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Minority Energy Assessment Report: Fall 1992

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Minority Energy Assessment Report: Fall 1992

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ABSTRACT

The purpose of this research is to project household energy consumption, energy expenditure, and energy expenditure as share of income for five population groups from 1991 to 2009. The approach uses the Minority Energy Assessment Model (MEAM), developed by Argonne National Laboratory for the U.S. Department of Energy's Office of Minority Economic Impact. The MEAM provides a framework that can be used to forecast regional energy consumption and energy expenditure for majority, black, Hispanic, poor, and nonpoor households. The forecasts of key macroeconomic and energy variables used as exogenous variables in the MEAM were obtained from the Data Resources, Inc., Macromodel and Energy Model. Generally, the projections of household energy consumption, expenditure, and energy expenditure as share of income vary across population groups and census regions.

SUMMARY

This report projects household energy consumption, expenditure, and energy expenditure as share of income for the following population groups: majority, black, Hispanic, poor, and nonpoor. The projections are made at the level of census regions for the forecast period 1991-2009. The base-year historical energy data for these population groups are provided for 1987.

The Minority Energy Assessment Model (MEAM), developed by Argonne National Laboratory for the U.S. Department of Energy's Office of Minority Economic Impact, was used for making the projections. The model and its methodology are briefly discussed in Section 2.

The base-case forecasts of key macroeconomic and energy variables used as exogenous variables in the MEAM were obtained from the Data Resources, Inc., Macromodel and Energy Model scenarios released in the second quarter of 1992. The key exogenous variables include the U.S. Consumer Price Index, the prices of residential energy (natural gas, home heating oil, and electricity), and household income by census region. The energy and economic forecasts under this base-case scenario are discussed in Appendix A. One of

the most important economic indicators is the price of crude oil. Under the base case, crude oil prices, which act as prominent driving forces in the energy markets, are forecast to rise from \$17/bbl in 1991 to \$19/bbl (1989 dollars) in 1995. However, as the gap between the world oil supply and demand narrows at a moderate pace, crude oil prices are forecast to rise to \$22/bbl by 2000 and to \$29/bbl by 2010 (1989 dollars).

Several conclusions can be drawn on the basis of the past household energy consumption and expenditure patterns of majority, black, Hispanic, poor, and nonpoor population groups in four census regions (Northeast, Midwest, South, and West). In 1987:

- Total energy consumption was highest for black households in the Midwest (172×10^6 Btu/household) and lowest for poor households in the West (72×10^6 Btu/household).
- Total energy expenditure in 1989 dollars was highest (\$1,921/household) and lowest (\$759/household) for black households in the Northeast and in the West, respectively.
- Energy expenditure as share of household income was highest for poor households in the Northeast (20.9%) and lowest for nonpoor households in the West (2.2%).

The analysis of DOE's 1987 Residential Energy Consumption Survey data indicates that energy expenditure as share of income in black households is inordinately high with respect to the share of income spent on energy by majority and Hispanic households nationally. The level of energy expenditure by black households in the Northeast is of particular concern because they had the highest expenditure of any of the population groups in any census region in 1987.

Except for Hispanic households in the South, the cumulative change in household energy consumption among the five population groups during the 1987-2009 period ranges from -11% (for black and majority households in the Northeast and poor and Hispanic households in the Midwest) to -6% (for all population groups, except the poor in the West). The energy consumption for Hispanic households in the South in 2009, while it follows the general trajectory of energy demand for other households, still remains 1% above its 1987 level. Factors other than energy prices (such as type and age of home) contribute to this pattern for Hispanic households in the South.

During the 1987-1991 forecast period, the household energy expenditure declines for all population groups, primarily because of the rapid decline in the prices of both electric and nonelectric energy during the period. A turnaround in the household energy expenditure is projected for all population groups in 1995. With the sharper increases now under way in the price of nonelectric energy, energy expenditure is projected to increase dramatically for each population group between 1995 and 2005. In 2005, energy expenditure peaks for all population groups. Between 1987 and 2005, the energy expenditure rises most for black and

Hispanic households in the Midwest (51%) and least for nonpoor households in the South (24%).

The household energy expenditure as share of income declined during the 1987-91 period for all population groups. However, a turnaround in the household energy expenditure is projected for 1995. Because of the current economic recovery, the household income for all population groups is projected to increase at above-average rates during the 1991-95 period. Except in the Midwest, this combination of events would result in a slight lowering of energy expenditure as share of income for all population groups during the 1991-95 period. (In the Midwest, energy expenditure as share of income would rise slightly during this period.) During the subsequent 1995-2005 period, income gains are projected to slow down to long-term equilibrium levels. This combination of changes is expected to lead to a post-recovery high in energy expenditure as share of income for all population groups in all regions in 2005. Among all population groups, the peak in energy expenditure as share of income in 2005 ranges from 21% for poor households in the Northeast to 2.4% for nonpoor households in the West.

1 INTRODUCTION

Earlier research¹ has demonstrated that the differential economic impact of future energy price changes on poor and minority households could be significant. This raises potentially long-term research and policy issues for various government agencies, including the U.S. Department of Energy (DOE). The purpose of the research reported here, sponsored by the DOE Office of Minority Economic Impact (MI), is to provide an update on the economic effects of recent economic and energy scenarios on majority, black, Hispanic, poor, and nonpoor households from 1991 to 2009. The economic effects are measured by changes in household energy consumption, energy expenditure, and energy expenditure as share of income for these five population groups.

The approach uses the Minority Energy Assessment Model (MEAM), developed by Argonne National Laboratory (ANL) for DOE/MI.² The model provides a framework that can be used to forecast regional energy consumption and energy expenditure for majority, black, Hispanic, poor, and nonpoor households. The MEAM also estimates energy expenditure as share of income during the 1991-2009 forecast period. The forecasts of key macroeconomic and energy variables used as exogenous variables in MEAM were obtained from the Data Resources, Inc. (DRI), Macromodel and Energy Model.³⁻⁵

In this report, the historical 1987 energy consumption and expenditures for majority, black, Hispanic, poor, and nonpoor households are estimated from the DOE Energy Information Administration's (EIA's) 1987 Residential Energy Consumption Survey (RECS) sample data. The household energy consumption and expenditures are provided in 10^6 Btu/household and constant 1989 dollar/household, respectively. The energy expenditure as share of income is the ratio of household energy expenditures and household income (both in 1989 constant dollars). All income and other indicators in nominal dollars were converted into constant dollars (real) using the historical and projected values of the U.S. Consumer Price Index (CPI).

This report is divided into five sections. Section 2 discusses the methodology used for estimating the economic effects of projected energy price changes on households by population group. Section 3 provides the household economic and energy effects under the base-case scenario. Section 4 presents the conclusions of the report. Section 5 lists reference documents cited in this report. The Appendix describes the base-case energy and economic scenarios used for the analysis.

2 METHODOLOGY

The first task in assessing the effect of projected energy prices is to use the MEAM to investigate the relationship between energy consumption and economic welfare for various types of households in the U.S. A brief description of the structure of the model and its linkage with the DRI models follows.

2.1 STRUCTURE OF THE MEAM

The MEAM is a budgeting model based on a two-stage linear expenditure system. The model is a special case of Brown and Heien's S-branch utility tree model.⁶ The basic model was developed by Klein and Rubin, Samuelson, Geary, and Stone.⁷⁻¹⁰ In this model, energy is viewed as one commodity group, in which choices about the type of fuel and its level of use are determined.

The structure of the MEAM is rather complex because it is a combination of ideas put forth by various researchers. The MEAM is derived from the Stone-Geary utility function; the parameters that characterize this element are referred to as the structural parameters. A second aspect of the model is the dynamic element. The dynamics are incorporated into the structure of the model by allowing certain structural parameters in the energy demand equations to change over time. The work done by Philips is used extensively for this purpose.^{11,12}

A third aspect of the model is the quality component. Within this context, the effect of appliance choice on energy demand is introduced. In order to systematically capture this effect, together with the influence of demographic factors, household characteristics, and climate, we draw on the work of Muellbauer.¹³ The effect of appliance choices on energy demand and the patterns of demand are continued through their influence on the quality index. At a different structural level, the appliance choice is determined quantitatively through the estimation of a binomial logit model.

Structural parameters have been estimated using a longitudinal sample consisting of about 5,000 observations from four Residential Energy Consumption Surveys conducted by DOE.¹⁴⁻¹⁷

2.2 LINKAGE OF THE MEAM WITH DRI MODELS

To obtain household energy projections from the MEAM, the projections of certain regional economic and energy indicators are needed, including residential fuel prices, inflation rate, and household income. For this purpose, the MEAM has been linked with the DRI models.

The DRI Macro model provides annual projections of the U.S. Consumer Price Index (CPI) for the forecasting period. Because the CPI projections are available only at the

national level, they are assumed to be applicable for each of the four census regions (Northeast, Midwest, South, and West) used in the MEAM analysis.

The projections made by the census division of prices and demand for residential electricity, residential natural gas, and home heating oil were obtained from the DRI Energy Model. A demand-weighted price projection for each of these fuels was derived for each of the census regions. The nonelectric energy prices were obtained by weighting the prices of home heating oil and natural gas by their demand in the region. The projections of electric and nonelectric energy prices were then input into the MEAM.

The income per household by region was not available from any of the DRI models. The income per household by each of the census regions was estimated from projections of the aggregate disposable income and housing stocks by census division, available from the DRI Energy Model for the forecast periods.

3 HOUSEHOLD ECONOMIC AND ENERGY EFFECTS

The following subsections discuss energy consumption, energy expenditure, and energy expenditure as share of household income for majority, black, Hispanic, poor, and nonpoor population groups in each of four census regions (Northeast, Midwest, South, and West).

3.1 HOUSEHOLD ECONOMIC AND ENERGY EFFECTS IN THE NORTHEAST

3.1.1 Total Energy Consumption

Figure 1 and Table 1 provide the estimated 1987 household energy consumption for majority, black, Hispanic, poor, and nonpoor groups in the Northeast based on the 1987 RECS sample. Among these groups, total energy consumption was highest for black households (143×10^6 Btu/household) and lowest for Hispanic households (111×10^6 Btu/household).

Figure 1 also shows the projected household energy consumption for the selected population groups for the 1991-2009 forecast period. As is discussed in Section A.2.2, the prices of nonelectric energy (primarily natural gas and fuel oil) either fall at a lower average annual rate or rise at a higher rate than do the prices of electric energy throughout the 1987-2009 period. As a result, there is a decline in nonelectric energy consumption and a less-than-offsetting increase in electricity consumption for all groups during the 1987-2009 period. For example, for majority households, electricity consumption increases from 25.2×10^6 Btu/household in 1987 to 29.6×10^6 Btu/household in 2009; nonelectric energy consumption declines from 97.7×10^6 Btu/household in 1987 to 79.9×10^6 Btu/household in 2009. During the 1987-2009 period, the decline in total annual energy consumption is lowest for poor households (9%) and highest for majority households (11%) (Figure 1).

3.1.2 Total Energy Expenditure

Table 2 lists the 1987 household energy expenditure for majority, black, Hispanic, poor, and nonpoor groups in the Northeast. Among these groups, the total energy expenditure in 1989 dollars was highest for black households (\$1,921) and lowest for poor households (\$1,456).

With the rapid decline in the prices of both electric and nonelectric energy (Figure A.9), and only a modest change in the consumption of these fuels (see Figure 1), between 1987 and 1991 (Figure 1), the household energy expenditure declines for all population groups (Figure 2). As is discussed in Section A.2.2, the prices of electric energy are expected to continue declining until 2000 before stabilizing at those levels during the 2000-10 period. However, the prices of nonelectric energy are projected to rise at increasing

FIGURE 1 Household Energy Consumption by Population Group under Base Case: Northeast

**TABLE 1 Household Energy Consumption:
Northeast**

Year	Energy Consumption by Group (10^6 Btu/household)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	122.9	143.2	110.7	112.8	126.8
1991	124.7	140.8	112.8	113.6	130.5
1995	123.3	138.6	113.4	110.9	128.4
2001	115.4	133.4	110.3	105.2	119.7
2005	110.7	127.9	99.7	104.7	115.4
2009	109.5	127.9	99.5	102.4	114.8

TABLE 2 Household Energy Expenditure: Northeast

Year	Energy Expenditure by Group (\$/household ^a)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	1,604	1,921	1,494	1,457	1,667
1991	1,531	1,789	1,444	1,380	1,613
1995	1,665	2,017	1,609	1,514	1,745
2001	1,786	2,249	1,747	1,655	1,889
2005	2,017	2,483	1,883	1,889	2,129
2009	1,794	2,144	1,670	1,649	1,907

^a 1989 dollars.

FIGURE 2 Household Energy Expenditure by Population Group under Base Case: Northeast

average annual rates of 0.4% during 1991-95, 1.9% during 1995-2000, and 2.4% during 2000-05. Given the relative insensitivity of consumption to these rising energy prices (Section 3.1.1), energy expenditure increases dramatically for each population group between 1991 and 2005.

Figure 2 shows the projections of total household energy expenditure for the five population groups in the Northeast. With the continued declining trend in household energy consumption and a lower escalation rate in nonelectric energy prices, energy expenditure declines modestly for all population groups (Figure 2). The energy expenditure peaks in 2005 for all population groups. During the 1987-2005 period, the energy expenditure rises by a cumulative 30% for poor households, 29% for black households, 28% for nonpoor households, and 26% for Hispanic and majority households.

3.1.3 Energy Expenditure as Share of Income

Table 3 lists the 1987 household energy expenditure as share of income by population group in the Northeast. The household energy expenditure as share of income varied by group. As expected, the share was highest for poor households (20.9%) and lowest for nonpoor households (4.6%). Among the other groups, black households spent 8.8% of their disposable income on energy, Hispanic households spent 6.3%, and majority households spent 4.8%.

As is discussed in Section A.2.2, except for the recession year of 1991, household income is projected to increase for all groups each year during the 1987-2009 period. During the 1987-91 period, household income grew at an average annual rate of 1.4% for all groups. In addition, household energy expenditure declined for all population groups during the 1987-91 period (Section 3.1.2) because of the rapid decline in the prices of both electric and nonelectric energy during this period. This combination of events led to a decline in household energy expenditure as share of income during the 1987-91 period for all population groups (Figure 3).

Because of the current economic recovery, household income is projected to increase at a rate of 1.9% during the 1991-95 period. As is discussed in Section 3.1.2, because of the turnaround in nonelectric energy prices in 1992, energy expenditure is projected to increase modestly for each population group between 1991 and 1995. However, the growth in household income in an environment of economic recovery overshadows the increase in energy expenditure. These trends are expected to result in the lowering of household energy expenditure as share of income during the 1991-95 period (see Figure 3).

With the sharper increases now under way in the prices of nonelectric energy, energy expenditure is predicted to increase dramatically for each population group between 1995 and 2005 (Figure 2). In addition, during the 1995-2005 period, the income gains are predicted to slow down to long-term equilibrium levels. This combination of changes would lead to a turnaround in energy expenditure as share of income in 1995. This turnaround would be

**TABLE 3 Energy Expenditure as Share of Income:
Northeast**

Year	Share of Income by Group (%)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	4.75	8.78	6.33	20.86	4.55
1991	4.38	7.90	5.91	19.12	4.25
1995	3.99	7.46	5.52	17.62	3.85
2001	4.22	8.18	5.89	19.01	4.11
2005	4.55	8.62	6.07	20.76	4.42
2009	4.09	7.52	5.44	18.37	4.00

**FIGURE 3 Household Energy Expenditure as Share of Income by Population
Group under Base Case: Northeast**

expected to continue until it peaks in 2005 because of a modest drop in energy expenditure for all population groups during the 2005-10 period (Section 3.1.2). The energy expenditure as share of income reaches its post-1987 peak level in 2005 at 20.8% for poor households, 8.6% for black households, 6.1% for Hispanic households, 4.5% for majority households, and 4.4% for nonpoor households. For all population groups, the peak shares during the 1991-2009 period are expected to remain slightly short of their 1987 levels.

3.2 HOUSEHOLD ECONOMIC AND ENERGY EFFECTS IN THE MIDWEST

3.2.1 Total Energy Consumption

Figure 4 and Table 4 provide the estimated 1987 household energy consumption for majority, black, Hispanic, poor, and nonpoor groups in the Midwest based on the 1987 RECS sample. Among these groups, total energy consumption was highest for black households (172×10^6 Btu/household). For the other groups, energy consumption ranged from 118 to 124×10^6 Btu/household.

Figure 4 also shows forecasts of household energy consumption for all population groups during the 1991-2009 forecast period. As is discussed in Section A.2.2, nonelectric energy prices either fall at a lower average annual rate or rise at a faster rate than electric energy prices throughout the forecast period. As a result, there would be a major decline in nonelectric energy consumption for all households during the 1991-2009 period, but only a small change in electric energy consumption during the 1987-2009 period ($+1.6 \times 10^6$ Btu/household for Hispanic households and -2.7 for black households) (Figure 4). During the 1987-2009 period, the decline in total annual energy consumption is lowest for black households (9%) and highest for Hispanic households (11%).

3.2.2 Total Energy Expenditure

Table 5 lists the 1987 household energy expenditure for majority, black, Hispanic, poor, and nonpoor population groups in the Midwest. Among these groups, the total energy expenditure was highest for black households (\$1,349 in 1989 dollars) and lowest for poor households (\$1,061).

With the rapid decline in the prices of both electric and nonelectric energy between 1987 and 1991 (Figure A.10), household energy expenditure declined for all population groups during that period (Figure 5). As is discussed in Section A.2.3, electric energy prices are expected to keep declining until 1995 before settling down at the levels forecast for the 1995-2000 period. In this scenario, a slow but steady recovery in the price of electric energy begins at an average annual rate of 1.5% during the 2000-10 period. However, nonelectric energy prices rise at increasing average annual rates of 0.1% during the 1991-95 period, 3.1% during 1995-2000, and 3.4% during 2000-05.

FIGURE 4 Household Energy Consumption by Population Group under Base Case: Midwest

TABLE 4 Household Energy Consumption by Group: Midwest

Year	Energy Consumption by Group (10 ⁶ Btu/household)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	119.2	171.8	118.3	118.2	123.6
1991	119.3	169.9	109.7	118.5	123.5
1995	116.8	166.9	115.1	116.3	120.2
2001	112.2	161.4	104.7	110.4	114.9
2005	108.5	158.8	103.3	108.1	112.2
2009	107.6	157.1	105.4	105.7	111.2

**TABLE 5 Household Energy Expenditure by Group:
Midwest**

Year	Energy Expenditure by Group (\$/household ^a)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	1,124	1,349	1,176	1,061	1,160
1991	950	1,134	963	900	986
1995	1,136	1,399	1,249	1,084	1,164
2001	1,459	1,798	1,513	1,385	1,503
2005	1,645	2,035	1,780	1,567	1,687
2009	1,419	1,659	1,514	1,310	1,462

^a 1989 dollars.

FIGURE 5 Household Energy Expenditure by Population Group under Base Case: Midwest

Given the relative insensitivity of consumption to these rising energy prices (see Section 3.2.1), energy expenditure is projected to increase dramatically for each population group between 1991 and 2005. Figure 5 shows the projections of total household energy expenditure for majority, black, Hispanic, poor, and nonpoor population groups in the Midwest. With the small change in household energy consumption and a lower escalation rate in nonelectric energy prices, energy expenditure is expected to decline modestly for all population groups during the 2005-2009 period (Figure 5). Energy expenditure is expected to peak in 2005 for all population groups.

During the 1987-2005 period, energy expenditure is projected to rise by a cumulative 51% for black and Hispanic households, 48% for poor households, 46% for majority households, and 45% for nonpoor households.

3.2.3 Energy Expenditure as Share of Income

Table 6 lists the 1987 household energy expenditure as share of income for the specified population groups in the Midwest. The household energy expenditure as share of income varied by group. As expected, the share was highest for poor households (14.7%) and lowest for nonpoor households (3.6%). Among the other groups, black households spent 7.6% of their disposable income on energy, Hispanic households spent 5.4%, and majority households spent 4.0%.

As is discussed in Section A.2.3, except for the recession year of 1991, household income is projected to increase each year during the 1987-2009 period. Because of the healthy growth in manufacturing and agriculture sectors during the 1987-91 period, income grew at an average annual rate of 2.7%. In contrast, household energy expenditure declined for all population groups during this same period (Section 3.2.2), primarily because of the rapid decline in the real prices of both electric and nonelectric energy during the 1987-91 period. This combination of events led to a decline in household energy expenditure as share of income during the 1987-91 period for all population groups (Figure 6).

With the current economic recovery, household income is projected to increase at a rate of 1.9% during the 1991-95 period. As is discussed in Section A.2.3, the declining trend since 1987 in nonelectric energy prices is projected to end in 1992. Because of the modest recovery in the prices of nonelectric energy between 1992 and 1995, household energy expenditure, after hitting bottom in 1991, surpasses 1987 levels for each population group by 1995. Even the growth in household income in an environment of economic recovery is not able to compensate for the increases in energy expenditure. These trends result in a slight increase in household energy expenditure as share of income during the 1991-95 period (Figure 6).

With the sharper increases now under way in the prices of nonelectric energy, and with the bottoming of prices for electric energy in 1995, energy expenditure is predicted to increase rather dramatically for each population group between 1995 and 2005 (Figure 5).

TABLE 6 Energy Expenditure as Share of Income by Group: Midwest

Year	Share of Income by Group (%)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	3.99	7.57	5.41	14.71	3.58
1991	3.15	5.98	4.15	11.69	2.85
1995	3.30	6.48	4.74	12.37	2.95
2001	4.27	8.42	5.81	15.97	3.84
2005	4.54	9.00	6.45	17.06	4.06
2009	4.02	7.56	5.65	14.68	3.61

FIGURE 6 Household Energy Expenditure as Share of Income by Population Group under Base Case: Midwest

In addition, during the 1995-2005 period, income gains are expected to slow down to long-term equilibrium levels. This combination of changes is projected to lead to an upward trend in energy expenditure as share of income during the 1991-2005 period. The share of income will peak in 2005 because of the modest drop in energy expenditure for all population groups in the 2005-10 period, as discussed in Section 3.2.2. The energy expenditure as share of income reaches the post-1987 peak level of 17.1% for poor households, 9.0% for black households, 6.4% for Hispanic households, 4.5% for majority households, and 4.1% for nonpoor households in 2005. Also, the 1987 peak levels for energy expenditure as share of income for all population groups are projected to be surpassed by the year 2001.

3.3 HOUSEHOLD ECONOMIC AND ENERGY EFFECTS IN THE SOUTH

3.3.1 Total Energy Consumption

Table 7 shows the 1987 household energy consumption for majority, black, Hispanic, poor, and nonpoor population groups in the South based on the 1987 RECS sample. Among these groups, total energy consumption was highest for black households (90×10^6 Btu/household) and lowest for Hispanic households (73×10^6 Btu/household). Because of the lower demand for space heating in this region (as compared with the Northeast and Midwest), energy consumption for all population groups in the South is much lower than in these snowbelt regions. For example, in 1987, black households consumed 143×10^6 Btu/household in the Northeast and 172×10^6 Btu/household in the Midwest.

Figure 7 shows the household energy consumption for the five population groups during the 1991-2009 period. During the 1987-95 period, nonelectric energy prices and electricity prices follow similar trajectories, providing no relative advantage of one fuel over another. Compared to the 1.4% average annual decline of the electric energy prices during the 1987-95 period, the nonelectric energy prices decline by a closely similar 1.3% rate. However, as is discussed in Section A.2.4, in the remaining 1995-2009 forecast period, the prices of nonelectric energy rise at a faster rate than the prices of electric energy, favoring the consumption of electric energy over nonelectric energy. As a result, for all households except Hispanic, there is a major decline in nonelectric energy consumption (-4.3×10^6 Btu/household for poor households to -8.2×10^6 Btu/household for nonpoor households), but only a small change ($+0.9 \times 10^6$ Btu/household for nonpoor households to -0.4 for black households) in electric energy consumption during the 1987-2009 period. Therefore, except for Hispanic households, each group's total energy consumption is lower.

The energy consumption for Hispanic households, while following the general path of energy demand for other households (Figure 7), only comes close to its 1987 levels during the 1991-2009 forecast period. During the 1987-2009 period, the total energy consumption for Hispanic households increases slightly (0.9×10^6 Btu/household). In contrast, the total annual energy consumption declines for all other population groups within the range of

FIGURE 7 Household Energy Consumption by Population Group under Base Case: South

TABLE 7 Household Energy Consumption: South

Year	Energy Consumption by Group (10^6 Btu/household)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	83.6	89.9	73.1	73.8	87.9
1991	87.8	93.4	83.9	77.2	91.6
1995	86.2	89.8	83.5	75.8	89.7
2001	81.5	86.0	76.0	72.8	85.0
2005	79.6	83.9	75.4	70.5	83.0
2009	77.0	81.9	73.9	68.2	80.4

-5.5×10^6 Btu/household for poor households and -8.0×10^6 Btu/household for black households. The change in energy consumption during the 1987-2009 period ranges from 1% for Hispanic households to -9% for black households.

3.3.2 Total Energy Expenditure

Table 8 lists the household energy expenditure for majority, black, Hispanic, poor, and nonpoor population groups in the South. In 1987, the total energy expenditure (in 1989 dollars) was highest for nonpoor households (\$1,274) and lowest for poor households (\$1,014).

With the rapid decline in the prices of both electric and nonelectric energy between 1987 and 1991 (Figure A.11), household energy expenditure declined for all population groups (Figure 8). As is discussed in Section A.2.4, electric energy prices are expected to keep declining until 1995 before settling down at levels projected for the 1995-2000 period. In this scenario, a slow but steady recovery in the price of electric energy is expected to begin at an average annual rate of 1.0% during the 2000-10 period. However, nonelectric energy prices are projected to rise at increasing average annual rates of 0.3% during the 1991-95 period, 2.6% during 1995-2000, and 2.9% during 2000-05. With the relative insensitivity of consumption with respect to these rising energy prices (Section 3.3.1), energy expenditure is predicted to increase rather dramatically for each population group between 1991 and 2005. Figure 8 shows the total household energy expenditure for the specified population groups in the South. With the small decline in household energy consumption and a lower escalation rate in electric and nonelectric energy prices, the energy expenditure falls back modestly for all population groups. The energy expenditure is expected to peak in 2005 for all population groups.

During 1987-2005 period, energy expenditure is projected to rise by a cumulative 29% for Hispanic households, 28% for poor households, 27% for black households, 24% for majority households, and 23% for nonpoor households.

3.3.3 Energy Expenditure as Share of Income

Table 9 lists the household energy expenditure as share of income for majority, black, Hispanic, poor, and nonpoor population groups in the South. The household energy expenditure as share of income varied among the groups. In 1987, the share was highest for poor households (13.9%) and lowest for nonpoor households (3.6%). Among the other groups, black households spent 6.1% of their disposable income on energy, Hispanic households spent 3.7%, and majority households spent 4.0%.

As is discussed in Section A.2.4, except for the recession in 1991, household income is projected to increase each year during the 1987-2009 period. During the 1987-91 period, including the 1991 recession, household income grew at an average annual rate of 2.9%.

TABLE 8 Household Energy Expenditure: South

Year	Energy Expenditure by Group (\$/household ^a)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	1,225	1,159	1,242	1,014	1,274
1991	1,098	1,031	1,161	913	1,138
1995	1,208	1,136	1,296	1,022	1,246
2001	1,386	1,332	1,424	1,202	1,431
2005	1,523	1,467	1,596	1,303	1,573
2009	1,377	1,280	1,413	1,133	1,420

^a 1989 dollars.

FIGURE 8 Household Energy Expenditure by Population Group under Base Case: South

**TABLE 9 Energy Expenditure as Share of Income:
South**

Year	Share of Income by Group (%)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	3.99	6.14	3.65	13.85	3.59
1991	3.65	5.61	3.49	12.78	3.28
1995	3.50	5.41	3.41	12.30	3.14
2001	4.01	6.38	3.77	14.87	3.61
2005	4.13	6.61	3.97	15.19	3.73
2009	3.68	5.73	3.49	13.12	3.33

Additionally, household energy expenditure declined for all population groups during this period primarily because of the rapid decline in the prices of both electric and nonelectric energy. This combination of events led to a decline in household energy expenditure as share of income during the 1987-91 period for the five population groups (Figure 9).

Because of the current economic recovery, household income is projected to increase at a rate of 2.0% during the 1991-95 period. As is discussed in Section 3.3.2, because of the turnaround in the prices of nonelectric energy in 1992, the energy expenditure is expected to increase for each population group between 1991 and 1995. However, the growth in the household income in an environment of economic recovery slightly overshadows the increases in energy expenditure. These trends would result in the lowering of household energy expenditure as share of income during the 1991-95 period (Figure 9).

With the sharper increases now under way in the prices of nonelectric energy, the energy expenditure is predicted to increase rather dramatically for each population group between 1995 and 2005 (Figure 8). During this same period, income gains are expected to slow down to long-term equilibrium levels. This combination of changes leads to a turnaround in energy expenditure as share of income in 1995. This turnaround continues until 2005, when it peaks because of the modest drop in energy expenditure for all population groups during the 2005-10 period (Section 3.3.2). The peak levels of energy expenditure are 15.2% for poor households, 6.6% for black households, 4.1% for majority households, 4.0% for Hispanic households, and 3.7% for nonpoor households.

FIGURE 9 Household Energy Expenditure as Share of Income by Population Group under Base Case: South

3.4 HOUSEHOLD ECONOMIC AND ENERGY EFFECTS IN THE WEST

3.4.1 Total Energy Consumption

Table 10 presents the household energy consumption for majority, black, Hispanic, poor, and nonpoor households in the West based on the 1987 RECS sample. Among these groups, total energy consumption was highest for black households (82×10^6 Btu/household) and lowest for poor households (72×10^6 Btu/household). Except for Hispanic households, the energy consumption for all population groups in the West was slightly lower than their counterparts in the South. For Hispanic households, the energy consumption in the South and West was almost the same. There is, however, no statistical significance to this disparity because the data for Hispanic households had a much larger standard error, compared with the data for the other population groups. Because of lower space-heating requirements in the South and West, energy consumption in these two regions is much lower than in the Northeast and Midwest, the two snowbelt regions. For example, the 1987 energy consumption for black households was 90×10^6 Btu/household in the South, 82×10^6 Btu/household in the West, 143×10^6 Btu/household in the Northeast, and 172×10^6 Btu/household in the Midwest.

FIGURE 10 Household Energy Consumption by Population Group under Base Case: West

TABLE 10 Household Energy Consumption: West

Year	Energy Consumption by Group (10 ⁶ Btu/household)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	78.1	82.4	73.3	72.2	78.9
1991	80.9	81.7	75.3	72.2	81.3
1995	80.4	82.1	73.2	70.6	80.6
2001	75.6	77.3	69.2	69.5	75.5
2005	73.6	76.1	68.7	68.0	73.7
2009	73.3	77.2	68.6	66.3	73.8

Figure 10 shows the projected household energy consumption for the five population groups from 1991 to 2009. As is discussed in Section A.2.5, nonelectric energy prices either fall at a lower average annual rate or rise at a faster rate than the prices of electric energy throughout the 1991-2009 forecast period. As a result, there is a major decline in nonelectric energy consumption for all households, but only a small change for majority households ($+2.6 \times 10^6$ Btu/household) and black households (-0.6×10^6 Btu/household) in electric energy consumption during the 1987-2009 period. Therefore, each group's total energy consumption in 2009 is lower than the consumption in 1987 (Figure 10). During the 1987-2009 period, the decline in total annual energy consumption is lowest for black and majority households (6%) and highest for poor households (8%).

3.4.2 Total Energy Expenditure

Table 11 lists the household energy expenditure for majority, black, Hispanic, poor, and nonpoor households in the West. In 1987, the total energy expenditure (in 1989 dollars) was highest for majority households (\$860) and lowest for black households (\$759).

With the rapid decline in the prices of both electric and nonelectric energy (Figure A.12) and only a modest change in the consumption of these fuels (Figure 10) between 1987 and 1991, the household energy expenditure declines for all population groups during this period (Figure 11).

As is discussed in Section A.2.5, the prices of electric energy are expected to keep declining until 2000 before starting a mild turnaround with 1% average annual escalation rate in the prices during the 2000-10 period. However, the prices of nonelectric energy will be rising at increasing average annual rates of 0.1% during the 1991-95 period, 2.8% during 1995-2000, and 3.2% during 2000-05. With the relative insensitivity of consumption to these rising energy prices (Section 3.4.1), energy expenditure increases rather dramatically for each population group between 1991 and 2005. Figure 11 shows the projections of household total energy expenditure for the specified population groups in the West. With small changes in household energy consumption and a lower escalation rate in the prices of nonelectric energy, the expenditure falls back modestly for all population groups (Figure 11). The energy expenditure peaks in 2005 for all population groups.

During the 1987-2005 period, energy expenditure rises by a cumulative 45% for black households, 44% for nonpoor households, 43% for poor households, 42% for majority households, and 41% for Hispanic households.

3.4.3 Energy Expenditure as Share of Income

Table 12 lists the 1987 household energy expenditure as share of income for majority, black, Hispanic, poor, and nonpoor households in the South. The household energy

TABLE 11 Household Energy Expenditure: West

Year	Energy Expenditure by Group (\$/household ^a)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	860	759	765	775	858
1991	769	658	674	687	774
1995	878	786	761	781	877
2001	1,040	937	930	957	1,042
2005	1,221	1,100	1,078	1,111	1,233
2009	1,056	907	904	937	1,054

^a 1989 dollars **FIGURE 11 Household Energy Expenditure by Population Group under Base Case: West**

**TABLE 12 Energy Expenditure as Share of Income:
West**

Year	Share of Income by Group (%)				
	Majority	Black	Hispanic	Poor	Nonpoor
1987	2.42	3.48	3.06	10.26	2.22
1991	2.06	2.87	2.59	8.70	1.91
1995	1.99	2.90	2.49	8.39	1.83
2001	2.36	3.47	3.07	10.33	2.17
2005	2.63	3.86	3.39	11.40	2.44
2009	2.24	3.14	2.82	9.51	2.05

expenditure as share of income varied among the groups. As expected, the share was highest for poor households (10.3%) and lowest for nonpoor households (2.2%). Among the other groups, black households spent 3.5% of their disposable income on energy, Hispanic households spent 3.1%, and majority households spent 2.4%.

As is discussed in Section A.2.5, except for the recession year of 1991, household income is projected to increase each year during the 1987-2009 period. During the 1987-91 period, including the recession during 1991, income grew at average annual rate of 1.7%. Additionally, household energy expenditure declined for all population groups during the 1987-91 period because of the rapid decline in the prices of both electric and nonelectric energy (Section 3.4.2). This combination of events led to a decline in household energy expenditure as share of income during the 1987-91 period for the five population groups (Figure 12).

With the current economic recovery under way, household income is projected to increase at a rate of 2.3% during the 1991-95 period. As is discussed in Section A.4.2, because of the turnaround in the prices of nonelectric energy in 1992, the energy expenditure registers increases for each population group between 1991 and 1995. However, except for black households, the growth of household income in an environment of economic recovery slightly overshadows the increases in the energy expenditure. These trends result in the lowering of household energy expenditure as share of income during the 1991-95 period (Figure 12). In the case of black households, household income growth during the 1991-95 period lags behind the relatively higher increase in energy expenditure (19% as opposed to 13-14% for the other population groups). Therefore, the energy expenditure as share of income remains flat at 2.9% during the 1991-95 period.

With the sharper increases now under way in the price of nonelectric energy, the energy expenditure is predicted to increase rather dramatically for each population group between 1995 and 2005 (Figure 11). During the 1995-2005 period, household income gains are expected to slow to long-term equilibrium levels. This combination of changes would lead

FIGURE 12 Household Energy Expenditure as Share of Income by Population Group under Base Case: West

to a turnaround in energy expenditure as share of income in 1995. This turnaround would continue until 2005, when it would peak because of the modest drop in the energy expenditure for all population groups during the 2005-09 period, as is discussed in Section 3.4.2. The energy expenditure as share of income is projected to reach its peak level in 2005 at 11.4% for poor households, 3.9% for black households, 3.4% for Hispanic households, 2.6% for majority households, and 2.4% for nonpoor households in 2005.

4 CONCLUSIONS

Several conclusions can be drawn on the basis of the analysis. Among all population groups (majority, black, Hispanic, poor, and nonpoor) in 1987, the following conclusions were drawn with respect to household energy consumption and energy expenditure:

1. Total energy consumption was highest for black households in the Midwest (172×10^6 Btu/household) and lowest for poor households in the West (72×10^6 Btu/household).
2. Total energy expenditure (in 1989 dollars) was highest (\$1,921) for black households in the northeast and lowest (\$759) for black households in the West, respectively.
3. Energy expenditure as share of income was highest for poor households in the Northeast (20.9%) and lowest for nonpoor households in the West (2.2%).

The analysis of the 1987 DOE Residential Energy Consumption Survey (RECS) data indicates that the energy expenditure as share of income in black households is inordinately high compared with the energy expenditure in majority and Hispanic households nationally. Moreover, the level of energy expenditures by black households in the Northeast is of particular concern because they had the highest expenditures of any of the population groups in any census region in 1987.

Except for Hispanic households in the Northeast, total energy consumption for all population groups in the four census regions peaks in the initial period of the forecast (1987-91). For Hispanic households in the Northeast, a turnaround in the energy consumption comes in 1995, following statistically insignificant growth during the 1991-95 period. Total household energy consumption generally follows a declining trend over the remaining forecast period (1995-2009). Total energy consumption for all population groups reaches a minimal value during the final period of the forecast (2005-09). The cumulative change in total energy consumption during the 1987-2009 period ranges from -11% (for black and majority households in the Northeast and poor and Hispanic households in the Midwest) to -6% (for all households, except poor households in the West). The energy consumption for Hispanic households in the South, while following the general trajectory of energy demand for other households (Figure 7), is 1% higher in 2009 than it was in 1987. Factors other than energy prices (such as type and age of home) contribute to this pattern for Hispanic households in the South.

During the 1987-91 period, the household energy expenditure declined for all population groups, primarily because of the rapid decline in the prices of both electric and nonelectric energy. A turnaround in household energy expenditure is projected for all household groups in 1995. With the sharper increases currently under way in the prices of nonelectric energy, the energy expenditure is predicted to increase dramatically for each

population group between 1995 and 2005. During the 1991-2009 forecast period, energy expenditure peaks in 2005 for all household groups. Among all population groups, between 1987 and 2005, energy expenditure rises most for black and Hispanic households in the Midwest (51%) and least for nonpoor households in the South (24%).

Finally, except for the recession year of 1991, household income in the four census regions is projected to increase each year during the 1987-2009 period. During the 1987-91 period, household real energy expenditure declined for all population groups. This combination of events led to a decline in household energy expenditure as share of income during the 1987-91 period for all population groups. A turnaround in the household energy expenditure is projected in 1995. However, because of the current economic recovery, household income is projected to increase at rates of about 1.9% during the 1991-95 period. Except in the Midwest, this combination of events would result in a slight lowering of energy expenditure as share of income for all population groups during the 1991-95 period. In the Midwest, the energy expenditure as share of income is expected to rise slightly during the 1991-95 period. Energy expenditure is predicted to increase dramatically for each population group between 1995 and 2005. In addition, during this 1995-2005 period, gains in household income are projected to slow to long-term equilibrium levels. This combination of changes leads to a post-recovery high in energy expenditure as share of income in 2005 for all population groups in all census regions. Among all population groups, the peak in energy expenditure as share of income in 2005 ranges from 21% for poor households in the Northeast to 2.4% for nonpoor households in the West.

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APPENDIX:

BASE-CASE ECONOMIC AND ENERGY FORECAST

The base-case forecasts are made on the basis of macroeconomic and energy variable forecasts under the Data Resources, Inc. (DRI), scenario released in the second quarter of 1992.^{1,2} The highlights of the base-case forecasts are discussed below.

A.1 BASE-CASE ENERGY FORECAST

The forecast prices of imported crude oil, home heating oil, residential natural gas, and residential electricity are discussed below.

A.1.1 National Crude Oil Price Forecast

The tremendous political changes in the world, including the breakup of the old Soviet Union, the improved prospects for greater production in mature fields in the United States and elsewhere as a result of such new technologies as horizontal drilling, and Saudi Arabia's expanding moderating role in OPEC, point to an abundance of world crude oil supplies over the near term. Additionally, the world oil demand growth is projected to be sluggish because of the current economic downturn in the United States, Japan, and major European countries. As a result, crude oil prices, after declining at an average annual rate of 2.8% between 1987 and 1991, are forecast to be flat over the next few years (Figure A.1). Crude oil prices are expected to move from approximately \$17/bbl in 1991 to about \$19/bbl by 1995 (1989 dollars). However, as the gap between the world oil supply and demand narrows at a moderate pace, crude oil prices are projected to rise to \$22/bbl by 2000, \$26/bbl by 2005, and \$29/bbl by 2010 (1989 dollars). This price escalation is equivalent to an average annual rate of change of 2.3% during the period 1991-95, 3.0% during 1995-2000, 3.6% during 2000-05, and 2.1% during 2005-10.

A.1.2 National and Regional Home Heating Oil Price Forecast

Figure A.2 shows the projections of home heating oil prices in constant 1989 dollars at the national level. Home heating oil, a distillate petroleum product, is expected to be directly affected by the cost of crude oil. However, home heating oil prices will not increase as rapidly as crude oil prices over the long term. The average annual rate of increase for the period 1991-2010 is projected to be only 1.5% for home heating oil, compared with the 2.8% rate for crude oil.

Figures A.3-A.6 show the projections of real home heating oil prices for the four census regions: Northeast, Midwest, South, and West. The variation in home heating oil prices across the regions is small. The 1991 average price was highest for the Northeast (\$7.61/10⁶ Btu) and lowest for the Midwest (\$6.70/10⁶ Btu). Moreover, the average annual

FIGURE A.1 Imported Crude Oil Prices under Base Case

FIGURE A.2 National Energy Prices under Base Case

FIGURE A.3 Energy Prices under Base Case: Northeast **FIGURE A.4 Energy Prices under Base Case: Midwest**

FIGURE A.5 Energy Prices under Base Case: South

FIGURE A.6 Energy Prices under Base Case: West

rate of increase across the regions is projected to be close as well. Between 1991 and 2010, home heating oil prices are expected to increase at an average annual rate of 1.6% in the Midwest and South and 1.5% in the Northeast and West.

A.1.3 National and Regional Residential Natural Gas Price Forecast

Figure A.2 shows the projections of average residential natural gas prices in 1989 dollars at the national level. After declining at an annual average rate of about 3.5% during the 1987-91 period, residential gas prices reached a minimum at the level of \$4.99/10⁶ Btu in 1992. Because of the increasingly favorable relative economics of natural gas over residual fuel and coal, and its advantages over coal as a relatively cleaner fuel (environmentally), a steady growth in the national demand for natural gas is projected. This narrowing in the supply/demand gap results in a higher natural gas price trajectory. The average annual rate of increase is projected to be 1.9% for residential gas prices between 1991 and 2010, compared with a rate of 1.5% for home heating oil.

Figures A.3-A.6 show the projections of residential natural gas prices for the four census regions. The variation in natural gas prices is expected to be much larger than the variation in home heating oil prices for several reasons: (1) Residential natural gas prices are regulated at the state level, (2) the cost of transportation through pipelines increases with the distance from the source, and (3) the type of gas-spot market (contract, new or old, or imported) varies. The 1991 average residential natural gas price in 1989 dollars was \$6.44/10⁶ Btu in the Northeast, \$5.38/10⁶ Btu in the South, \$4.99/10⁶ Btu in the West, and \$4.56/10⁶ Btu in the Midwest. However, the average annual rate of increase across the four regions is projected to be close. Natural gas prices are projected to increase at an average annual rate of 2.2% in the Midwest, 2.0% in the West, 1.9% in the South, and 1.6% in the Northeast between 1991 and 2010.

A.1.4 National and Regional Residential Electricity Price Forecast

The price of crude oil is expected to affect the price of electric energy less than it does the price of home heating oil or natural gas. Capital costs play a major role in the cost of electric energy. Petroleum accounts for a very small share of electric energy generation (about 4% in 1991). The average annual rate of increase between 1991 and 2010 for average residential electric energy prices is projected to be only 0.1%, compared with a rate of 2.7% for crude oil prices.

Figures A.3-A.6 show the projections of residential electric energy prices for the four census regions. The prices of electric energy are expected to vary among the four regions for several reasons: (1) Residential electric energy prices are regulated at the state level, (2) the cost of transmission through the power grid increases with the distance from the source of generation, and (3) the energy source (coal, natural gas, petroleum, hydroelectric energy, or nuclear energy) varies. The 1991 average price for residential electric energy in 1989 dollars was \$27.21/10⁶ Btu in the Northeast, \$20.46/10⁶ Btu in the Midwest, \$20.38/10⁶ Btu in the

West, and \$20.00/10⁶ Btu in the South. The rate of change across the regions is also projected to vary. Between 1991 and 2010, the prices of electric energy are projected to decline at an average annual rate of -0.9% in the Northeast and -0.3% in the West and to increase at a rate of 0.5% in the Midwest and the South.

A.2 BASE-CASE ECONOMIC FORECAST

The highlights of the economic outlook for the nation are discussed in Section A.2.1. Sections A.2.2-A.2.5 summarize the economic outlook for the four census regions.

A.2.1 Economic Forecast: National

The gross domestic product (GDP), which declined in the fourth quarter of 1990 and the first quarter of 1991, is expected to pick up as the housing industry is helped by lower mortgage rates, automobiles and other consumer durables are sold more heavily to absorb the pent-up demand over the last several years, and the trend of export growth rates outpacing the overall growth rate for the economy continues.² After declining by 0.6% in 1991, the GDP is projected to grow at an average annual rate of 1.7% in 1992. The economy continues to gain strength as it comes out of several years of slump and grows at an above-average rate of 3.8% in 1993. This growth brings slightly higher rates of inflation, resulting in rising interest rates (as typified by the average annual increase in federal fund rates of more than 1.5% in 1993). Economic growth cools off and returns to the long-term trend rates. Figure A.7 shows changes in the GDP and other selected key macroeconomic variables during the periods of 1987-89, 1989-91, 1991-95, 1995-2000, 2000-05, and 2005-10. The average GDP growth rate, which had fallen to almost zero during the period 1989-91, bounces back to 2.9% during the 1991-95 forecast period. At this point, economic projections begin to be influenced by long-term considerations. For example, to reflect the current demographic trends, only 1.3% and 0.6% average growth rates are assumed in the working-age population during the periods 1991-2000 and 2000-10, respectively, compared with an average growth rate of 1.6% from 1978 to 1991. A slowdown in the growth of the labor force results in slower economic growth. The GDP is projected to grow at the average annual rate of 2.7% during 1995-2000, and then slow to 2.25% during 2000-05, and to 2.0% during 2005-10 (Figure A.7).

Inflation has slowed during the 1990-91 recession, but most of the improvement is because of lower crude oil prices. The broad-based GDP deflator which had fallen from a pre-recession 4.2% average annual rate of change during 1987-89 to a rate of 3.7% during 1989-91, is projected to drop to a rate of 2.9% during 1991-95 (see Figure A.7). However, as the growth in the economy continues to absorb the slack in the industry and puts increasing pressure on prices, the rate of inflation accelerates over the forecast period. The GNP deflator rises to an average rate of 3.3% during 1995-2000, 4.0% during 2000-05, and 4.2% during 2005-10. Figure A.7 shows a similar trajectory of inflation as indicated by the U.S. consumer price index (CPI). In all, the CPI is expected to average 4.2% between 1990 and 2010, with the GDP deflator rising 3.7% annually.

FIGURE A.7 Key Economic Indicators under Base Case: United States

The 1990-1991 recession is expected to be mild as compared to the last recession in 1981-82. The average annual unemployment rate hit a peak of 9.7% in 1982 and declined each year until 1989.³ By 1989, it had fallen to a rate of 5.3%. The recession broke this trend as the unemployment rate reversed back to 5.5% in 1990 and 6.8% in 1991. The unemployment rate is projected to peak at 7% in 1992 and then slide back to average rates of 5.6% during 1995-2000 and 5.8% during the following 10 years.

Another key macroeconomic indicator of interest is personal income. Personal disposable income fell from its pre-recession 2.8% average annual rate during 1987-89³ to about 1% during 1989-91. With the recovery in the economy, the real income growth is projected to bounce back to a rate of 2.4% during 1991-95. Thereafter, personal income growth slows to 2.2% during 1995-2000, 1.8% during 2000-05, and 1.6% during 2005-10 to reflect the consumer spending's shrinking share of the GDP (see Figure A.7).

A.2.2 Economic Forecast: Northeast

Changes in the price of energy are expected to have varying economic effects across the four census regions (Northeast, Midwest, South, and West).

Figure A.8 shows the estimated household disposable income by census region. In 1991, the region with the highest household income was the Northeast at \$46,700 in constant

FIGURE A.8 Household Disposable Income by Region under Base Case

1989 dollars (\$50,200 in current dollars); the region with the lowest household income was the South at \$39,600 in constant 1989 dollars. The West will experience the highest income growth during the forecast period (1.6% annually between 1990 and 2010). It will be closely followed by the Northeast with a 1.5% growth rate (see Table A.1).

Figure A.9 shows the forecast of selected economic and energy indicators for the Northeast during the periods of 1991-95, 1995-2000, 2000-05, and 2005-10. The three economic indicators that are analyzed at the regional level are residential electric energy prices, residential nonelectric energy prices (a weighted indicator of residential natural gas prices and home heating oil prices), and household income. Changes in the crude oil prices at the national level are also shown in Figure A.9. The price of crude oil is not expected to vary by much by region because prices are mainly determined by the changes in the world oil market. Additionally, Figure A.9 shows the average annual rate of change during the specified periods. For example, the data point for 1987-89 is the average annual percentage rate of change from 1987 to 1989. This is consistent with the input data requirements for the MEAM.

As shown in Figure A.9, energy prices in a given region generally follow the national trends discussed in Section A.1. The prices of nonelectric energy closely follow the prices of crude oil. Compared with an average annual rate of change of +2.6% in national crude oil prices between 1991 and 2010, an increase of 1.5% is forecasted for nonelectric energy prices in the northeast. As discussed in Section A.1.4, electric energy prices are less influenced by

TABLE A.1 Annual Rates of Change in Key Regional Economic and Energy Variables: 1991-2010

Variable	Rate of Change by Region (%)			
	Northeast	Midwest	South	West
Household income	1.53	1.34	1.38	1.56
Electricity price	-0.90	0.49	0.28	-0.26
Nonelectricity price	1.55	2.10	1.86	1.94

Source: Ref. 1 (DRI, En.R. 2Q1992).

FIGURE A.9 Key Economic Indicators under Base Case: Northeast

crude oil prices. As a matter of fact, between 1991 and 2010, electric energy prices are projected to decline at an average annual rate of -0.9% in the Northeast. Moreover, nonelectric energy prices either fall at a lower average annual rate or rise at a higher rate than the prices of electric energy throughout the forecast period. These trends in the relative prices of electric and nonelectric energy should encourage the consumption of electric energy.

Finally, except for 1991 (a recession period), household income is expected to increase each year. The average annual rate of change between 1991 and 2010 is projected to be 1.5% in the Northwest (Table A.1).¹

A.2.3 Economic Forecast: Midwest

Figure A.8 shows the estimated household disposable income by census region. The 1991 household income of \$39,900 in constant 1989 dollars (\$42,900 in current dollars) in the Midwest was less than the U.S. average of \$40,900. Household income in the Midwest was lower than the household income in the Northeast (\$46,700) and in the West (\$44,500). However, household income in the Midwest was higher than in the South (\$36,800). This pattern in income across regions will remain the same throughout the forecast period (see Figure A.8). Additionally, during the period 1991-2010, household income in the Midwest will increase at a rate of 1.34%, the lowest average annual rate of increase of all the regions (Table A.1).

Figure A.10 provides the forecast of the selected economic and energy indicators for the Midwest during the periods 1991-95, 1995-2000, 2000-05 and 2005-10 (for some remarks on these indicators, see Section A.2.2). As shown in Figure 10, energy prices in the Midwest follow the national trends in the crude oil market discussed in Section A.1. Nonetheless, prices for nonelectric energy have a higher correlation to crude oil prices than do electric energy prices. Compared with an average annual rate of change of 2.6% for the price of U.S. crude oil during the forecast period 1991-2010, increases of 2.1% and 0.5% are forecasted for nonelectric and electric energy prices, respectively, in the Midwest. Moreover, the prices of nonelectric energy rise faster than electric energy prices during each of the forecast periods. These trends in relative prices of electric and nonelectric energy should encourage the consumption of electric energy over nonelectric energy.

Finally, except for 1991 (a recession period), household income is projected to increase each year during the period 1991-2010. Specifically, the average annual rate of change between 1991 and 2010 is projected to be 1.3% in the Midwest (Table A.1).¹

A.2.4 Economic Forecast: South

Figure A.8 shows the estimated household disposable income by census region. In the South, the 1991 household income was \$36,820 in constant 1989 dollars (\$39,600 in current dollars), which was the lowest income among the four census regions. Moreover,

FIGURE A.10 Key Economic Indicators under Base Case: Midwest

household income in the South was 10% lower than the average income in the United States. The average household income in the South is projected to remain lower than the incomes of all other regions because it will increase at a rate close to the lowest average annual rate of 1.3% between 1991 and 2000 (see Table A.1).

Figure A.11 provides the forecast of the selected economic and energy indicators for the South during the periods of 1987-89, 1989-91, 1991-95, 1995-2000, 2000-05, and 2005-10 (for some remarks on these indicators, see Section A.2.2). As shown in Figure A.11, crude oil prices in the South follow the national trends in the crude oil market, as discussed in Section A.1. The prices of nonelectric energy have a higher correlation than the prices of electric energy to the crude oil prices. Compared with an average annual rate of change of 2.6% for the price of U.S. crude oil during the period 1991-2010, increases of 1.9% and 0.3% are projected for the prices of nonelectric and electric energy, respectively, in the South. These trends in the relative prices of electric and nonelectric energy should encourage the consumption of electric over nonelectric energy.

Finally, except for 1991 (a recession period), household income is projected to increase each year during the period 1991-2010. The average annual rate of change between 1991 and 2010 is projected to be 1.4% in the South (see Table A.1).¹

FIGURE A.11 Key Economic Indicators under Base Case: South

A.2.5 Economic Forecast: West

Figure A.8 shows the estimated household disposable income by census region. The West was ranked as second among the four census regions, with a 1991 real household income of \$45,500 in constant 1989 dollars (\$47,800 in current dollars). Moreover, this relative pattern in income across regions will remain same throughout the forecast period (see Figure A.8). Household income in the West will grow at the highest average annual rate of 1.6% during the period 1991-2010 (see Table A.1).

Figure A.12 provides the forecasts of the selected economic and energy indicators for the West during the periods of 1991-95, 1995-2000, 2000-05, and 2005-10. For some remarks on these indicators, see Section A.2.2. As can be observed in Figure A.12, energy prices in the region generally follow the national trends discussed in Section A.1. The nonelectric energy prices closely follow the crude oil prices. Compared with an average annual rate of change of 2.6% for the price of national crude oil prices between 1991 and 2010, an increase of 1.9% is forecasted for nonelectric energy prices in the region. As discussed in Section A.1.4, electricity prices are less influenced by crude oil prices. As a matter of fact, between 1991 and 2010, electric energy prices are projected to decline at an average annual rate of 0.3% in the West. Moreover, nonelectric energy prices rise faster than electric prices during each of the forecast periods. These trends in relative prices of electric and nonelectric energy should encourage the consumption of electric over nonelectric energy.

FIGURE A.12 Key Economic Indicators under Base Case: West

Finally, except for 1991 (a recession period), the real household income is projected to increase each year during the period 1991-2010. The average annual rate of change between 1991 and 2010 is projected to be 1.6%, the highest growth rate of any census region (Table A.1).¹

A.3 REFERENCES CITED IN THIS APPENDIX

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