Appendix D-1: Detailed results

This appendix describes the the calculation of energy consumption forecasts and details of the results reported in Chapter 4. We rely on a three-step process for creating our analysis: first, we assess the potential impact of individual policies on energy demand in detailed spreadsheets. Then we change hurdle rates (implicit discount rates) and other parameters inside the buildings sector modules of CEF-NEMS (our version of the National Energy Modeling System)[1] so that the model mimics the energy savings calculated from the spreadsheets when these modules are run in stand-alone mode (equipment efficiency standards were implemented directly in the CEF-NEMS modules). Finally (for the Advanced Scenario only) we add a carbon permit trading fee of $50/t and the CEF-NEMS modules respond to that fee using the modified hurdle rates, reflecting a policy and market environment that is working towards substantial carbon reductions. This procedure follows that used in the earlier study by Koomey et al. (1998b).

Appendix D presents the results of the spreadsheet analyses, which contain summaries of technology costs, techno-economic potentials, and achievable fractions; and results from the CEF-NEMS analyses, which contain energy and carbon emissions estimates from the integrated model runs. Because of the integration and price changes in the various scenarios, the integrated results may differ somewhat from the spreadsheet results, so use care in interpreting them.

The Spreadsheet Analysis

The purpose of the spreadsheet analysis is to produce forecasts of energy consumption in 2010 and 2020 under the moderate and advanced case policy assumptions detailed in Appendix B-1 and C-1. The analysis relies for its basic structure on the spreadsheet analysis documented in the study *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond* (Interlaboratory Working Group 1997). We updated the spreadsheets to reflect some of the improvements in the NEMS Annual Energy Outlook forecast since that study was published, including detailed breakdowns of the residential and commercial miscellaneous end-uses, explicit accounting for halogen torchieres in lighting, and extension of the analysis period to 2020. Inputs to the analysis include base year energy consumption by end use, unit energy consumptions, equipment lifetimes and turnover in the building stock in addition to the Appendix B-1 and C-1 data.

[1] As in other parts of this report, we use the term "CEF-NEMS" to refer to the NEMS model as modified for our policy analyses, and use the term "NEMS" whenever we discuss issues generic to the NEMS model in all its incarnations.

Our analysis focuses on three years: 2000, 2010, and 2020. We treat 2000 as the base year, and 2010 and 2020 as the years for which we assess potential savings. We use the Annual Energy Outlook 1999 (AEO 99, US DOE 1998b) as the source for base year energy use by fuel and end-use. All energy use is expressed in site energy terms to be consistent with the AEO forecast. New and existing buildings are treated separately, where new buildings refers to buildings built in 2000 or later (post-1999) and existing buildings refers to buildings constructed in 1999 or earlier (pre-2000).[2]

We analyze five scenarios: frozen efficiency, business-as-usual, techno-economic potential, a moderate policy case and an advanced policy case. An energy consumption forecast is calculated for each scenario from the base year energy consumption forecast, taking into account replacement of existing stock with new equipment, growth in the building stock, and changes in the UEC over time. The difference between the calculations for the five scenarios lies in the UEC used for new equipment, as described below:

1) Frozen efficiency: This scenario assumes that new equipment sold throughout the period will have the same efficiency as new equipment in 2000 (i.e. the frozen efficiency UEC). The frozen efficiency UEC is from the CEF-NEMS model. Note that stock efficiencies are not frozen: If new units in 2000 are more efficient than the average stock in 2000, the stock efficiency will improve over time as old units are replaced with more efficient units. Where applicable, we use different frozen efficiency UECs for new buildings and existing buildings.[3]

2) Business-as-Usual (BAU): This scenario reproduces the AEO 99 forecast (US DOE 1998b). We use UEC forecasts from the CEF-NEMS model to measure the baseline progress embodied in the AEO forecast, then calibrate our forecast to exactly match the AEO 99 forecast. Where applicable, shell improvements for new buildings from the CEF-NEMS model were taken into account and separate BAU UECs were calculated for new and existing buildings.

3) Techno-Economic Potential: This scenario assumes that all equipment purchased during the analysis period is as efficient as is cost effective. For each end-use we estimate the techno-economic potential savings—the percent reduction in frozen efficiency unit energy consumption represented by the lowest life cycle cost technology. The techno-economic potential is expressed as a percent of frozen efficiency UEC purely as a matter of convenience. The alternative, defining techno-

[2] The distinction between new and existing buildings matters for several reasons. First, some end uses are affected by the building shell, and our model assumes different shell characteristics for new and existing buildings. Second, some of the policies analyzed affect only new buildings (e.g. building codes).

[3] The distinction between new and existing buildings matters only for the following products: residential heating and cooling, residential water heating, commercial heating and cooling, commercial ventilation, commercial lighting, and commercial water heating.

economic potential with respect to the business-as-usual case, is more difficult because business-as-usual energy consumptions change over time, making accounting difficult. Whether techno-economic potential is expressed relative to frozen efficiency or BAU is unimportant (we can easily convert from one to the other, and the absolute amount of energy use for a scenario in a given year is the same either way); however, its use must be consistent with its definition—that is, as we have defined it, the techno-economic potential savings must be applied to frozen efficiency UECs or frozen efficiency energy, not business-as-usual UECs or energy. Where applicable, separate techno-economic potential savings were calculated for new buildings and existing buildings.

4) Moderate Policy Case: This scenario assumes a moderate policy effort throughout the analysis period. Policy data from Appendix B-1 and Appendix C-1 is used to calculate the fraction of the techno-economic potential savings that can be achieved (the *achievable fraction*) by 2010 and 2010 using the policies analyzed. The techno-economic potential savings is multiplied by the achievable fraction to obtain the achievable savings for the moderate case. The moderate policy case UEC is the frozen efficiency UEC reduced by the achievable savings (this process is described in detail below). Where applicable, separate achievable fractions were calculated for new buildings and existing buildings.

5) Advanced Policy Case: This scenario assumes a more aggressive policy effort than the moderate case. Depending on the end-use, the advanced case may include additional policies, the time table may be sped up compared to the moderate case, or policy penetrations may be increased. This will result in a different achievable fraction and achievable savings than obtained in the moderate case. Otherwise, the advanced case calculation is identical to the moderate case. The advanced case achievable savings for each end use are as high or higher than the moderate case.

Below we discuss each step of the calculations performed in the spreadsheet analysis to estimate energy consumption for the five scenarios described above. For simplicity, we discuss the calculations for 2010 (the 2020 calculations are analogous). After each step we provide an example (in *italics*) of the calculation using residential refrigeration as our model end-use.

Base year energy use

The calculations begin with the 2000 total energy use by end-use. The 1999 Annual Energy Outlook is the basis for this base-year breakdown.

For residential refrigerators, 2000 base year electricity use is 0.37 quads (site).

Stock accounting

In any forecast of the future impacts of technologies, some method of accounting for changes in the stock of equipment must be adopted. Stock accounting allows calculation

of the effect of normal stock turnover on the efficiency of the stock of equipment existing in any year. It also accounts for overall growth in the total number of households. We divide the stock into three segments: equipment already in place in 2000 still existing in 2010, equipment in existing homes (built before 2000) that has been replaced with new equipment during the analysis period, and new equipment in new homes (built in 2000 or later). Each of the three stock segments will have its own UEC, described further below under "Unit Energy Consumptions." Distinguishing new (post-1999) from existing (pre-2000) homes is a simple way to capture the trend toward building shell improvements over time. Shell characteristics affect the performace of some equipment, such as heating and cooling equipment. Distinguishing new and existing homes is also valuable because it lets us analyze policies targeting only new buildings, such as building codes.

We use a simple retirement model for equipment purchased during the analysis period. The age of equipment at retirement ranges from 2/3 of the average life to 4/3 of the average life of the equipment, and retirement age is uniformly distributed over that interval. Figure D-1.1 shows the probability of equipment survival as a function of equipment age.

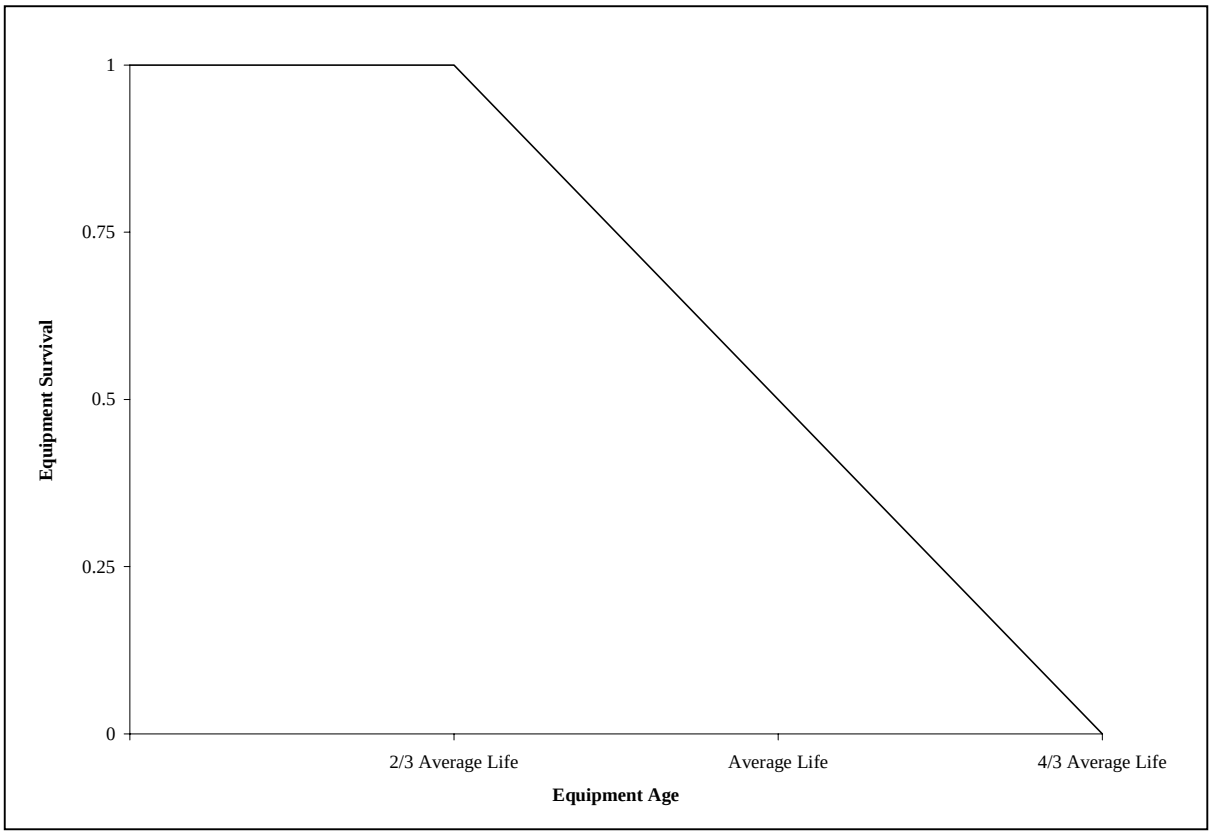

Figure D-1.1. New equipment survival as a function of equipment age

To model the retirement of the equipment stock existing in 2000, we use the following retirement function:

$$
\begin{aligned}
R(Y) &= 0 && \text{if } Y - 1999 > L_{\max} \\
&= 1 - \frac{Y - 1999}{L_{\text{avg}} + 0.5} && \text{if } Y - 1999 < L_{\min} \\
&= \frac{0.5 * (L_{\max} - (Y - 1999))(L_{\max} - (Y - 1999) + 1)}{(L_{\text{avg}} + 0.5) * (L_{\max} - L_{\min})} && \text{otherwise}
\end{aligned}
$$

where:

R(Y) = fraction of existing equipment in 2000 that is still alive in year Y;
Y = year, value between 2000 and 2020
L_{min} = minimum equipment lifetime (assumed to be 2/3 of the average lifetime L_{avg});
L_{max} = maximum equipment lifetime (assumed to be 4/3 of the average lifetime L_{avg});
and L_{avg} = average equipment lifetime.

Refrigerator lifetimes are about 19 years.[4] Using our stock retirement function we find that 49% of the stock of refrigerators existing in 2000 is still in place in 2010. These keep the same characteristics as the stock in 2000 (no retrofits). Another 47% were replaced in existing homes. The remaining 4% of refrigerators existing in 2000 were retired due to turnover in the housing stock and replaced by new refrigerators in new homes. AEO projects about a 12% growth in households from 2000 to 2010 (US DOE 1998b). Expressed as a percent of the stock of refrigerators existing in 2000, the total share of new refrigerators in new homes is 16% (=4% + 12%).

In summary, 49% of the 2000 stock is the same in 2010 as it was in 2000. Another 47% of the 2000 stock were replaced with new units in existing homes. New refrigerators in new homes add up to an additional 16% of the 2000 stock. In the frozen efficiency case, replacements and new additions are assumed to have the same efficiency as new equipment in 2000. The total, 112% (=49% + 47% + 16%) represents the refrigerator stock in 2010 as a percent of the stock in 2000.

Exogenous changes in service demand

Overall growth in service demand is governed by the growth in number of households, but for the various end-uses other trends can affect service demand. These trends, such as fuel switching, structural shifts, leveling off of service demand, or rapid growth in a new end-use, can be captured by the use of another factor, which we call here the exogenous energy service growth factor. It can be equal to, more, or less than 1.0.

[4] Lifetimes are given in Appendix C-1.

On a practical level, the exogenous energy service growth factor is calculated in such a way that the business-as-usual forecasts calculated in our spreadsheets are equal to the AEO reference case forecasts. That is, we make a rough cut at reproducing the AEO 99 forecast using the forecast of energy intensities over time from the CEF-NEMS model. We then calculate a multiplier which will yield the total AEO 99 energy consumption for each end-use when applied to our rough estimate. This factor is then included in the BAU calculation, the techno-economic potential calculation and the two policy case calculations. Thus any factors captured in the AEO forecast that our simplified model overlooks are captured here.

The exogenous growth factor for refrigeration is 0.92 for the 2000-2010 period, implying that our independent spreadsheet analysis overestimates refrigeration energy consumption slightly compared to the AEO99 forecast.

Unit Energy Consumptions

We use five different levels of unit energy consumption to account for the changes in end-use energy consumption over the analysis period.

1) Stock UECs for existing devices in 2000. This is the average energy consumption for devices in place in 2000. *The UEC for stock refrigerators in 2000 is about 944 kWh/year.*

2) Frozen efficiency UEC for new equipment in existing buildings. This is the average energy consumption of new devices sold in 2000 and installed in existing buildings. We distinguish UECs for new and existing buildings because shell characteristics affect the performance of some types of equipment, particularly heating and cooling. *The UEC for new refrigerators in existing homes is about 647 kWh/year.*

3) Frozen efficiency UEC for new equipment in new buildings. This is the average energy consumption of new devices sold in 2000 and installed in new buildings. *Since the building shell does not materially affect refrigerator efficiency, the UEC for new refrigerators in new homes is the same as new refrigerators in existing homes: about 647 kWh/year.*

4) Business-as-usual UEC for new equipment in existing buildings. We use the UEC forecast from the CEF-NEMS model to measure the baseline progress embodied in the AEO forecast. We use this forecast to calculate a UEC for new equipment in existing buildings that represents the average UEC for the analysis period assuming business-as-usual progress in efficiencies. *The expected average UEC for new refrigerators in existing homes over the 2000 to 2010 period is about 551 kWh/year.*

5) Business-as-usual UEC for new equipment in new buildings. The methodology for new homes is analogous to the existing homes methodology. *Since the building shell does not materially affect refrigerator efficiency, the BAU UEC for new refrigerators in new homes is the same as for new refrigerators in existing homes: about 551 kWh/year.*

Techno-economic Potential

Techno-economic potential savings represent the maximum cost effective reduction in energy intensities for each end use expressed as a percent of energy use. Where appropriate, we use different techno-economic potentials for new and existing buildings. Techno-economic potential savings for residential non-HVAC and commercial technologies (except residential refrigerators[5]) are from the 5 Lab Study (Interlaboratory Working Group 1997) and reflect the minimum life cycle cost technology. Techno-economic potentials for residential HVAC are detailed in Tables D-1.5 and D-1.6. Techno-economic potentials can be interpreted as a reduction in unit energy consumption. For the techno-economic potential scenario, where 100% of units sold during the analysis period meet this efficiency level, the savings can also be interpreted as the reduction in total energy use for units sold after 1999. Techno-economic potential savings is expressed as a percent of the frozen efficiency UEC.[6]

The techno-economic potential savings for residential refrigerators is 44% of the frozen efficiency baseline for both new and existing buildings.

Achievable Potential Fractions

The policies described in Appendix B-1 and Appendix C-1 are distilled into a single number for each end use and for each policy case: the fraction of the techno-economic potential that can be achieved, called the achievable fraction for short. Since each policy affected only a fraction of units sold, and savings varied from policy to policy, it was necessary to do a complete stock accounting to assess the policy impacts in the analysis year. We calculated what percent of stock energy use in 2010 was affected by each policy, taking into account equipment retirements using our retirement model. We assessed how much savings accrued on each segment of the stock, adjusting savings to avoid double-counting where necessary (such as when standards affect the same equipment as a whole building policy; see Appendix C-1 for detailed information). From these we derived an estimate of the percent reduction in end-use energy in each policy case in 2010 and 2020. Whenever there are policies that target only new or only existing buildings, we calculate separate achievable savings for each market segment.

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[5] The techno-economic potential for residential refrigerators in the 5 Lab study (Interlaboratory Working Group 1997) was determined to be too low in light of the upcoming 2001 standard, which will accelerate efficiency improvements, and (we expect) lower the costs of some efficiency measures. Since refrigerators are currently available on the market that consume only one kWh per day, we based our techno-economic potential calculation on this UEC.

[6] Note that the techno-economic potential savings described here is an input to the analysis and represents percent savings compared a typical year 2000 new unit. It should not be taken to represent aggregate savings compared to the AEO 99 reference case forecast.

We now have achievale potential savings expressed as a percent of end-use energy in 2010 and 2020, and techno-economic potential expressed as a percent of year 2000 new equipment unit energy consumption. We therefore use the same stock accounting model with the techno-economic potential saving to calculate techno-economic potential savings as a percent of total end-use energy. Once we have achievable and techno-economic potential savings expressed relative to a common metric, we can calculate the achievable fraction.

The achievable fraction for residential refrigerators is 62% of the technoeconomic potential savings for both new and existing buildings in the advanced case.

Calculating Energy Use

The inputs described above are used to calculate energy consumption for each of our five scenarios: frozen efficiency, business-as-usual, techno-economic potential, our moderate policy case and our advanced policy case. We describe below the general methodology and provide the specific equations for our calculations. Because the calculations for the moderate and advanced policy case differ only in which achievable fraction is used, we will condense the two scenarios into a single policy case.

Each scenario uses the same basic technique: we begin with year 2000 energy use and use our stock accounting (described above) to parse it into three segments: the energy use that will be the same in 2010 (because the equipment has not been replaced), energy use that is changing because equipment is replaced, and energy growth attributable to new construction. We make further adjustments to the energy use for each segment according to our assumptions about the UEC for that segment. Since in the first segment equipment is not replaced, energy use is the same in all scenarios and equal to stock UEC in 2000. For the other segments we scale the energy consumption according to the ratio of new unit energy consumption to stock 2000 energy consumption. For example, if we assume that new units installed in existing buildings in the analysis period use ¾ as much energy as stock units in 2000, we would multiply year 2000 energy use for that segment by ¾ to get the year 2010 equivalent. Once the stock turnover and UEC adjustments are made, we apply the exogenous energy service growth factor described above.

For brevity and ease of exposition, we will use the following notation:

E_{2000} = Energy Use in 2000 (quadrillion Btu)
S_E = Percent of surviving year 2000 stock (%)
S_R = Percent of year 2000 stock that has been replaced in existing homes (%)
S_N = Stock factor representing equipment in homes built after 2000, expressed as a percent of year 2000 stock (%)
ρ = Exogenous energy service growth factor
UEC_S = UEC of existing stock in 2000 (kWh/yr or MBtu/yr)
UEC_E^F = Frozen efficiency UEC for existing buildings (kWh/yr or MBtu/yr)

UEC_N^F = Frozen efficiency UEC for new buildings (kWh/yr or MBtu/yr)

UEC_E^B = Business-as-usual efficiency UEC for existing buildings (kWh/yr or MBtu/yr)

UEC_N^B = Business-as-usual efficiency UEC for new buildings (kWh/yr or MBtu/yr)

T_E = Technoeconomic potential savings for equipment in existing homes (%)

T_N = Technoeconomic potential savings for equipment in new homes (%)

A_E = Achievable fraction for existing buildings in the policy case (%)

A_N = Achievable fraction for new buildings in the policy case (%)

These parameters are all described in greater detail above. These inputs are used to calculate energy use in 2010 in the various scenarios:

E_{2010}^F = Energy Use in 2010 in the frozen efficiency case (quads)

E_{2010}^B = Energy Use in 2010 in the business-as-usual case (quads)

E_{2010}^T = Energy Use in 2010 in the techno-economic potential case (quads)

E_{2010}^P = Energy Use in 2010 in the policy case (quads)

Frozen Efficiency Energy Use

The formula for frozen efficiency energy use in 2010 is:

$$E_{2010}^F = \rho * E_{2000} * (S_E + S_R * \frac{UEC_E^F}{UEC_S} + S_N * \frac{UEC_N^F}{UEC_S})$$

The stock factors, S_E, S_R and S_N account for stock replacement and new construction, while the UEC ratios scale energy use up or down to account for the difference between new equipment efficiency and existing equipment efficiency. These factors are used to weight base year energy consumption (E_{2000}) to approximate year 2010 energy use. Finally we apply our other energy service growth factor to account for factors captured in the AEO 99 model that our simpler model does not address directly.

For refrigerators, this formula yields

$$E_{2010}^F = 0.92 * 0.37\ quads * (0.49 + 0.47 * \frac{647}{944} + 0.16 * \frac{647}{944}) = 0.31\ quads$$

Business-as-Usual Energy Use

The formula for business-as-usual energy use in 2010 is very similar to the frozen efficiency calculation except for the numerators in the UEC ratios—instead of year 2000 new unit efficiencies we use the forecast of future UECs from the CEF-NEMS model.

$$E^{B}_{2010} = \rho * E_{2000} * (S_E + S_R * \frac{UEC^{B}_{E}}{UEC_S} + S_N * \frac{UEC^{B}_{N}}{UEC_S})$$

For refrigerators, this formula yields

$$E^{B}_{2010} = 0.92 * 0.37\ quads * (0.49 + 0.47 * \frac{551}{944} + 0.16 * \frac{551}{944}) = 0.29\ quads$$

Techno-Economic Potential Energy Use

The calculation for techno-economic potential energy use in 2010 is again similar to the frozen efficiency calculation. In this case, we use the techno-economic potential savings to scale back the frozen efficiency UECs.

$$E^{T}_{2010} = \rho * E_{2000} * (S_E + S_R * \frac{UEC^{F}_{E}}{UEC_S}(1 - T_E) + S_N * \frac{UEC^{F}_{N}}{UEC_S} * (1 - T_N))$$

For refrigerators, this formula yields

$$E^{T}_{2010} = 0.92 * 0.37\ quads * (0.49 + 0.47 * \frac{647}{944}(1 - 0.44) + 0.16 * \frac{647}{944}(1 - 0.44)) = 0.25\ quads$$

The technoeconomic potential savings is therefore 0.31 – 0.25 = 0.06 quads relative to the frozen efficiency case and 0.29 – 0.25 = 0.04 quads relative to the Business-as-Usual case.

Policy Case Energy Use

The formula for energy use in 2010 for the policy case parallels the techno-economic savings calculation, except that the achievable fraction is applied to the techno-economic potential savings.

$$E^{P}_{2010} = \rho * E_{2000} * (S_E + S_R * \frac{UEC^{F}_{E}}{UEC_S}(1 - T_E * A_E) + S_N * \frac{UEC^{F}_{N}}{UEC_S} * (1 - T_N * A_N))$$

This formula can be used to calculate energy use in the moderate or advanced policy case, depending on which achievable fractions are used. For the refrigerator example below, we use the achievable potential for the advanced policy case to obtain 2010 energy use in the advanced policy case.

For residential refrigerators in the advanced case, this formula yields

$$E_{2010}^{P} = 0.92 * 0.37\ quads * (0.49 + 0.47 * \frac{647}{944}(1 - 0.44 * 0.62) + 0.16 * \frac{647}{944}(1 - 0.44 * 0.62))$$

$$E_{2010}^{P} = 0.27\ \ quads$$

The achievable potential savings is therefore 0.31 – 0.27 = 0.04 quads relative to the frozen efficiency case and 0.29 – 0.27 = 0.02 quads relative to the Business-as-Usual case.

Results of the spreadsheet analyses

Tables D-1.1 and D-1.2 (mod and adv) present the percent reduction in total energy consumption (compared to the AEO 99 forecast) for the techno-economic potential scenario, the share of the techno-economic reduction that can be achieved in our policy cases, and technology costs by fuel and end-use. These numbers were calculated from our energy consumption forecasts, and should not be equated with the techno-economic potential savings and achievable fractions (described above) used as inputs to the analysis. Those inputs were calculated relative to the frozen efficiency baseline, while the results in Tables D-1.1 and D-1.2 represent savings relative to the business-as-usual forecast.

The share of total U.S. residential energy savings by end-use and type of policy is shown in Table D-1.3 (mod and adv). Commercial building energy savings is in Table D-1.4 (mod and adv).

Details of how the techno-economic potential energy savings were estimated for each of the residential HVAC end-uses are provided separately for existing (pre-2000) homes (Table D-1.5) and new (post-1999) homes (Table D-1.6). Note that the techno-economic potential savings for existing homes does not evaluate any savings due to building shell retrofits. Building shell retrofits were not included in this analysis. Residential non-HVAC and Commercial techno-economic potentials were taken from the 5 Lab Study (Interlaboratory Working Group 1997).

Modeling the Scenarios in CEF-NEMS

To match the CEF-NEMS projection in our scenarios to our detailed spreadsheet forecasts of energy savings by end-use and technology, we changed hurdle rates, technology costs, and growth trends for each end-use. We directly input the equipment efficiency standards to the CEF-NEMS buildings sector modules. These changes reflect the effect of a variety of non-energy-price policies that eliminate many of the barriers to investing in cost-effective efficiency technologies.

We match the CEF-NEMS run for each building sector module run in "stand-alone" mode against the spreadsheet results. The fuel price interactions in the integrated runs would make it difficult to exactly match against the spreadsheets. Running the CEF-NEMS modules in stand-alone mode eliminates this complexity. Appendix A-1 contains

information on how we modified the CEF-NEMS input files and code to reproduce the energy savings from the spreadsheets.

On the demand side, NEMS interprets a series of "hurdle rates" (sometimes referred to as "implicit discount rates") as a proxy for all the various reasons why people don't purchase apparently cost-effective efficiency technologies in the building sector. They include constraints for both the consumer (purchasing) and for the supplier (product manufacturing and distribution). Among the constraints are transaction costs, manufacturer aversion to innovation, information-gathering costs, hassle costs, misinformation, and information processing costs. The hurdle rates embody the consumers' time value of money, plus all of the other factors that prevent the purchase of the more efficient technologies.

In the residential and commercial sectors, for example, the financial component of the reference case hurdle rate is about 15 percent (in real terms) with the other institutional and market factors pushing such rates to well above 100 percent for some end-uses. In our scenarios, we reduce the hurdle rates as appropriate for many end-uses to reflect the policies described above. When we reduce the hurdle rates in the CEF-NEMS model, we are increasing the responsiveness of the model to changes in energy prices. This change accurately (though indirectly) reflects a world in which aggressive programs and policies remove barriers to adoption of energy-efficient technologies.

In the advanced scenario, the $50/t carbon permit trading fee is modeled directly in the CEF-NEMS model, and the building sector modules respond using the revised hurdle rates that we input to those modules. The $50/t fee corresponds to about a 10% increase in base year electricity prices, and a 15% increase in natural gas prices, not accounting for price effects from fuel switching caused by the fee.

Summary of CEF-NEMS Outputs

Tables D-1.7 through D-1.18 contain the summary energy and carbon results for the residential and commercial sectors from our integrated CEF-NEMS runs. These results are reported in Chapter 4.

Index to the Tables in Appendix D-1

Introduction to Technoeconomic and Achievable Potential Tables
(Table D-1.1mod, D-1.1adv, D-1.2mod, D-1.2adv)

Tables D-1.1 and D-1.2 (mod and adv) present technoeconomic, achievable potential savings and technology costs for the end-uses analyzed. Please refer to the introduction to Appendix D-1 for a detailed explanation of the techno-economic potential case and the achievable potential case and how they are calculated.

Description of Results
Here we present aggregate technoeconomic potential energy reduction for each end-use, relative to business-as-usual energy consumption. This is calculated from the outputs of the spreadsheet analysis, and should not be confused with the technoeconomic potential savings (percent of UEC) that is relative to the frozen efficiency baseline and is used as an input to the analysis.[1]

The achievable potential presented here corresponds to the technoeconomic potential presented in the table. We calculate aggregate energy savings over BAU represented by our policy case forecast. The savings is then represented as a percent of the techno-economic energy reduction described above.

Depending on our policy pathways, the shape of the AEO 99 forecast, and the degree to which our policies kept pace with business-as-usual progress, in some cases we achieved zero savings relative to business-as-usual. These are reported as N/A. In many cases, we simply had no policies that applied to a particular end-use. In some cases we have savings in 2010 but not in 2020, or vice versa.

[1] As described in the introduction to Appendix D-1, the techno-economic potential savings is developed using the frozen efficiency unit energy consumption as a reference point. This is for computational convenience, since the frozen efficiency UEC remains constant over time, unlike the business-as-usual UEC. Although this definition of savings is convenient an appropriate as an input to the analysis, it should not be taken as a representation of actual savings since it fails to account for business-as-usual efficiency improvements and exogenous changes in energy demand. The accurate representation of total savings is the difference between business-as-usual aggregate energy consumption and techno-economic potential energy consumption.

Table D-1.1mod. Summary of residential buildings sector program effectiveness and costs, by end-use, residential moderate case

Fuel	End-use	Technoeconomic potential % savings relative to business as usual case 2010	Technoeconomic potential % savings relative to business as usual case 2020	Achievable potential % of technoeconomic potential that is achieved 2010	Achievable potential % of technoeconomic potential that is achieved 2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	Technology cost[1,2,3,4] 1997$/MBtu 2020
Electricity	Space heating	8%	17%	3%	9%	12.37	9.60
	Space cooling	18%	27%	41%	53%	14.58	14.28
	Water heating	27%	30%	36%	68%	5.56	4.62
	Refrigeration	15%	31%	39%	49%	10.46	10.64
	Cooking	12%	11%	N/A	N/A	N/A	N/A
	Clothes Dryers	22%	20%	N/A	N/A	N/A	N/A
	Freezers	11%	21%	30%	35%	17.28	17.28
	Lighting						
	torchieres	77%	77%	48%	58%	17.67	16.92
	other	43%	50%	15%	38%	3.02	2.79
	Clothes Washers	36%	50%	43%	91%	7.78	5.46
	Dishwashers	0%	0%	N/A	N/A	N/A	N/A
	Color Televisions	21%	25%	32%	49%	2.07	2.07
	Personal Computers	0%	0%	N/A	N/A	N/A	N/A
	Furnace Fans	44%	75%	N/A	1%	N/A	N/A
	Other Uses						
	coils	22%	26%	35%	42%	N/A	N/A
	motors	46%	55%	20%	28%	5.33	5.82
	electronics	54%	64%	41%	66%	3.35	3.19
	Total electric	28%	37%	28%	45%	6.00	5.47
Natural gas	Space heating	5%	12%	N/A	5%	N/A	3.17
	Space cooling	0%	0%	N/A	N/A	N/A	N/A
	Water heating (5)	13%	17%	39%	53%	1.87	1.84
	Cooking (5)	(5)	10%	N/A	N/A	N/A	N/A
	Clothes dryers (5)	(5)	(5)	N/A	N/A	N/A	N/A
	Other Uses	9%	10%	N/A	N/A	N/A	N/A
	Total gas	5%	12%	21%	22%	2.11	2.27

Table D-1.1mod (continued). Summary of residential buildings sector program effectiveness and costs, by end-use, residential moderate case

Fuel	End-use	Technoeconomic potential % savings relative to business as usual case 2010	Technoeconomic potential % savings relative to business as usual case 2020	Achievable potential % of technoeconomic potential that is achieved 2010	Achievable potential % of technoeconomic potential that is achieved 2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	Technology cost[1,2,3,4] 1997$/MBtu 2020
Distillate oil	Space heating	4%	11%	N/A	N/A	N/A	N/A
	Water heating	15%	20%	28%	49%	1.87	1.84
	Other Uses	0%	0%	N/A	N/A	N/A	N/A
	Total oil	6%	13%	N/A	N/A	N/A	N/A
LPG	Space heating	2%	10%	N/A	N/A	N/A	N/A
	Water heating	14%	15%	N/A	N/A	N/A	N/A
	Cooking	19%	31%	N/A	N/A	N/A	N/A
	Other Uses	9%	10%	N/A	N/A	N/A	N/A
	Total LPG	6%	13%	N/A	N/A	N/A	N/A
Renewables	Wood	0%	0%	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	0%	0%	N/A	N/A	N/A	N/A
Totals		14%	21%	24%	36%	5.23	4.89

Notes to table D.1.1mod

(1) Technology cost is the incremental cost of efficiency measures, expressed as a cost of conserved energy (CCE). It does not include program implementation costs.

(2) CCEs for electricity expressed in terms of site energy at 3412 Btus/kWh

(3) CCEs calculated using a real discount rate of 7% and lifetimes as shown in Appendix C-1.

(4) CCEs for individual policies were weighted by the savings attributable to each policy to obtain average CCE's for each end-use. Subtotals for each fuel type are similarly weighted by the mix of savings attributable to each end-use.

(5) Technoeconomic potential for water heating, cooking and clothes dryers includes the effect of fuel switching. Programs that promote changing from electric to gas appliances reduce electricity use but increase natural gas use. It is therefore possible to have negative technoeconomic potentials for gas appliances. This is the case for gas clothes dryers in 2010 and 2020 and gas cooking in 2010. Technoeconomic potential savings would actually increase gas cooking energy use by 5% in 2010 and more than double gas clothes drying energy. Of course, these increases are more than offset by the decrease in electricity use for these end uses. We did not present these numbers in the table to avoid confusion. Water heating and cooking in 2020 show a positive technoeconomic potential because savings from other (non-fuel switching) policies more than offset the increase in energy use due to fuel switching. The achievable case includes no fuel switching in the moderate case.

Table D-1.1adv. Summary of residential buildings sector program effectiveness and costs, by end-use, residential advanced case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	Techno-economic potential % savings relative to business as usual case 2020	Achievable potential % of techno-economic potential that is achieved 2010	Achievable potential % of techno-economic potential that is achieved 2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	Technology cost[1,2,3,4] 1997$/MBtu 2020
Electricity	Space heating	8%	17%	20%	34%	12.37	8.09
	Space cooling	18%	27%	60%	70%	14.96	12.43
	Water heating	27%	30%	42%	91%	0.09	0.16
	Refrigeration	15%	31%	42%	65%	10.46	10.64
	Cooking	12%	11%	8%	20%	N/A	N/A
	Clothes Dryers	22%	20%	9%	22%	N/A	N/A
	Freezers	11%	21%	33%	57%	17.28	17.28
	Lighting						
	torchieres	77%	77%	53%	71%	17.67	16.92
	other	43%	50%	27%	74%	3.02	2.79
	Clothes Washers	36%	50%	67%	98%	7.78	5.46
	Dishwashers	0%	0%	N/A	N/A	N/A	N/A
	Color Televisions	21%	25%	34%	72%	2.07	2.07
	Personal Computers	0%	0%	N/A	N/A	N/A	N/A
	Furnace Fans	44%	75%	N/A	1%	N/A	N/A
	Other Uses						
	coils	22%	26%	35%	42%	N/A	N/A
	motors	46%	55%	20%	31%	5.33	5.82
	electronics	54%	64%	43%	98%	3.35	3.19
	Total electric	28%	37%	34%	65%	5.43	4.31
Natural gas	Space heating	5%	12%	14%	31%	4.25	2.85
	Space cooling	0%	0%	N/A	N/A	N/A	N/A
	Water heating (5)	13%	17%	39%	50%	1.87	1.84
	Cooking (5)	(5)	10%	(5)	(5)	N/A	N/A
	Clothes dryers (5)	(5)	(5)	(5)	(5)	N/A	N/A
	Other Uses	9%	10%	N/A	N/A	N/A	N/A
	Total gas	5%	12%	28%	36%	2.48	1.95

Table D-1.1adv (continued). Summary of residential buildings sector program effectiveness and costs, by end-use, residential advanced case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	2020	Achievable potential % of techno-economic potential that is achieved 2010	2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	2020
Distillate oil	Space heating	4%	11%	N/A	8%	N/A	1.91
	Water heating	15%	20%	31%	50%	1.87	1.84
	Other Uses	0%	0%	N/A	N/A	N/A	N/A
	Total oil	6%	13%	N/A	18%	N/A	1.88
LPG	Space heating	2%	10%	N/A	10%	N/A	3.17
	Water heating	14%	15%	N/A	N/A	N/A	N/A
	Cooking	19%	31%	N/A	N/A	N/A	N/A
	Other Uses	9%	10%	N/A	N/A	N/A	N/A
	Total LPG	6%	13%	N/A	N/A	N/A	N/A
Renewables	Wood	0%	0%	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	0%	0%	N/A	N/A	N/A	N/A
Totals		14%	21%	31%	55%	5.13	4.00

Notes to table D.1.1adv

(1) Technology cost is the incremental cost of efficiency measures, expressed as a cost of conserved energy (CCE). It does not include program implementation costs.

(2) CCEs for electricity expressed in terms of site energy at 3412 Btus/kWh

(3) CCEs calculated using a real discount rate of 7% and lifetimes as shown in Appendix C-1.

(4) CCEs for individual policies were weighted by the savings attributable to each policy to obtain average CCE's for each end-use. Subtotals for each fuel type are similarly weighted by the mix of savings attributable to each end-use.

(5) Techno-economic potential for water heating, cooking and clothes dryers includes the effect of fuel switching. Programs that promote changing from electric to gas appliances reduce electricity use but increase natural gas use. It is therefore possible to have negative techno-economic potentials for gas appliances. This is the case for gas clothes dryers in 2010 and 2020 and gas cooking in 2010. Techno-economic and achievable potentials are shown below for these products. Fuel switching increases gas cooking energy use by 5% in 2010 (negative savings should be interpreted as an increase in energy use). In our policy case, we implement some fuel switching for cooking, resulting in electricity savings but increased gas use equal to 42% of the technical potential, i.e. a 2.1% (=42% x -5%) increase in gas cooking energy use. By 2020, the fuel switching effect is more than offset

Notes to table D.1.1adv (continued)

by other technological changes for a net savings of 10%. However, in our policy case, all the cooking savings come from fuel switching, so gas cooking energy increases in the policy case even though it decreases in the techno-economic potential case. 2020 cooking energy increases by 3.8% in our policy case; expressed as a percent of techno-economic potential gives the -38% value shown in the table. Gas clothes dryer energy more than doubles due to fuel switching (-105% savings is equivalent to a 105% increase in energy use). Fuel switching assumptions in the policy case result in a 10% increase (= -105% x 9%) in gas clothes dryer energy in 2010 and a 23% increase (= -105% x 22%) in 2020.

	Techno-economic potential % savings relative to business as usual case		Achievable potential % of techno-economic potential that is achieved	
	2010	2020	2010	2020
Cooking (5)	-5%	10%	42%	-38%
Clothes dryers (5)	-105%	-105%	9%	22%

We did not present these numbers in the main table to avoid confusion.

Table D-1.2mod. Summary of commercial buildings sector program effectiveness and costs, by end-use, commercial moderate case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	2020	Achievable potential % of techno-economic potential that is achieved 2010	2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	2020
Electricity	Space heating	20%	39%	3%	N/A	1.32	N/A
	Space cooling	29%	48%	23%	36%	6.04	6.32
	Water heating	16%	11%	5%	N/A	3.00	N/A
	Ventilation	26%	45%	19%	42%	1.32	1.24
	Cooking	0%	0%	N/A	N/A	N/A	N/A
	Lighting	20%	25%	36%	54%	12.74	13.47
	Refrigeration	22%	38%	14%	31%	3.03	3.03
	Office equip.-PCs	0%	0%	N/A	N/A	N/A	N/A
	Office equip.-non-PCs	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Miscellaneous	50%	58%	55%	75%	5.25	5.59
	District Services	29%	46%	19%	18%	1.32	1.23
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total electric	19%	26%	37%	54%	7.45	7.53
Natural gas	Space heating	27%	47%	18%	21%	1.33	1.24
	Space cooling	38%	38%	16%	N/A	3.18	N/A
	Water heating	13%	15%	55%	69%	2.16	2.01
	Cooking	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Misc.	12%	13%	N/A	N/A	N/A	N/A
	District Services	28%	46%	14%	19%	1.32	1.23
	Cogen	0%	0%	N/A	N/A	N/A	N/A
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total gas	16%	26%	22%	25%	1.60	1.43

Table D-1.2mod (continued). Summary of commercial buildings sector program effectiveness and costs, by end-use, commercial moderate case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	Techno-economic potential % savings relative to business as usual case 2020	Achievable potential % of techno-economic potential that is achieved 2010	Achievable potential % of techno-economic potential that is achieved 2020	Technology cost[1,2,3,4] 1997$/MBtu 2010	Technology cost[1,2,3,4] 1997$/MBtu 2020
Distillate oil	Space heating	14%	22%	N/A	N/A	N/A	N/A
	Water heating	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Misc.	16%	13%	N/A	N/A	N/A	N/A
	District Services	28%	45%	16%	15%	1.32	1.23
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total oil	16%	26%	N/A	N/A	N/A	N/A
Renewables	Biomass	0%	0%	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	0%	0%	N/A	N/A	N/A	N/A
Totals		17%	25%	27%	37%	6.1	6.2

Notes to Table D-1.2mod

(1) Technology cost is the incremental cost of efficiency measures, expressed as a cost of conserved energy (CCE) calculated using a real discount rate of 7%. It does not include program implementation costs.

(2) CCEs for electricity expressed in terms of site energy at 3412 Btus/kWh

(3) See Appendix C-1 for detailed CCEs by technology

(4) CCEs for individual policies were weighted by the savings attributable to each policy to obtain average CCE's for each end-use. Subtotals for each fuel type are similarly weighted by the mix of savings attributable to each end-use.

Table D-1.2adv. Summary of commercial buildings sector program effectiveness and costs, by end-use, commercial advanced case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	2020	Achievable potential % of techno-economic potential that is achieved 2010	2020	Technology cost[1,2,3] 1997$/MBtu 2010	2020
Electricity	Space heating	20%	39%	9%	3%	1.27	1.11
	Space cooling	29%	48%	29%	49%	5.63	6.62
	Water heating	16%	11%	18%	N/A	2.72	N/A
	Ventilation	26%	45%	30%	64%	1.26	1.12
	Cooking	0%	0%	N/A	N/A	N/A	N/A
	Lighting	20%	25%	43%	64%	11.71	12.11
	Refrigeration	22%	38%	14%	31%	3.03	3.03
	Office equip.-PCs	0%	0%	N/A	N/A	N/A	N/A
	Office equip.-non-PCs	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Miscellaneous	50%	58%	58%	79%	5.28	5.63
	District Services	29%	46%	25%	27%	1.23	1.10
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total electric	19%	26%	42%	62%	7.14	7.13
Natural gas	Space heating	27%	47%	23%	35%	1.31	1.53
	Space cooling	38%	38%	21%	N/A	3.74	N/A
	Water heating	13%	15%	69%	87%	2.12	1.83
	Cooking	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Misc.	12%	13%	N/A	N/A	N/A	N/A
	District Services	28%	46%	22%	34%	1.29	1.55
	Cogen	0%	0%	N/A	N/A	N/A	N/A
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total gas	16%	26%	29%	40%	1.59	1.57

Table D-1.2adv (continued). Summary of commercial buildings sector program effectiveness and costs, by end-use, commercial advanced case

Fuel	End-use	Techno-economic potential % savings relative to business as usual case 2010	Techno-economic potential % savings relative to business as usual case 2020	Achievable potential % of techno-economic potential that is achieved 2010	Achievable potential % of techno-economic potential that is achieved 2020	Technology cost[1,2,3] 1997$/MBtu 2010	Technology cost[1,2,3] 1997$/MBtu 2020
Distillate oil	Space heating	14%	22%	N/A	N/A	N/A	N/A
	Water heating	0%	0%	N/A	N/A	N/A	N/A
	Other Uses						
	Misc.	16%	13%	N/A	N/A	N/A	N/A
	District Services	28%	45%	22%	24%	1.29	1.55
	Adjust to SEDS	0%	0%	N/A	N/A	N/A	N/A
	Total oil	16%	26%	N/A	N/A	N/A	N/A
Renewables	Biomass	0%	0%	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	0%	0%	N/A	N/A	N/A	N/A
Totals		17%	25%	33%	48%	5.4	5.3

Notes to Table D-1.2adv

(1) Technology cost is the incremental cost of efficiency measures, expressed as a cost of conserved energy (CCE) calculated using a real discount rate of 7%. It does not include program implementation costs.

(2) CCEs for electricity expressed in terms of site energy at 3412 Btus/kWh

(3) See Appendix C-1 for detailed CCEs by technology

(4) CCEs for individual policies were weighted by the savings attributable to each policy to obtain average CCE's for each end-use. Subtotals for each fuel type are similarly weighted by the mix of savings attributable to each end-use.

Table D-1.3mod. Shares of U.S. residential sector energy saving by end-use and policy type under moderate implementation of efficiency resources

		Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Electricity	Space heating						
	New Buildings	20%	22%	36%	0%	13%	10%
	Existing Buildings	67%	0%	13%	0%	20%	0%
	Total	40%	12%	26%	0%	16%	5%
	Space cooling						
	New Buildings	66%	9%	17%	0%	5%	4%
	Existing Buildings	77%	0%	12%	0%	10%	0%
	Total	74%	2%	13%	0%	9%	1%
	Water heating						
	New Buildings	67%	0%	16%	3%	5%	9%
	Existing Buildings	69%	0%	14%	3%	3%	10%
	Total	69%	0%	14%	3%	3%	10%
	Refrigeration	91%	0%	4%	4%	0%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Freezers	100%	0%	0%	0%	0%	0%
	Lighting						
	torchieres	0%	0%	25%	0%	0%	75%
	other	0%	0%	98%	0%	0%	2%
	Clothes Washers	84%	0%	16%	0%	0%	0%
	Dishwashers	N/A	N/A	N/A	N/A	N/A	N/A
	Color Televisions	0%	0%	100%	0%	0%	0%
	Personal Computers	N/A	N/A	N/A	N/A	N/A	N/A
	Furnace Fans	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses						
	coils	N/A	N/A	N/A	N/A	N/A	N/A
	motors	0%	0%	63%	0%	0%	37%
	electronics	0%	0%	100%	0%	0%	0%
	Total electric	46%	1%	47%	1%	2%	3%
Natural gas	Space heating						
	New Buildings	0%	25%	49%	0%	12%	15%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	16%	67%	0%	8%	9%
	Space cooling	N/A	N/A	N/A	N/A	N/A	N/A
	Water heating						
	New Buildings	96%	0%	2%	0%	2%	0%
	Existing Buildings	97%	0%	1%	0%	2%	0%
	Total	97%	0%	1%	0%	2%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total gas	71%	4%	19%	0%	4%	2%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3mod (continued). Shares of U.S. residential sector energy saving by end-use and policy type under moderate implementation of efficiency resources

		Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Distillate oil	Space heating						
	New Buildings	0%	21%	51%	0%	16%	13%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	15%	65%	0%	11%	9%
	Water heating	97%	0%	1%	0%	2%	0%
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total oil	48%	7%	33%	0%	7%	5%
LPG	Space heating						
	New Buildings	0%	25%	49%	0%	12%	15%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	16%	66%	0%	8%	10%
	Water heating	N/A	N/A	N/A	N/A	N/A	N/A
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total LPG	0%	16%	66%	0%	8%	10%
Renewables	Wood	N/A	N/A	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	N/A	N/A	N/A	N/A	N/A	N/A
Totals		53%	2%	38%	1%	3%	3%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3mod (continued). Shares of U.S. residential sector energy saving by end-use and policy type under moderate implementation of efficiency resources

		Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Electricity	Space heating						
	New Buildings	15%	27%	26%	0%	4%	29%
	Existing Buildings	67%	0%	33%	0%	0%	0%
	Total	31%	18%	28%	0%	3%	20%
	Space cooling						
	New Buildings	59%	13%	14%	0%	2%	12%
	Existing Buildings	83%	0%	17%	0%	0%	0%
	Total	74%	5%	16%	0%	1%	5%
	Water heating						
	New Buildings	66%	0%	17%	5%	3%	9%
	Existing Buildings	66%	0%	16%	5%	3%	10%
	Total	66%	0%	16%	5%	3%	10%
	Refrigeration	89%	0%	5%	6%	0%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Freezers	100%	0%	0%	0%	0%	0%
	Lighting						
	torchieres	0%	0%	57%	0%	0%	43%
	other	0%	0%	77%	0%	0%	23%
	Clothes Washers	99%	0%	1%	0%	0%	0%
	Dishwashers	N/A	N/A	N/A	N/A	N/A	N/A
	Color Televisions	0%	0%	100%	0%	0%	0%
	Personal Computers	N/A	N/A	N/A	N/A	N/A	N/A
	Furnace Fans	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses						
	coils	N/A	N/A	N/A	N/A	N/A	N/A
	motors	0%	0%	49%	0%	0%	51%
	electronics	0%	0%	100%	0%	0%	0%
	Total electric	41%	1%	47%	2%	1%	8%
Natural gas	Space heating						
	New Buildings	0%	28%	33%	0%	4%	36%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	19%	53%	0%	3%	25%
	Space cooling	N/A	N/A	N/A	N/A	N/A	N/A
	Water heating						
	New Buildings	98%	0%	1%	0%	1%	0%
	Existing Buildings	99%	0%	1%	0%	1%	0%
	Total	99%	0%	1%	0%	1%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total gas	60%	8%	22%	0%	1%	10%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3mod (continued). Shares of U.S. residential sector energy saving by end-use and policy type under moderate implementation of efficiency resources

		Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Distillate oil	Space heating						
	New Buildings	0%	25%	35%	0%	5%	35%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	19%	51%	0%	4%	26%
	Water heating	99%	0%	1%	0%	1%	0%
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total oil	37%	12%	32%	0%	3%	16%
LPG	Space heating						
	New Buildings	0%	28%	33%	0%	4%	36%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	20%	51%	0%	3%	26%
	Water heating	N/A	N/A	N/A	N/A	N/A	N/A
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total LPG	0%	20%	51%	0%	3%	26%
Renewables	Wood	N/A	N/A	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	N/A	N/A	N/A	N/A	N/A	N/A
Totals		47%	4%	38%	1%	1%	9%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3adv. Shares of U.S. residential sector energy saving by end-use and policy type under advanced implementation of efficiency resources

		Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Electricity	Space heating						
	New Buildings	9%	16%	38%	0%	29%	8%
	Existing Buildings	23%	0%	7%	38%	32%	0%
	Total	16%	8%	23%	19%	30%	4%
	Space cooling						
	New Buildings	44%	10%	25%	0%	15%	5%
	Existing Buildings	50%	0%	13%	0%	37%	0%
	Total	49%	3%	16%	0%	31%	1%
	Water heating						
	New Buildings	68%	0%	12%	1%	7%	12%
	Existing Buildings	73%	0%	7%	1%	6%	13%
	Total	72%	0%	8%	1%	6%	13%
	Refrigeration	93%	0%	3%	4%	0%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Freezers	100%	0%	0%	0%	0%	0%
	Lighting						
	torchieres	0%	0%	51%	0%	0%	97%
	other	0%	0%	90%	0%	0%	10%
	Clothes Washers	95%	0%	5%	0%	0%	0%
	Dishwashers	N/A	N/A	N/A	N/A	N/A	N/A
	Color Televisions	19%	0%	81%	0%	0%	0%
	Personal Computers	N/A	N/A	N/A	N/A	N/A	N/A
	Furnace Fans	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses						
	coils	N/A	N/A	N/A	N/A	N/A	N/A
	motors	0%	0%	66%	0%	0%	34%
	electronics	0%	0%	100%	0%	0%	0%
	Total electric	40%	1%	44%	1%	8%	5%
Natural gas	Space heating						
	New Buildings	0%	17%	42%	0%	30%	11%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	12%	58%	0%	22%	8%
	Space cooling	N/A	N/A	N/A	N/A	N/A	N/A
	Water heating						
	New Buildings	96%	0%	1%	0%	3%	0%
	Existing Buildings	97%	0%	1%	0%	3%	0%
	Total	97%	0%	1%	0%	3%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total gas	56%	5%	24%	0%	11%	3%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3adv (continued). Shares of U.S. residential sector energy saving by end-use and policy type under advanced implementation of efficiency resources

		Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Distillate oil	Space heating						
	New Buildings	0%	16%	45%	0%	29%	10%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	12%	56%	0%	23%	8%
	Water heating	97%	0%	1%	0%	3%	0%
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total oil	34%	8%	36%	0%	16%	5%
LPG	Space heating						
	New Buildings	0%	17%	42%	0%	30%	11%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	13%	56%	0%	23%	8%
	Water heating	N/A	N/A	N/A	N/A	N/A	N/A
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total LPG	0%	13%	56%	0%	23%	8%
Renewables	Wood	N/A	N/A	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	N/A	N/A	N/A	N/A	N/A	N/A
Totals		45%	3%	38%	1%	9%	5%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3adv (continued). Shares of U.S. residential sector energy saving by end-use and policy type under advanced implementation of efficiency resources

		Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Electricity	Space heating						
	New Buildings	7%	21%	34%	0%	8%	30%
	Existing Buildings	27%	0%	22%	50%	1%	0%
	Total	14%	14%	30%	17%	6%	20%
	Space cooling						
	New Buildings	37%	15%	24%	0%	5%	19%
	Existing Buildings	74%	0%	25%	0%	1%	0%
	Total	57%	7%	24%	0%	3%	9%
	Water heating						
	New Buildings	51%	0%	21%	8%	4%	17%
	Existing Buildings	58%	0%	16%	10%	4%	12%
	Total	56%	0%	17%	9%	4%	14%
	Refrigeration	97%	0%	1%	1%	0%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Freezers	100%	0%	0%	0%	0%	0%
	Lighting						
	torchieres	0%	0%	67%	0%	0%	87%
	other	0%	0%	70%	0%	0%	30%
	Clothes Washers	100%	0%	0%	0%	0%	0%
	Dishwashers	N/A	N/A	N/A	N/A	N/A	N/A
	Color Televisions	85%	0%	15%	0%	0%	0%
	Personal Computers	N/A	N/A	N/A	N/A	N/A	N/A
	Furnace Fans	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses						
	coils	N/A	N/A	N/A	N/A	N/A	N/A
	motors	0%	0%	70%	0%	0%	30%
	electronics	0%	0%	100%	0%	0%	0%
	Total electric	34%	1%	52%	2%	1%	10%
Natural gas	Space heating						
	New Buildings	0%	21%	37%	0%	9%	34%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	16%	51%	0%	7%	26%
	Space cooling	N/A	N/A	N/A	N/A	N/A	N/A
	Water heating						
	New Buildings	99%	0%	0%	0%	1%	0%
	Existing Buildings	99%	0%	0%	0%	1%	0%
	Total	99%	0%	0%	0%	1%	0%
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Clothes Dryers	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total gas	43%	9%	29%	0%	4%	15%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.3adv (continued). Shares of U.S. residential sector energy saving by end-use and policy type under advanced implementation of efficiency resources

		Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Distillate oil	Space heating						
	New Buildings	0%	19%	39%	0%	9%	33%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	16%	49%	0%	8%	28%
	Water heating	97%	0%	1%	0%	3%	0%
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total oil	22%	12%	38%	0%	6%	21%
LPG	Space heating						
	New Buildings	0%	21%	37%	0%	9%	34%
	Existing Buildings	0%	0%	100%	0%	0%	0%
	Total	0%	17%	49%	0%	7%	27%
	Water heating	N/A	N/A	N/A	N/A	N/A	N/A
	Cooking	N/A	N/A	N/A	N/A	N/A	N/A
	Other Uses	N/A	N/A	N/A	N/A	N/A	N/A
	Total LPG	0%	17%	49%	0%	7%	27%
Renewables	Wood	N/A	N/A	N/A	N/A	N/A	N/A
Other fuels	Coal + kerosene	N/A	N/A	N/A	N/A	N/A	N/A
Totals		36%	4%	44%	1%	2%	12%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4mod. Shares of U.S. commercial sector energy saving by end-use and policy type, moderate case

Fuel	*End-use*	Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Electricity	Space heating						
	New Buildings	0%	1.1%	0%	0%	0%	99%
	Existing Buildings	0%	0.0%	76%	0%	0%	24%
	Total	0%	0.2%	61%	0%	0%	39%
	Space cooling						
	New Buildings	74%	0.3%	0%	0%	0%	26%
	Existing Buildings	25%	0.0%	60%	0%	0%	15%
	Total	43%	0.1%	37%	0%	0%	19%
	Water heating						
	New Buildings	0%	1.0%	0%	38%	0%	61%
	Existing Buildings	0%	0.0%	66%	16%	0%	18%
	Total	0%	0.1%	56%	20%	0%	24%
	Ventilation						
	New Buildings	0%	0.9%	0%	0%	0%	99%
	Existing Buildings	0%	0.0%	78%	0%	0%	22%
	Total	0%	0.2%	56%	0%	0%	44%
	Cooking	NA	NA	NA	NA	NA	NA
	Lighting						
	New Buildings	84%	0.3%	0%	0%	0%	16%
	Existing Buildings	54%	0.0%	40%	0%	0%	6%
	Total	61%	0.1%	30%	0%	0%	8%
	Refrigeration	0%	0.0%	100%	0%	0%	0%
	Office equip.-PCs	NA	NA	NA	NA	NA	NA
	Office equip.-other	NA	NA	NA	NA	NA	NA
	Other Uses						
	Miscellaneous	0%	0.0%	100%	0%	0%	0%
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total electric	43%	0.1%	45%	0%	0%	11%
Natural gas	Space heating						
	New Buildings	0%	1.1%	0%	0%	0%	99%
	Existing Buildings	0%	0.0%	76%	0%	0%	24%
	Total	0%	0.1%	71%	0%	0%	28%
	Space cooling						
	New Buildings	0%	1.0%	0%	0%	0%	99%
	Existing Buildings	0%	0.0%	79%	0%	0%	21%
	Total	0%	0.2%	65%	0%	0%	35%
	Water heating						
	New Buildings	0%	1.6%	0%	0%	0%	98%
	Existing Buildings	0%	0.0%	78%	0%	0%	22%
	Total	0%	0.2%	70%	0%	0%	30%
	Cooking	NA	NA	NA	NA	NA	NA

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4mod (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, moderate case

Fuel	*End-use*	Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
	Other Uses						
	Misc.	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Cogen	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total gas	0%	0.1%	70%	0%	0%	29%
Distillate oil	Space heating						
	New Buildings	0%	1.1%	0%	0%	0%	99%
	Existing Buildings	0%	0.0%	76%	0%	0%	24%
	Total	0%	0.2%	61%	0%	0%	39%
	Water heating						
	New Buildings	0%	1.6%	0%	0%	0%	98%
	Existing Buildings	0%	0.0%	78%	0%	0%	22%
	Total	0%	0.2%	70%	0%	0%	30%
	Other Uses						
	Misc.	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total oil	0%	0.2%	63%	0%	0%	37%
Renewables	Biomass	NA	NA	NA	NA	NA	NA
Other fuels	Coal + kerosene	NA	NA	NA	NA	NA	NA
Totals		31%	0.1%	52%	0%	0%	17%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4mod (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, moderate case

Fuel	*End-use*	Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Electricity	Space heating						
	New Buildings	0%	7%	0%	0%	0%	93%
	Existing Buildings	0%	0%	49%	0%	0%	51%
	Total	0%	3%	30%	0%	0%	67%
	Space cooling						
	New Buildings	65%	2%	0%	0%	0%	32%
	Existing Buildings	29%	0%	40%	0%	0%	31%
	Total	48%	1%	19%	0%	0%	32%
	Water heating						
	New Buildings	0%	6%	0%	39%	0%	55%
	Existing Buildings	0%	0%	39%	26%	0%	35%
	Total	0%	2%	23%	31%	0%	43%
	Ventilation						
	New Buildings	0%	5%	0%	0%	0%	95%
	Existing Buildings	0%	0%	52%	0%	0%	48%
	Total	0%	2%	33%	0%	0%	65%
	Cooking	NA	NA	NA	NA	NA	NA
	Lighting						
	New Buildings	75%	3%	0%	0%	0%	22%
	Existing Buildings	55%	0%	31%	0%	0%	14%
	Total	63%	1%	19%	0%	0%	17%
	Refrigeration	0%	0%	100%	0%	0%	0%
	Office equip.-PCs	NA	NA	NA	NA	NA	NA
	Office equip.-other	NA	NA	NA	NA	NA	NA
	Other Uses						
	Miscellaneous	0%	0%	100%	0%	0%	0%
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total electric	40%	1%	35%	0%	0%	23%
Natural gas	Space heating						
	New Buildings	0%	7%	0%	0%	0%	93%
	Existing Buildings	0%	0%	49%	0%	0%	51%
	Total	0%	2%	32%	0%	0%	66%
	Space cooling						
	New Buildings	0%	6%	0%	0%	0%	94%
	Existing Buildings	0%	0%	55%	0%	0%	45%
	Total	0%	2%	36%	0%	0%	62%
	Water heating						
	New Buildings	0%	9%	0%	0%	0%	91%
	Existing Buildings	0%	0%	53%	0%	0%	47%
	Total	0%	3%	33%	0%	0%	63%
	Cooking	NA	NA	NA	NA	NA	NA

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4mod (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, moderate case

Fuel	*End-use*	Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
	Other Uses						
	Misc.	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Cogen	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total gas	0%	3%	33%	0%	0%	65%
Distillate oil	Space heating						
	New Buildings	0%	7%	0%	0%	0%	93%
	Existing Buildings	0%	0%	49%	0%	0%	51%
	Total	0%	3%	30%	0%	0%	67%
	Water heating						
	New Buildings	0%	9%	0%	0%	0%	91%
	Existing Buildings	0%	0%	53%	0%	0%	47%
	Total	0%	3%	33%	0%	0%	63%
	Other Uses						
	Misc.	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total oil	0%	3%	31%	0%	0%	67%
Renewables	Biomass	NA	NA	NA	NA	NA	NA
Other fuels	Coal + kerosene	NA	NA	NA	NA	NA	NA
Totals		29%	2%	34%	0%	0%	35%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4adv. Shares of U.S. commercial sector energy saving by end-use and policy type, advanced case

Fuel	*End-use*	Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
Electricity	Space heating						
	New Buildings	0%	13%	0%	0%	0%	87%
	Existing Buildings	0%	0%	73%	0%	0%	27%
	Total	0%	3%	56%	0%	0%	41%
	Space cooling						
	New Buildings	65%	4%	0%	0%	0%	31%
	Existing Buildings	20%	0%	61%	0%	0%	18%
	Total	37%	1%	39%	0%	0%	23%
	Water heating						
	New Buildings	0%	13%	0%	26%	0%	61%
	Existing Buildings	0%	0%	68%	11%	0%	21%
	Total	0%	2%	58%	13%	0%	27%
	Ventilation						
	New Buildings	0%	10%	0%	0%	0%	90%
	Existing Buildings	0%	0%	75%	0%	0%	25%
	Total	0%	3%	51%	0%	0%	46%
	Cooking	NA	NA	NA	NA	NA	NA
	Lighting						
	New Buildings	74%	5%	0%	0%	0%	20%
	Existing Buildings	45%	0%	47%	0%	0%	8%
	Total	52%	1%	36%	0%	0%	11%
	Refrigeration	0%	0%	100%	0%	0%	0%
	Office equip.-PCs	NA	NA	NA	NA	NA	NA
	Office equip.-other	NA	NA	NA	NA	NA	NA
	Other Uses						
	Miscellaneous	33%	0%	67%	0%	0%	0%
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total electric	40%	1%	44%	0%	0%	14%
Natural gas	Space heating						
	New Buildings	17%	10%	0%	0%	0%	73%
	Existing Buildings	7%	0%	69%	0%	0%	25%
	Total	9%	2%	57%	0%	0%	33%
	Space cooling						
	New Buildings	0%	12%	0%	0%	0%	88%
	Existing Buildings	0%	0%	76%	0%	0%	24%
	Total	0%	2%	60%	0%	0%	38%
	Water heating						
	New Buildings	0%	17%	0%	0%	0%	83%
	Existing Buildings	0%	0%	77%	0%	0%	23%
	Total	0%	2%	67%	0%	0%	31%
	Cooking	NA	NA	NA	NA	NA	NA

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4adv (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, advanced case

Fuel	*End-use*	Equip Standards 2010	Building Codes 2010	Voluntary Programs 2010	Utility Programs 2010	Tax Credits 2010	R&D Programs 2010
	Other Uses						
	Misc	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Cogen	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total gas	5%	2%	61%	0%	0%	32%
Distillate oil	Space heating						
	New Buildings	17%	10%	0%	0%	0%	73%
	Existing Buildings	7%	0%	69%	0%	0%	25%
	Total	9%	2%	53%	0%	0%	36%
	Water heating						
	New Buildings	0%	17%	0%	0%	0%	83%
	Existing Buildings	0%	0%	77%	0%	0%	23%
	Total	0%	2%	67%	0%	0%	31%
	Other Uses						
	Misc	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total oil	7%	2%	56%	0%	0%	35%
Renewables	Biomass	NA	NA	NA	NA	NA	NA
Other fuels	Coal + kerosene	NA	NA	NA	NA	NA	NA
Totals		28%	2%	49%	0%	0%	20%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4adv (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, advanced case

Fuel	*End-use*	Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
Electricity	Space heating						
	New Buildings	0%	13%	0%	0%	0%	87%
	Existing Buildings	0%	0%	44%	0%	0%	56%
	Total	0%	5%	27%	0%	0%	68%
	Space cooling						
	New Buildings	66%	3%	0%	0%	0%	31%
	Existing Buildings	29%	0%	36%	0%	0%	34%
	Total	48%	2%	17%	0%	0%	33%
	Water heating						
	New Buildings	0%	12%	0%	28%	0%	60%
	Existing Buildings	0%	0%	40%	19%	0%	41%
	Total	0%	5%	24%	22%	0%	48%
	Ventilation						
	New Buildings	0%	10%	0%	0%	0%	90%
	Existing Buildings	0%	0%	44%	0%	0%	56%
	Total	0%	4%	27%	0%	0%	69%
	Cooking	NA	NA	NA	NA	NA	NA
	Lighting						
	New Buildings	65%	8%	0%	0%	0%	28%
	Existing Buildings	46%	0%	35%	0%	0%	20%
	Total	53%	3%	21%	0%	0%	23%
	Refrigeration	0%	0%	100%	0%	0%	0%
	Office equip.-PCs	NA	NA	NA	NA	NA	NA
	Office equip.-other	NA	NA	NA	NA	NA	NA
	Other Uses						
	Miscellaneous	36%	0%	64%	0%	0%	0%
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total electric	40%	2%	29%	0%	0%	28%
Natural gas	Space heating						
	New Buildings	44%	5%	0%	0%	0%	51%
	Existing Buildings	30%	0%	31%	0%	0%	39%
	Total	36%	2%	17%	0%	0%	44%
	Space cooling						
	New Buildings	0%	11%	0%	0%	0%	89%
	Existing Buildings	0%	0%	49%	0%	0%	51%
	Total	0%	4%	31%	0%	0%	65%
	Water heating						
	New Buildings	0%	17%	0%	0%	0%	83%
	Existing Buildings	0%	0%	50%	0%	0%	50%
	Total	0%	6%	31%	0%	0%	62%
	Cooking	NA	NA	NA	NA	NA	NA

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.4adv (continued). Shares of U.S. commercial sector energy saving by end-use and policy type, advanced case

Fuel	*End-use*	Equip Standards 2020	Building Codes 2020	Voluntary Programs 2020	Utility Programs 2020	Tax Credits 2020	R&D Programs 2020
	Other Uses						
	Misc	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Cogen	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total gas	27%	3%	21%	0%	0%	49%
Distillate oil	Space heating						
	New Buildings	44%	5%	0%	0%	0%	51%
	Existing Buildings	30%	0%	31%	0%	0%	39%
	Total	36%	2%	19%	0%	0%	44%
	Water heating						
	New Buildings	0%	17%	0%	0%	0%	83%
	Existing Buildings	0%	0%	50%	0%	0%	50%
	Total	0%	6%	31%	0%	0%	62%
	Other Uses						
	Misc	NA	NA	NA	NA	NA	NA
	District Services	NA	NA	NA	NA	NA	NA
	Adjust to SEDS	NA	NA	NA	NA	NA	NA
	Total oil	31%	3%	20%	0%	0%	46%
Renewables	Biomass	NA	NA	NA	NA	NA	NA
Other fuels	Coal + kerosene	NA	NA	NA	NA	NA	NA
Totals		36%	3%	26%	0%	0%	35%

(1) End-use percentage savings are weighted by site energy to calculate totals.

Table D-1.5: Techno-Economic Potential Energy Savings for Existing Residential Building HVAC End-Uses
(Equipment replacements only - no shell retrofits)[1]

End-Use	Equipment type	Measure Efficiency[2]	Measure Energy Savings[3] (%)	Market Share of Measure in Techno-Economic Potential Case[4] (% of shipments of given equipment) 2010	2020	Market Share Notes	End-Use Weighting Factor[5] (fraction of annual replacements) 2010	2020	Potential Energy Savings in Techno-Economic Potential Case[6] (% of frozen efficiency consumption) 2010	2020
Electric Heating										
	Air Source Heat Pump	frozen effic. (7.17 HSPF)	0.0%	0%	0%	7				
		7.4 HSPF/12 SEER	3.1%	30%	30%	7				
		7.6 HSPF/13 SEER	5.6%	60%	60%	7				
		8.5 HSPF/15 SEER	15.6%	10%	10%	7				
		Total (all measures)	-	100%	100%		0.49	0.35	5.9%	5.9%
	Geothermal Heat Pump	frozen efficiency	0.0%	100%	100%	8				
		Total (all measures)	-	100%	100%		0.02	0.02	0%	0%
	Resistance	frozen efficiency	0.0%	74%	74%	9				
		switch to HP (7.4 HSPF)	53.9%	26%	26%	9				
		Total (all measures)	-	100%	100%		0.49	0.63	14.1%	14.1%
	End-Use Average						1.00	1.00	2.8%	2.0%
Electric Cooling										
	Central A/C	12 SEER	13.2%	35%	35%	10				
		13 SEER	19.8%	60%	60%	10				
		15 SEER	30.5%	5%	5%	10				
		Total (all measures)	-	100%	100%		0.61	0.54	18.0%	18.0%
	Air Source Heat Pump	12 SEER	9.2%	30%	30%	7				
		13 SEER	16.2%	60%	60%	7				
		15 SEER	27.4%	10%	10%	7				
		Total (all measures)	-	100%	100%		0.13	0.12	15.3%	15.3%
	Geothermal Heat Pump	frozen efficiency	0.0%	100%	100%	8				
		Total (all measures)	-	100%	100%		0.01	0.01	0.0%	0.0%

Table D-1.5: Techno-Economic Potential Energy Savings for Existing Residential Building HVAC End-Uses
(Equipment replacements only - no shell retrofits)[1]

End-Use	Equipment type	Measure Efficiency[2]	Measure Energy Savings[3] (%)	Market Share of Measure in Techno-Economic Potential Case[4] (% of shipments of given equipment) 2010	2020	Market Share Notes	End-Use Weighting Factor[5] (fraction of annual replacements) 2010	2020	Potential Energy Savings in Techno-Economic Potential Case[6] (% of frozen efficiency consumption) 2010	2020
Elec Cooling, cont	Room A/C	9.7 EER	5.9%	60%	0%	10				
		10.5 EER	13.0%	35%	75%	10				
		12 EER	23.9%	5%	20%	10				
		13 EER	29.8%	0%	5%	10				
		Total (all measures)	-	100%	100%		0.26	0.34	9.3%	16.1%
	End-Use Average						1.00	1.00	12.9%	11.5%
Gas Heating										
	Central Furnace	froz. effic. (81.7 AFUE)	0.0%	54%	30%	11				
		90 AFUE	9.2%	46%	70%	11				
		Total (all measures)	-	100%	100%		0.71	0.71	4.3%	6.4%
	Heat Pump (gas-fired)	frozen efficiency	0.0%	100%	100%	12				
		Total (all measures)	-	100%	100%		0.002	0.001	0.0%	0.0%
	Boiler	froz. effic. (80.0 AFUE)	0.0%	55%	20%	13				
		86 AFUE	7.0%	45%	60%	13				
		90 AFUE	11.1%	0%	20%	13				
		Total (all measures)	-	100%	100%		0.29	0.29	3.2%	6.4%
	End-Use Average						1.00	1.00	3.0%	4.6%
Oil Heating										
	Central Furnace	froz. effic. (81.9 AFUE)	0.0%	40%	25%	14				
		90 AFUE	9.0%	60%	75%	14				
		Total (all measures)	-	100%	100%	14	0.43	0.50	5.4%	6.8%
	Boiler	froz. effic. (80.4 AFUE)	0.0%	56%	20%	15				
		86 AFUE	6.5%	44%	60%	15				
		90 AFUE	10.6%	0%	20%	15				
		Total (all measures)	-	100%	100%		0.57	0.50	2.9%	6.0%
	End-Use Average						1.00	1.00	2.3%	3.4%

Table D-1.5: Techno-Economic Potential Energy Savings for Existing Residential Building HVAC End-Uses
(Equipment replacements only - no shell retrofits)[1]

End-Use	Equipment type	Measure Efficiency[2]	Measure Energy Savings[3] (%)	Market Share of Measure in Techno-Economic Potential Case[4] (% of shipments of given equipment) 2010	2020	Market Share Notes	End-Use Weighting Factor[5] (fraction of annual replacements) 2010	2020	Potential Energy Savings in Techno-Economic Potential Case[6] (% of frozen efficiency consumption) 2010	2020
LPG Heating										
	Central Furnace	froz. effic. (82.2 AFUE)	0.0%	54%	30%	16				
		90 AFUE	9.5%	46%	70%	16				
		Total (all measures)	-	100%	100%		1.00	1.00	4.4%	6.6%
	End-Use Average						1.00	1.00	0.0%	0.0%

Notes

1 The techno-economic potential energy savings in this table are only for HVAC equipment replacements in homes built before 2000. We did not evaluate energy savings due to residential building shell retrofits in this study.

2 Efficiency of unit bought to replace an existing retired unit. Measure efficiency levels in this table are used to determine overall energy savings possible in the techno-economic case.

3 Energy savings for a replacement of given efficiency, as a percent of the "frozen efficiency" consumption for the given equipment type. The frozen efficiency consumption is the average annual energy consumption of a new unit bought in 2000 to replace a retired unit in an existing home (a home built before 2000), from an output file of the CEF-NEMS model. Percent energy savings in this table are estimates based on the ratio of equipment efficiencies for the frozen efficiency unit and the measure (see Appendix C-1 for more details).

4 LBNL estimate of the percent of all replacements in 2010 or 2020 that are cost-effective at the given efficiency level, in the techno-economic potential case. For example, in 2020, we estimate that it would be cost-effective to replace 30% of all the retiring air source heat pumps with a 7.4 HSPF heat pump (which is the new NAECA standard efficiency as of 2006), 60% of replacements would be cost-effective at 7.6 HSPF, and the remaining 10% would be cost-effective at 8.5 HSPF.

5 Equipment Type Weighting Factor is the number of equipment replacements of given equipment type, in 2010 or 2020, as a fraction of all equipment replacements for that end-use in 2010 or 2020. For example, in 2020, 63% of all electric heating equipment replacements were replacements of electric resistance heating equipment. It is used to weight the average energy savings for each equipment type in order to calculate the average techno-economic potential energy savings for each end-use. The equipment replacements in each year were calculated using the method described in the "Introduction to the Residential HVAC Tables" text preceding Table C-1.1.mod.

6 Techno-economic potential energy savings is shown by equipment type and by end-use (averaged over all equipment types for the end-use). The energy savings potential by equipment type is an average of the energy savings for the different equipment efficiency levels (described in note 2), weighted by the estimated market share of each in the techno-economic potential case (described in note 3). The "End-use Average" energy savings potential is the average of the energy savings by equipment type, weighted by the end-use weighting factor for each equipment type (the weighting factor is based on the replacments in each year - see note 5 for more details).
The techno-economic potential energy savings is relative to the average consumption of a new unit of frozen efficiency in 2000 in an existing home (from an output file of the CEF-NEMS model).

7 Assumptions for electric air source heat pumps are LBNL estimates.

8 We did not evaluate the technical potential for geothermal heat pump improvements, so we assumed 0% improvement over frozen efficiency in the techno-economic potential case.

9 Electric resistance heated homes were divided into those with CAC and those without CAC. For homes with CAC, we assumed that a fraction of the homes could be cost-effectively switched to an electric air source heat pump. We assumed they would switch to a heat pump of efficiency equal to the minimum efficiency allowed by the 2006 NAECA standard (7.4 HSPF/12 SEER). Measure market share in 2010 and 2020 is based on the assumption that 80% of single-family and manufactured homes in the South and 20% in the North could cost-effectively switch; of multifamily homes, we assume that 30% in the South and 5% in the North could cost-effectively switch to a standard heat pump.
Homes not switched to a heat pump are replaced with the same equipment as they had before (i.e., an electric resistance unit of baseline efficiency 100% AFUE).
For electric resistance heated homes that do not have CAC, we assumed that it would not be cost-effective to switch to a heat pump and that there is no energy savings potential.

10 Assumptions for central and room air conditioners are LBNL estimates.

11 In 2010, we assume that some of the gas furnace replacements can be cost-effectively upgraded to the EPA ENERGY STAR level (90 AFUE). The measure market share is based on the assumption that the upgrade is cost-effective in 75% of Northern and 10% of Southern single-family and manufactured homes, and in 54% of Northern and 22% of Southern

Table D-1.5 Notes, continued

multifamily buildings. The rest of the equipment is replaced with a frozen efficiency unit (average efficiency of a unit bought in 2000 to replace retired equipment - 81.7 AFUE from an output file of the CEF-NEMS reference case). In 2020, we assume that the cost of condensing gas furnaces has decreased significantly, making the technology cost-effective in more applications.

12 We did not evaluate the technical potential for gas-fired heat pump improvements, so we assumed 0% improvement over frozen efficiency in the techno-economic potential case.

13 In 2010, we assume that some of the gas boiler replacements can be cost-effectively upgraded to the EPA ENERGY STAR level (86 AFUE). The measure market share is based on the assumption that the upgrade is cost-effective in 40% of Northern and 10% of Southern single family and manufactured homes, and in 54% of Northern and 22% of Southern multifamily buildings. The rest of the equipment is replaced with a frozen efficiency unit (average efficiency of a unit bought in 2000 to replace retired equipment - 80.0 AFUE from an output file of the CEF-NEMS reference case). In 2020, we assume that the cost of ENERGY STAR gas boilers and condensing gas boilers (90 AFUE) have decreased significantly, making these technologies more cost-effective.

14 Oil furnace measure efficiencies and measure market shares are based on the same assumptions as gas furnaces (see Note 11). The measure market shares are different for oil furnaces because the fraction of existing homes with oil furnaces is distributed differently by house type and region. The measure energy savings is different for oil furnaces because the frozen efficiency of an oil furnace is not the same as a gas furnace (oil furnace frozen efficiency is 81.9 AFUE, from an output file of the CEF-NEMS reference case).

15 Oil boiler measure efficiencies and measure market shares are based on the same assumptions as gas boilers (see Note 13). The measure market shares are different for oil furnaces because the fraction of existing homes with oil boilers is distributed differently by house type and region. The measure energy savings is different for oil boilers because the frozen efficiency of an oil boiler is not the same as a gas boiler (oil boiler frozen efficiency is 80.4 AFUE, from an output file of the CEF-NEMS reference case).

16 LPG furnace measure efficiencies and market shares are assumed to be the same as for gas furnaces (see Note 11). The measure energy savings is different for a LPG furnace because the frozen efficiency is different (LPG furnace is 82.2 AFUE, from an output file of the CEF-NEMS reference case).

Table D-1.6: Techno-Economic Potential Energy Savings for New Residential Buildings

			Annual Market Share by House type and Efficiency Level[1]												
End-Use	House Type	Efficiency Level[2]	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020
Electric Heating															
	SF	20%	10%	9%	8%	7%	6%	5%	4%	3%	2%	1%	0%	0%	0%
		30%	15%	14%	13%	12%	11%	10%	9%	8%	7%	6%	5%	5%	5%
		40%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	35%	25%
		50%	30%	32%	34%	36%	38%	40%	42%	44%	46%	48%	50%	60%	70%
	MH	20%	30%	29%	28%	27%	26%	25%	24%	23%	22%	21%	20%	10%	0%
		30%	45%	45%	44%	44%	43%	43%	42%	42%	41%	41%	40%	30%	20%
		40%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	30%	40%
		50%	5%	7%	8%	10%	11%	13%	14%	16%	17%	19%	20%	30%	40%
	MF	20%	60%	59%	58%	57%	56%	55%	54%	53%	52%	51%	50%	40%	30%
		30%	35%	36%	36%	37%	37%	38%	38%	39%	39%	40%	40%	43%	45%
		50%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%	10%	18%	25%
Electric Cooling															
	SF	20%	20%	19%	18%	17%	16%	15%	14%	13%	12%	11%	10%	5%	0%
		40%	30%	29%	28%	27%	26%	25%	24%	23%	22%	21%	20%	10%	0%
		50%	30%	31%	31%	32%	32%	33%	33%	34%	34%	35%	35%	33%	30%
		60%	20%	22%	23%	25%	26%	28%	29%	31%	32%	34%	35%	53%	70%
	MH	20%	45%	44%	42%	41%	39%	38%	36%	35%	33%	32%	30%	15%	0%
		40%	45%	45%	44%	44%	43%	43%	42%	42%	41%	41%	40%	30%	20%
		50%	5%	7%	8%	10%	11%	13%	14%	16%	17%	19%	20%	30%	40%
		60%	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	25%	40%
	MF	20%	75%	73%	70%	68%	65%	63%	60%	58%	55%	53%	50%	40%	30%
		30%	20%	22%	24%	26%	28%	30%	32%	34%	36%	38%	40%	43%	45%
		50%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%	10%	18%	25%
Gas, LPG, or Oil Heating															
	SF	20%	35%	34%	33%	32%	31%	30%	29%	28%	27%	26%	25%	13%	0%
		30%	45%	44%	43%	42%	41%	40%	39%	38%	37%	36%	35%	23%	10%
		40%	15%	17%	18%	20%	21%	23%	24%	26%	27%	29%	30%	45%	60%
		50%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%	10%	20%	30%
	MH	20%	40%	39%	38%	37%	36%	35%	34%	33%	32%	31%	30%	15%	0%
		30%	45%	45%	44%	44%	43%	43%	42%	42%	41%	41%	40%	30%	20%
		40%	15%	16%	16%	17%	17%	18%	18%	19%	19%	20%	20%	30%	40%
		50%	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	25%	40%
	MF	20%	60%	59%	58%	57%	56%	55%	54%	53%	52%	51%	50%	40%	30%
		30%	35%	36%	36%	37%	37%	38%	38%	39%	39%	40%	40%	43%	45%
		50%	5%	6%	6%	7%	7%	8%	8%	9%	9%	10%	10%	18%	25%
			Techno-Economic Potential Energy Savings[3] (% of baseline in 2000)												
Electric Heating	all	all	33.5%	33.8%	34.1%	34.5%	34.8%	34.9%	35.2%	35.4%	35.7%	35.9%	36.3%	39.4%	41.7%
Electric Cooling	all	all	36.4%	36.8%	37.3%	37.8%	38.4%	38.9%	39.4%	39.8%	40.2%	40.6%	41.1%	45.8%	50.5%
Gas or LPG Heating	all	all	28.1%	28.5%	28.8%	29.1%	29.4%	29.7%	30.0%	30.3%	30.6%	30.8%	31.2%	35.6%	40.1%
Oil Heating	all	all	28.6%	28.9%	29.2%	29.5%	29.9%	30.2%	30.5%	30.8%	31.1%	31.5%	31.8%	36.5%	41.3%

SF = Single-family, MH = Manufactured Housing, MF = Multifamily

Table D-1.6 Notes

[1] LBNL estimates of cost-effective energy savings by house type, in the techno-economic potential case. The table presents the market share of new homes in each year that could be cost-effectively built to each of several energy efficiency levels. For heating in single-family and manufactured housing, the energy efficiency levels considered are 20%, 30%, 40%, and 50% better than average construction in 2000. For heating in multifamily homes, we consider three energy efficiency levels: 20%, 30%, and 50% better than average construction of multifamily homes in 2000. Cooling efficiency levels considered for single-family and manufactured homes are 20%, 40%, 50%, and 60%; and for multifamily homes: 20%, 30%, and 50%. The efficiency levels and market shares for heating and cooling are assumed to be completely independent. For example, houses with 50% cooling savings potential do not necessarily have a 50% heating savings potential.

[2]Cost-effective energy efficiency levels in the techno-economic potential case. The efficiency levels are expressed as percent savings relative to the average consumption of homes built in 2000, from the CEF-NEMS 1999 reference case forecast.

[3]Average annual energy savings potential per house in the techno-economic potential case, expressed as a percent of the average consumption of homes built in 2000 (from the CEF-NEMS 1999 reference case). This is the average savings potential for all house types (single-family, multifamily, and manufactured homes). It was calculated from the market shares and efficiency levels shown in this table, which were weighted by the annual housing starts for each house type (from the CEF-NEMS model). The techno-economic potential is larger in 2020 than in 2010 because of assumptions about increased availability and decreased cost of higher-efficiency equipment, and improvements in average building practices. Oil heating techno-economic potential forecast is different than gas/LPG forecast, even though they have the same market share forecast, because the number of oil-heated starts of each house type differs from the number of gas or LPG heated starts of each house type.

Table D-1.7: Residential Sector Forecast Summary (Quadrillion Btu)

CEF-NEMS Business As Usual (990811)

demand side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.44	0.45	0.47	0.47	0.49	0.52
Space Cooling	0.46	0.50	0.52	0.55	0.58	0.60
Water Heating	0.35	0.36	0.37	0.37	0.39	0.40
Refrigeration	0.39	0.37	0.32	0.29	0.27	0.28
Cooking	0.13	0.14	0.14	0.15	0.16	0.17
Clothes Dryers	0.19	0.20	0.21	0.22	0.24	0.25
Freezers	0.12	0.11	0.08	0.07	0.07	0.07
Lighting	0.34	0.36	0.38	0.40	0.43	0.46
Clothes Washers	0.03	0.03	0.03	0.03	0.04	0.04
Dishwashers	0.05	0.05	0.05	0.05	0.06	0.06
Color Televisions	0.21	0.25	0.29	0.30	0.31	0.33
Personal Computers	0.02	0.02	0.03	0.04	0.04	0.05
Furnace Fans	0.09	0.10	0.11	0.12	0.13	0.14
Other Uses	0.83	1.08	1.32	1.52	1.73	1.91
Total Site Electricity	3.65	4.02	4.32	4.58	4.94	5.28
Natural Gas						
Space Heating	3.58	3.61	3.67	3.81	3.99	4.11
Space Cooling	0.00	0.00	0.00	0.00	0.00	0.01
Water Heating	1.27	1.29	1.32	1.38	1.46	1.51
Cooking	0.16	0.16	0.17	0.17	0.18	0.19
Clothes Dryers	0.05	0.05	0.05	0.06	0.06	0.06
Other Uses	0.09	0.10	0.10	0.11	0.11	0.12
Total Natural Gas	5.15	5.21	5.31	5.53	5.80	6.00
Distillate						
Space Heating	0.84	0.77	0.69	0.64	0.60	0.56
Water Heating	0.10	0.09	0.09	0.09	0.09	0.09
Other Uses	0.00	0.00	0.00	0.00	0.00	0.00
Total Distillate	0.94	0.86	0.78	0.73	0.69	0.65
LPG						
Space Heating	0.32	0.32	0.32	0.31	0.30	0.28
Water Heating	0.07	0.08	0.08	0.08	0.08	0.07
Cooking	0.03	0.03	0.03	0.03	0.03	0.03
Other Uses	0.01	0.01	0.01	0.01	0.01	0.01
Total LPG	0.43	0.44	0.44	0.43	0.42	0.39
Renewable (1)						
Biomass	0.6	0.6	0.61	0.62	0.64	0.65
Other Fuels						
Other Uses	0.15	0.13	0.13	0.12	0.12	0.12
Total Site Electricity	3.65	4.02	4.32	4.58	4.94	5.28
Total Fuels	7.27	7.24	7.27	7.43	7.67	7.81
Total Site Energy	10.92	11.26	11.59	12.01	12.61	13.09
Electricity Related Losses	8.07	8.76	8.93	9.17	9.62	10.11
Total Primary Energy	18.99	20.02	20.52	21.18	22.23	23.20
Average Heatrate (kWh.primary/kWh.site)	3.21	3.18	3.07	3.00	2.95	2.91

(1) Non-marketed renewables are not included.

Table D-1.8: Commercial Sector Forecast Summary (Quadrillion Btu)

CEF-NEMS Business As Usual (990811)

demand side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.13	0.13	0.13	0.12	0.12	0.12
Space Cooling	0.34	0.35	0.35	0.36	0.36	0.36
Water Heating	0.07	0.07	0.07	0.07	0.06	0.06
Ventilation	0.17	0.17	0.18	0.18	0.19	0.19
Cooking	0.02	0.02	0.02	0.02	0.02	0.02
Lighting	1.22	1.25	1.26	1.29	1.32	1.33
Refrigeration	0.18	0.19	0.19	0.20	0.21	0.21
Office Equipment (PC)	0.12	0.14	0.18	0.20	0.22	0.24
Office Equipment (Non-PC)	0.29	0.32	0.37	0.42	0.48	0.53
Other Uses	0.91	1.05	1.23	1.41	1.58	1.70
Total Site Electricity	3.45	3.69	3.98	4.27	4.56	4.76
Natural Gas						
Space Heating	1.31	1.31	1.34	1.38	1.42	1.42
Space Cooling	0.01	0.02	0.02	0.03	0.03	0.03
Water Heating	0.62	0.64	0.66	0.69	0.72	0.73
Cooking	0.23	0.25	0.26	0.28	0.30	0.30
Other Uses	1.20	1.33	1.40	1.47	1.53	1.55
Total Natural Gas	3.37	3.55	3.68	3.85	4.00	4.03
Distillate						
Space Heating	0.21	0.23	0.22	0.20	0.19	0.18
Water Heating	0.05	0.05	0.05	0.05	0.04	0.04
Other Uses	0.23	0.10	0.09	0.09	0.10	0.09
Total Distillate	0.49	0.38	0.36	0.34	0.33	0.31
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	0.32	0.30	0.31	0.32	0.33	0.33
Total Electricity	3.45	3.69	3.98	4.27	4.56	4.76
Total Fuels	4.18	4.23	4.35	4.51	4.66	4.67
Total Site Energy	7.63	7.92	8.33	8.78	9.22	9.43
Electricity Related Losses	7.59	8.06	8.23	8.55	8.89	9.07
Total Primary Energy	15.22	15.98	16.56	17.33	18.11	18.50
Average Heatrate (kWh.primary/kWh.site)	3.20	3.18	3.07	3.00	2.95	2.91

Table D-1.9: Residential Sector Forecast Summary (MtC)

CEF-NEMS Business As Usual (990811)

demand side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	22.0	23.1	23.4	23.2	23.8	25.1
Space Cooling	23.0	25.7	25.9	27.1	28.2	28.9
Water Heating	17.5	18.5	18.4	18.2	19.0	19.3
Refrigeration	19.5	19.0	15.9	14.3	13.1	13.5
Cooking	6.5	7.2	7.0	7.4	7.8	8.2
Clothes Dryers	9.5	10.3	10.5	10.8	11.7	12.1
Freezers	6.0	5.7	4.0	3.4	3.4	3.4
Lighting	17.0	18.5	18.9	19.7	20.9	22.2
Clothes Wahers	1.5	1.5	1.5	1.5	1.9	1.9
Dishwashers	2.5	2.6	2.5	2.5	2.9	2.9
Color Televisions	10.5	12.9	14.4	14.8	15.1	15.9
Personal Computers	1.0	1.0	1.5	2.0	1.9	2.4
Furnace Fans	4.5	5.1	5.5	5.9	6.3	6.7
Other Uses	41.5	55.6	65.7	74.9	84.1	92.1
Total Electricity	182.3	206.8	215.0	225.7	240.1	254.5
Natural Gas						
Space Heating	51.5	52.0	52.9	54.9	57.5	59.1
Space Cooling	0.0	0.0	0.0	0.0	0.0	0.1
Water Heating	18.3	18.6	19.0	19.9	21.0	21.7
Cooking	2.3	2.3	2.4	2.5	2.6	2.7
Clothes Dryers	0.7	0.7	0.7	0.9	0.9	0.9
Other Uses	1.3	1.4	1.4	1.6	1.6	1.7
Total Natural Gas	74.1	75.0	76.5	79.7	83.6	86.3
Distillate						
Space Heating	17.9	16.2	14.5	13.4	12.6	12.0
Water Heating	2.1	1.9	1.9	1.9	1.9	1.9
Other Uses	0.0	0.0	0.0	0.0	0.0	0.0
Total Distillate	20.0	18.1	16.4	15.3	14.5	13.9
LPG						
Space Heating	5.8	5.7	5.7	5.5	5.4	5.1
Water Heating	1.3	1.4	1.4	1.4	1.4	1.3
Cooking	0.5	0.5	0.5	0.5	0.5	0.5
Other Uses	0.2	0.2	0.2	0.2	0.2	0.2
Total LPG	7.8	7.9	7.9	7.7	7.5	7.1
Renewable (1)						
Biomass	0.0	0.0	0.0	0.0	0.0	0.0
Other Fuels						
Other Uses	1.4	1.5	1.4	1.3	1.3	1.3
Total Carbon Emissions	285.6	309.3	317.2	329.7	347.0	363.1

(1) Non-marketed renewables are not included.

Table D-1.10: Commercial Sector Forecast Summary (MtC)

CEF-NEMS Business As Usual (990811)

demand side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Base*	*Base*	*Base*	*Base*	*Base*	*Base*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	6.46	6.70	6.47	5.91	5.84	5.76
Space Cooling	16.90	18.04	17.43	17.74	17.52	17.27
Water Heating	3.48	3.61	3.49	3.45	2.92	2.88
Ventilation	8.45	8.76	8.96	8.87	9.25	9.12
Cooking	0.99	1.03	1.00	0.99	0.97	0.96
Lighting	60.65	64.43	62.75	63.56	64.23	63.82
Refrigeration	8.95	9.79	9.46	9.85	10.22	10.08
Office Equipment (PC)	5.97	7.22	8.96	9.85	10.71	11.52
Office Equipment (Non-PC)	14.42	16.49	18.43	20.70	23.36	25.43
Other Uses	45.24	54.12	61.25	69.48	76.89	81.57
Total Electricity	171.50	190.20	198.20	210.40	221.90	228.40
Natural Gas						
Space Heating	18.89	18.86	19.34	19.86	20.41	20.44
Space Cooling	0.14	0.29	0.29	0.43	0.43	0.43
Water Heating	8.94	9.21	9.52	9.93	10.35	10.51
Cooking	3.32	3.60	3.75	4.03	4.31	4.32
Other Uses	17.31	19.14	20.20	21.15	21.99	22.31
Total Natural Gas	48.60	51.10	53.10	55.40	57.50	58.00
Distillate						
Space Heating	6.17	7.02	6.91	6.53	6.33	6.15
Water Heating	1.47	1.53	1.57	1.63	1.33	1.37
Other Uses	6.76	3.05	2.83	2.94	3.33	3.08
Total Distillate	14.40	11.60	11.30	11.10	11.00	10.60
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	2.10	2.30	2.40	2.50	2.60	2.60
Total Carbon emissions	236.60	255.20	265.00	279.40	293.00	299.60

Table D-1.11: Residential Sector Forecast Summary (Quadrillion Btu)

CEF-NEMS Moderate Scenario (991213)

demand side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.44	0.45	0.47	0.48	0.49	0.51
Space Cooling	0.46	0.50	0.52	0.52	0.50	0.50
Water Heating	0.35	0.36	0.35	0.34	0.34	0.33
Refrigeration	0.39	0.36	0.31	0.27	0.25	0.24
Cooking	0.13	0.14	0.14	0.15	0.16	0.17
Clothes Dryers	0.19	0.20	0.21	0.22	0.23	0.25
Freezers	0.12	0.11	0.08	0.07	0.07	0.07
Lighting	0.34	0.36	0.37	0.38	0.39	0.39
Clothes Washers	0.03	0.03	0.03	0.03	0.03	0.03
Dishwashers	0.05	0.05	0.05	0.05	0.06	0.06
Color Televisions	0.21	0.25	0.28	0.27	0.27	0.29
Personal Computers	0.02	0.02	0.03	0.04	0.04	0.05
Furnace Fans	0.09	0.10	0.11	0.12	0.13	0.13
Other Uses	0.83	1.08	1.26	1.33	1.38	1.41
Total Site Electricity	3.65	4.01	4.21	4.27	4.34	4.43
Natural Gas						
Space Heating	3.58	3.61	3.69	3.83	4.00	4.13
Space Cooling	0.00	0.00	0.00	0.00	0.00	0.01
Water Heating	1.27	1.29	1.30	1.33	1.38	1.39
Cooking	0.16	0.16	0.17	0.17	0.18	0.19
Clothes Dryers	0.05	0.05	0.05	0.06	0.06	0.06
Other Uses	0.09	0.10	0.10	0.11	0.11	0.12
Total Natural Gas	5.15	5.21	5.31	5.50	5.73	5.90
Distillate						
Space Heating	0.84	0.77	0.69	0.64	0.61	0.57
Water Heating	0.10	0.09	0.09	0.09	0.09	0.09
Other Uses	0.00	0.00	0.00	0.00	0.00	0.00
Total Distillate	0.94	0.86	0.78	0.73	0.70	0.66
LPG						
Space Heating	0.32	0.32	0.32	0.31	0.29	0.28
Water Heating	0.07	0.08	0.08	0.08	0.08	0.07
Cooking	0.03	0.03	0.03	0.03	0.03	0.03
Other Uses	0.01	0.01	0.01	0.01	0.01	0.01
Total LPG	0.43	0.44	0.44	0.43	0.41	0.39
Renewable (1)						
Biomass	0.6	0.6	0.61	0.62	0.64	0.65
Other Fuels						
Other Uses	0.15	0.13	0.12	0.12	0.12	0.12
Total Site Electricity	3.65	4.01	4.21	4.27	4.34	4.43
Total Fuels	7.27	7.24	7.26	7.40	7.60	7.72
Total Site Energy	10.92	11.25	11.47	11.67	11.94	12.15
Electricity Related Losses	8.07	8.75	8.79	8.75	8.85	8.96
Total Primary Energy	18.99	20.00	20.26	20.42	20.79	21.11
Average Heatrate (kWh.primary/kWh.site)	3.21	3.18	3.09	3.05	3.04	3.02

(1) Non-marketed renewables are not included.

Table D-1.12: Commercial Sector Forecast Summary (Quadrillion Btu)

CEF-NEMS Moderate Scenario (991213)

demand side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.13	0.13	0.13	0.13	0.12	0.12
Space Cooling	0.34	0.35	0.33	0.31	0.30	0.29
Water Heating	0.07	0.07	0.07	0.06	0.06	0.05
Ventilation	0.17	0.17	0.17	0.17	0.17	0.17
Cooking	0.02	0.02	0.02	0.02	0.02	0.02
Lighting	1.22	1.25	1.20	1.22	1.20	1.17
Refrigeration	0.18	0.19	0.19	0.20	0.20	0.20
Office Equipment (PC)	0.12	0.14	0.16	0.21	0.23	0.25
Office Equipment (Non-PC)	0.29	0.32	0.36	0.42	0.51	0.53
Other Uses	0.91	1.05	1.17	1.28	1.30	1.35
Total Site Electricity	3.45	3.69	3.80	4.02	4.11	4.15
Natural Gas						
Space Heating	1.31	1.31	1.29	1.31	1.33	1.32
Space Cooling	0.01	0.02	0.03	0.03	0.04	0.04
Water Heating	0.62	0.64	0.64	0.66	0.68	0.69
Cooking	0.23	0.25	0.27	0.29	0.30	0.31
Other Uses	1.20	1.33	1.40	1.46	1.48	1.46
Total Natural Gas	3.37	3.55	3.63	3.75	3.83	3.82
Distillate						
Space Heating	0.21	0.23	0.22	0.22	0.21	0.20
Water Heating	0.05	0.05	0.05	0.05	0.05	0.04
Other Uses	0.23	0.10	0.09	0.09	0.10	0.10
Total Distillate	0.49	0.38	0.36	0.36	0.36	0.34
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	0.32	0.30	0.31	0.32	0.33	0.33
Total Electricity	3.45	3.69	3.80	4.02	4.11	4.15
Total Fuels	4.18	4.23	4.30	4.43	4.52	4.49
Total Site Energy	7.63	7.92	8.10	8.45	8.63	8.64
Electricity Related Losses	7.59	8.05	7.90	8.22	8.40	8.39
Total Primary Energy	15.22	15.97	16.00	16.67	17.03	17.03
Average Heatrate (kWh.primary/kWh.site)	3.20	3.18	3.08	3.04	3.04	3.02

Table D-1.13: Residential Sector Forecast Summary (MtC)

CEF-NEMS Moderate Scenario (991213)

demand side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	22.0	23.1	23.0	23.3	23.8	24.9
Space Cooling	23.0	25.7	25.4	25.2	24.3	24.4
Water Heating	17.5	18.5	17.1	16.5	16.5	16.1
Refrigeration	19.5	18.5	15.2	13.1	12.1	11.7
Cooking	6.5	7.2	6.8	7.3	7.8	8.3
Clothes Dryers	9.5	10.3	10.3	10.7	11.2	12.2
Freezers	6.0	5.7	3.9	3.4	3.4	3.4
Lighting	17.0	18.5	18.1	18.4	18.9	19.0
Clothes Wahers	1.5	1.5	1.5	1.5	1.5	1.5
Dishwashers	2.5	2.6	2.4	2.4	2.9	2.9
Color Televisions	10.5	12.8	13.7	13.1	13.1	14.2
Personal Computers	1.0	1.0	1.5	1.9	1.9	2.4
Furnace Fans	4.5	5.1	5.4	5.8	6.3	6.3
Other Uses	41.5	55.5	61.6	64.5	67.0	68.8
Total Electricity	182.3	206.1	205.9	207.2	210.6	216.2
Natural Gas						
Space Heating	51.5	52.0	53.2	55.2	57.7	59.5
Space Cooling	0.0	0.0	0.0	0.0	0.0	0.1
Water Heating	18.3	18.6	18.7	19.2	19.9	20.0
Cooking	2.3	2.3	2.4	2.4	2.6	2.7
Clothes Dryers	0.7	0.7	0.7	0.9	0.9	0.9
Other Uses	1.3	1.4	1.4	1.6	1.6	1.7
Total Natural Gas	74.1	75.0	76.5	79.2	82.7	85.0
Distillate						
Space Heating	17.9	16.2	14.5	13.5	12.9	12.1
Water Heating	2.1	1.9	1.9	1.9	1.9	1.9
Other Uses	0.0	0.0	0.0	0.0	0.0	0.0
Total Distillate	20.0	18.1	16.4	15.4	14.8	14.0
LPG						
Space Heating	5.8	5.7	5.7	5.6	5.2	5.0
Water Heating	1.3	1.4	1.4	1.4	1.4	1.3
Cooking	0.5	0.5	0.5	0.5	0.5	0.5
Other Uses	0.2	0.2	0.2	0.2	0.2	0.2
Total LPG	7.8	7.9	7.8	7.7	7.3	7.0
Renewable (1)						
Biomass	0.0	0.0	0.0	0.0	0.0	0.0
Other Fuels						
Other Uses	1.4	1.5	1.4	1.3	1.3	1.3
Total Carbon Emissions	285.6	308.6	308.0	310.8	316.7	323.5

(1) Non-marketed renewables are not included.

Table D-1.14: Commercial Sector Forecast Summary (MtC)

CEF-NEMS Moderate Scenario (991213)

demand side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
carbon charge ($/t)	*0*	*0*	*0*	*0*	*0*	*0*
supply side efficiency	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*	*Mod*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	6.46	6.68	6.33	6.29	5.84	5.85
Space Cooling	16.90	17.99	16.07	15.01	14.59	14.14
Water Heating	3.48	3.60	3.41	2.90	2.92	2.44
Ventilation	8.45	8.74	8.28	8.23	8.27	8.29
Cooking	0.99	1.03	0.97	0.97	0.97	0.98
Lighting	60.65	64.26	58.45	59.06	58.36	57.06
Refrigeration	8.95	9.77	9.26	9.68	9.73	9.75
Office Equipment (PC)	5.97	7.20	7.79	10.17	11.19	12.19
Office Equipment (Non-PC)	14.42	16.45	17.54	20.33	24.81	25.85
Other Uses	45.24	53.98	56.99	61.96	63.23	65.84
Total Electricity	171.50	189.70	185.10	194.60	199.90	202.40
Natural Gas						
Space Heating	18.89	18.86	18.51	18.90	19.13	19.01
Space Cooling	0.14	0.29	0.43	0.43	0.58	0.58
Water Heating	8.94	9.21	9.19	9.52	9.78	9.93
Cooking	3.32	3.60	3.88	4.18	4.32	4.46
Other Uses	17.31	19.14	20.09	21.06	21.29	21.02
Total Natural Gas	48.60	51.10	52.10	54.10	55.10	55.00
Distillate						
Space Heating	6.17	7.08	7.03	7.03	6.65	6.53
Water Heating	1.47	1.54	1.60	1.60	1.58	1.31
Other Uses	6.76	3.08	2.88	2.88	3.17	3.26
Total Distillate	14.40	11.70	11.50	11.50	11.40	11.10
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	2.10	2.30	2.40	2.50	2.60	2.60
Total Carbon emissions	236.60	254.80	251.10	262.70	269.00	271.10

Table D-1.15: Residential Sector Forecast Summary (Quadrillion Btu)

CEF_NEMS Advanced Scenario (991213)

demand side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
carbon charge ($/t)	*0*	*0*	*50*	*50*	*50*	*50*
supply side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.44	0.45	0.46	0.46	0.46	0.47
Space Cooling	0.46	0.50	0.49	0.47	0.45	0.45
Water Heating	0.35	0.36	0.35	0.34	0.33	0.31
Refrigeration	0.39	0.37	0.31	0.27	0.24	0.22
Cooking	0.13	0.14	0.14	0.15	0.16	0.18
Clothes Dryers	0.19	0.20	0.20	0.21	0.23	0.24
Freezers	0.12	0.11	0.08	0.07	0.07	0.07
Lighting	0.34	0.36	0.35	0.35	0.31	0.27
Clothes Washers	0.03	0.03	0.03	0.03	0.02	0.02
Dishwashers	0.05	0.05	0.05	0.05	0.05	0.06
Color Televisions	0.21	0.25	0.27	0.27	0.26	0.27
Personal Computers	0.02	0.02	0.03	0.04	0.04	0.05
Furnace Fans	0.09	0.10	0.10	0.11	0.11	0.11
Other Uses	0.83	1.08	1.21	1.28	1.25	1.18
Total Site Electricity	3.65	4.02	4.07	4.10	3.98	3.90
Natural Gas						
Space Heating	3.58	3.61	3.54	3.64	3.76	3.83
Space Cooling	0.00	0.00	0.00	0.00	0.00	0.01
Water Heating	1.27	1.29	1.25	1.29	1.33	1.34
Cooking	0.16	0.16	0.17	0.17	0.18	0.19
Clothes Dryers	0.05	0.05	0.05	0.05	0.06	0.06
Other Uses	0.09	0.10	0.10	0.10	0.11	0.12
Total Natural Gas	5.15	5.21	5.11	5.25	5.44	5.55
Distillate						
Space Heating	0.84	0.77	0.67	0.61	0.57	0.53
Water Heating	0.10	0.09	0.09	0.09	0.09	0.08
Other Uses	0.00	0.00	0.00	0.00	0.00	0.00
Total Distillate	0.94	0.86	0.76	0.70	0.66	0.61
LPG						
Space Heating	0.32	0.32	0.31	0.30	0.28	0.27
Water Heating	0.07	0.08	0.08	0.07	0.07	0.07
Cooking	0.03	0.03	0.03	0.03	0.03	0.03
Other Uses	0.01	0.01	0.01	0.01	0.01	0.01
Total LPG	0.43	0.44	0.43	0.41	0.39	0.38
Renewable (1)						
Biomass	0.6	0.6	0.61	0.62	0.64	0.65
Other Fuels						
Other Uses	0.15	0.13	0.12	0.12	0.11	0.11
Total Site Electricity	3.65	4.02	4.07	4.10	3.98	3.90
Total Fuels	7.27	7.24	7.03	7.10	7.24	7.30
Total Site Energy	10.92	11.26	11.10	11.20	11.22	11.20
Electricity Related Losses	8.07	8.60	7.99	8.04	7.69	7.14
Total Primary Energy	18.99	19.86	19.09	19.24	18.91	18.34
Average Heatrate (kWh.primary/kWh.site)	3.21	3.14	2.96	2.96	2.93	2.83

(1) Non-marketed renewables are not included.

Table D-1.16: Commercial Sector Forecast Summary (Quadrillion Btu)

CEF_NEMS Advanced Scenario (991213)

demand side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
carbon charge ($/t)	*0*	*0*	*50*	*50*	*50*	*50*
supply side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Site Electricity						
Space Heating	0.13	0.13	0.11	0.10	0.09	0.08
Space Cooling	0.34	0.35	0.32	0.30	0.29	0.28
Water Heating	0.07	0.07	0.07	0.06	0.06	0.05
Ventilation	0.17	0.17	0.16	0.16	0.16	0.16
Cooking	0.02	0.02	0.02	0.02	0.02	0.02
Lighting	1.22	1.25	1.18	1.19	1.15	1.11
Refrigeration	0.18	0.19	0.19	0.20	0.20	0.20
Office Equipment (PC)	0.12	0.14	0.15	0.20	0.23	0.24
Office Equipment (Non-PC)	0.29	0.32	0.35	0.42	0.50	0.53
Other Uses	0.91	1.05	1.13	1.24	1.27	1.26
Total Site Electricity	3.45	3.69	3.68	3.89	3.97	3.93
Natural Gas						
Space Heating	1.31	1.27	1.23	1.30	1.34	1.36
Space Cooling	0.01	0.02	0.03	0.03	0.04	0.04
Water Heating	0.62	0.64	0.61	0.64	0.66	0.66
Cooking	0.23	0.25	0.26	0.27	0.28	0.29
Other Uses	1.20	1.37	1.38	1.44	1.39	1.35
Total Natural Gas	3.37	3.55	3.51	3.68	3.71	3.70
Distillate						
Space Heating	0.21	0.25	0.23	0.20	0.18	0.15
Water Heating	0.05	0.05	0.05	0.05	0.04	0.04
Other Uses	0.23	0.08	0.07	0.07	0.07	0.07
Total Distillate	0.49	0.38	0.35	0.32	0.29	0.26
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	0.32	0.30	0.31	0.32	0.33	0.33
Total Electricity	3.45	3.69	3.68	3.89	3.97	3.93
Total Fuels	4.18	4.23	4.17	4.32	4.33	4.29
Total Site Energy	7.63	7.92	7.85	8.21	8.30	8.22
Electricity Related Losses	7.59	7.91	7.20	7.63	7.62	7.20
Total Primary Energy	15.22	15.83	15.05	15.84	15.92	15.42
Average Heatrate (kWh.primary/kWh.site)	3.20	3.14	2.96	2.96	2.92	2.83

Table D-1.17: Residential Sector Forecast Summary (MtC)

CEF_NEMS Advanced Scenario (991213)

demand side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
carbon charge ($/t)	*0*	*0*	*50*	*50*	*50*	*50*
supply side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	22.0	22.6	19.3	18.0	17.2	15.5
Space Cooling	23.0	25.1	20.6	18.4	16.8	14.8
Water Heating	17.5	18.1	14.7	13.3	12.3	10.2
Refrigeration	19.5	18.6	13.0	10.6	9.0	7.3
Cooking	6.5	7.0	5.9	5.9	6.0	5.9
Clothes Dryers	9.5	10.0	8.4	8.2	8.6	7.9
Freezers	6.0	5.5	3.4	2.7	2.6	2.3
Lighting	17.0	18.1	14.7	13.7	11.6	8.9
Clothes Wahers	1.5	1.5	1.3	1.2	0.7	0.7
Dishwashers	2.5	2.5	2.1	2.0	1.9	2.0
Color Televisions	10.5	12.6	11.3	10.6	9.7	8.9
Personal Computers	1.0	1.0	1.3	1.6	1.5	1.6
Furnace Fans	4.5	5.0	4.2	4.3	4.1	3.6
Other Uses	41.5	54.3	50.7	50.1	46.6	38.9
Total Electricity	182.3	202.0	170.7	160.5	148.5	128.6
Natural Gas						
Space Heating	51.5	52.0	51.0	52.6	54.1	55.0
Space Cooling	0.0	0.0	0.0	0.0	0.0	0.1
Water Heating	18.3	18.6	18.0	18.6	19.1	19.2
Cooking	2.3	2.3	2.4	2.5	2.6	2.7
Clothes Dryers	0.7	0.7	0.7	0.7	0.9	0.9
Other Uses	1.3	1.4	1.4	1.4	1.6	1.7
Total Natural Gas	74.1	75.0	73.6	75.8	78.3	79.7
Distillate						
Space Heating	17.9	16.2	14.0	12.9	12.1	11.4
Water Heating	2.1	1.9	1.9	1.9	1.9	1.7
Other Uses	0.0	0.0	0.0	0.0	0.0	0.0
Total Distillate	20.0	18.1	15.9	14.8	14.0	13.1
LPG						
Space Heating	5.8	5.7	5.5	5.4	5.0	4.9
Water Heating	1.3	1.4	1.4	1.3	1.3	1.3
Cooking	0.5	0.5	0.5	0.5	0.5	0.5
Other Uses	0.2	0.2	0.2	0.2	0.2	0.2
Total LPG	7.8	7.9	7.6	7.3	7.0	6.9
Renewable (1)						
Biomass	0.0	0.0	0.0	0.0	0.0	0.0
Other Fuels						
Other Uses	1.4	1.5	1.4	1.3	1.3	1.3
Total Carbon Emissions	285.6	304.5	269.2	259.7	249.1	229.6

(1) Non-marketed renewables are not included.

Table D-1.18: Commercial Sector Forecast Summary (MtC)

CEF_NEMS Advanced Scenario (991213)

demand side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
carbon charge ($/t)	*0*	*0*	*50*	*50*	*50*	*50*
supply side efficiency	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*	*Adv*
	1997	*2000*	*2005*	*2010*	*2015*	*2020*
Electricity						
Space Heating	6.46	6.55	4.59	3.92	3.34	2.64
Space Cooling	16.90	17.63	13.37	11.75	10.75	9.23
Water Heating	3.48	3.53	2.92	2.35	2.22	1.65
Ventilation	8.45	8.56	6.68	6.27	5.93	5.27
Cooking	0.99	1.01	0.84	0.78	0.74	0.66
Lighting	60.65	62.97	49.28	46.62	42.64	36.58
Refrigeration	8.95	9.57	7.94	7.84	7.42	6.59
Office Equipment (PC)	5.97	7.05	6.26	7.84	8.53	7.91
Office Equipment (Non-PC)	14.42	16.12	14.62	16.45	18.54	17.46
Other Uses	45.24	52.90	47.20	48.58	47.09	41.52
Total Electricity	171.50	185.90	153.70	152.40	147.20	129.50
Natural Gas						
Space Heating	18.89	18.21	17.73	18.72	19.32	19.63
Space Cooling	0.14	0.29	0.43	0.43	0.58	0.58
Water Heating	8.94	9.18	8.79	9.22	9.52	9.53
Cooking	3.32	3.58	3.75	3.89	4.04	4.19
Other Uses	17.31	19.64	19.89	20.74	20.04	19.48
Total Natural Gas	48.60	50.90	50.60	53.00	53.50	53.40
Distillate						
Space Heating	6.17	7.70	7.16	6.56	6.27	5.54
Water Heating	1.47	1.54	1.56	1.64	1.39	1.48
Other Uses	6.76	2.46	2.18	2.30	2.44	2.58
Total Distillate	14.40	11.70	10.90	10.50	10.10	9.60
Renewable						
Biomass	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels						
Other Uses	2.10	2.30	2.30	2.40	2.40	2.50
Total Carbon emissions	236.60	250.80	217.50	218.30	213.20	195.00

APPENDIX D-1 REFERENCES

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