

Table 15 shows the projected energy expenditures. Average residential energy expenditures decline the most for non-Hispanic white households (0.61% per year) and the least for Hispanic households (0.24% per year). Energy expenditures for non-Hispanic black households are projected to fall at a rate between the rates for Hispanic and white households, at a rate of 0.44% per year.

The decline in average household energy expenditures and the projected increase in household incomes bode well for the household energy expenditure burden — the percent of household income spent on energy. Figure 7 shows the projected energy expenditure share of income. For the entire forecast period, the share of income spent on energy is projected to decline for each of the population groups. The relative decline is least for Hispanics (3.38% in 1996 to 2.23% in 2020, or 1.7% per year) and equal for non-Hispanic white and black households (1.8% per year).

During the forecast period, non-Hispanic blacks are projected to spend a larger share of their income on energy. Hispanics and whites are projected to spend about an equal share of their income on energy.

TABLE 15 Projected Total Residential Energy Expenditures by Population Group for 1996, 2005, and 2020 (\$/yr per household, 1996 dollars)

Population Group	1996	2005	2020	Annual Rate of Change (%)
Hispanic	1,080	1,060	1,020	-0.24
Non-Hispanic black	1,310	1,270	1,180	-0.44
Non-Hispanic white	1,450	1,370	1,250	-0.61
U.S. average	1,400	1,330	1,210	-0.62

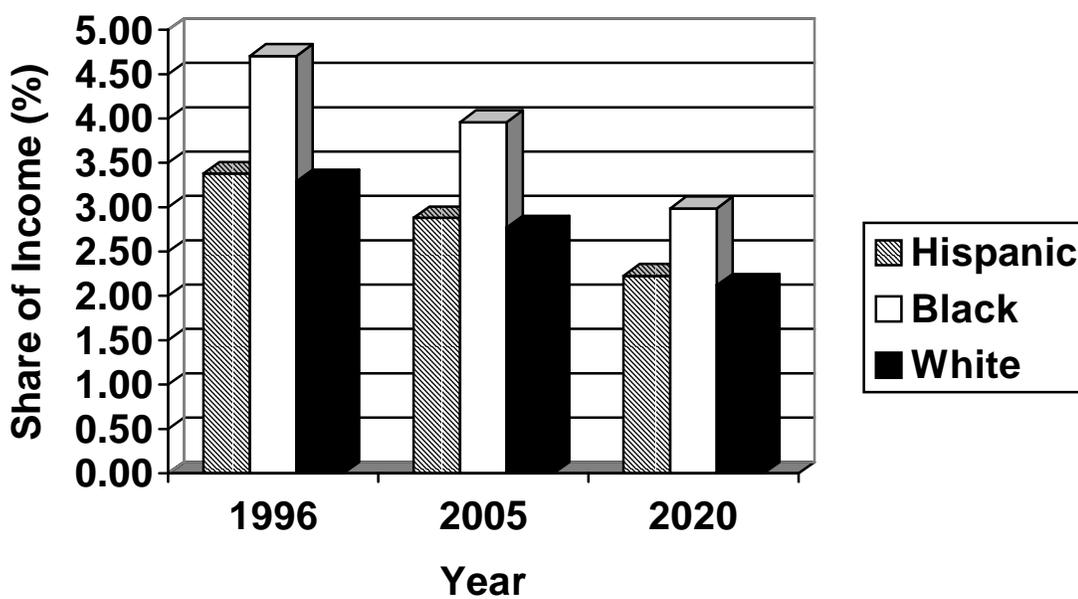


FIGURE 7 Projected Energy Expenditure Share of Income in 1996, 2005, and 2020 by Population Group

4 SIGNIFICANT DIFFERENCES BETWEEN 1998 AEO AND 1999 AEO

The *Annual Energy Outlook* projections are produced by using NEMS, which was developed by the Office of Integrated Analysis and Forecasting within the EIA (DOE 1997, p. 214). NEMS uses a market-based approach to energy analysis, accounting for supply and demand and economic competition between energy sources, and it represents the nine Census divisions in its various modules. Because this analytical technique is general, unforeseen changes in any economic variable considered can significantly alter the projections of the AEO base-case scenario.

Fuel price projections are similar in the 1998 and 1999 AEO scenarios. By 2020, the 1999 AEO price projections for electricity, crude oil, and natural gas are imperceptibly different from those of the 1998 AEO scenario. In the short term, however, the projected price of crude oil is much lower in the 1999 AEO than in the 1998 AEO forecast. The difference emerges as a result of the economic recession in many Asian countries, which lowers demand for world oil supplies. Oil demand is expected to grow rapidly in the next decade, restoring the 1999 AEO price level to 1998 AEO levels (DOE 1997, p. 2).

By 2020, the 1999 AEO projects that natural gas prices will be \$2.68 per thousand cubic feet, which is higher than the \$2.59 projection in the 1998 AEO (DOE 1997, p. 3). Electricity prices are expected to decline at the same rate in both cases. Electric restructuring activity on the federal and state level is assumed to pave the way for this decrease, but with the absence of in-place federal legislation, the future of electricity competition is uncertain.

Three areas discussed in this report changed dramatically as a result of new circumstances reported in the 1999 AEO. First, and most interesting, is the reversal in the direction of LPG consumption during the forecast period for non-Hispanic white and non-Hispanic black households. The 1998 scenario projects that LPG consumption will increase by 0.11% and 0.91% for non-Hispanic white and non-Hispanic black households, respectively, whereas the 1999 case projects that LPG consumption will decrease by 1.15% and 0.12% for white and black households, respectively.

Unlike the 1998 AEO projections, the 1999 AEO scenario projects that a larger percentage of the population will live in multifamily housing. The 1999 AEO scenario projects an annual increase of 1.09% in multifamily housing, compared with 0.89% in the 1998 AEO. This change partly contributes to the decline in LPG consumption seen in the 1999 AEO scenario, because far less LPG is consumed in multifamily housing than in mobile-home or single-family housing.

The second area that changed dramatically in the 1999 AEO is in the rate of change in distillate fuel consumption. The 1998 AEO projected consumption of distillate fuel to decline by 1.84% per year, whereas the 1999 AEO projected a larger decline of 2.54%. The continued decline in consumption is at least in part explained by the relative rise in the price of distillate fuel with respect to electricity and natural gas.

Third, rates of decline in total energy expenditures changed significantly. Non-Hispanic white households are projected to spend less on energy (0.53% per year) under the 1998 AEO. In the 1999 AEO, the rate of decline increases to 0.61% per year, but no corresponding change occurs in non-Hispanic black or Hispanic households. As a consequence, the relative level of expenditures among these groups narrows in the 1999 AEO case.

5 CONCLUSIONS

The overall makeup of energy consumption in the United States is projected to change rapidly under the 1999 AEO scenario. Electricity consumption is projected to increase across the board as electricity becomes increasingly more vital to American households. Consumption of natural gas and distillate fuels is projected to decline for all population groups, and LPG consumption is projected to fall on average.

Electricity consumption is projected to increase fastest for minority populations, and overall, it will rise, on average, at a rate of 0.35% per year. During the forecast period, consumption will rise from 37.5 to almost 41 million Btu/yr per household.

Natural gas consumption will fall under the 1999 AEO scenario, on average by about 0.75% per year. The decline will be slowest for Hispanic households, but non-Hispanic white households will decrease their natural gas consumption by as much as 1.17% per year (from 1996 to 2005). Consumption of natural gas will decline from about 55 to about 46 million Btu/yr per household on average during the forecast period.

Distillate fuel consumption is projected to decrease at a very fast rate for all population groups, averaging 2.54% per year during the forecast period. Non-Hispanic black households are projected to decrease consumption by 2.71% per year. Distillate fuel usage will fall from 10 to 5.5 million Btu/yr per household during the forecast period.

LPG usage will decrease on average during the forecast period. However, the rate of decrease will vary substantially by population group, and some increases are even projected from 1996 to 2005 in non-Hispanic black households. Usage of LPG will fall from 4.4 million to 3.1 million Btu/yr per household.

Annual energy expenditures are projected to fall for every population group. In the 1999 AEO, both declining energy consumption and energy prices drive down average household expenditures. The projected fall in annual energy expenditures, coupled with projected growth in real household income, results in a substantial decline in the projected share of household income spent on energy. The decline occurs for each population group.

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