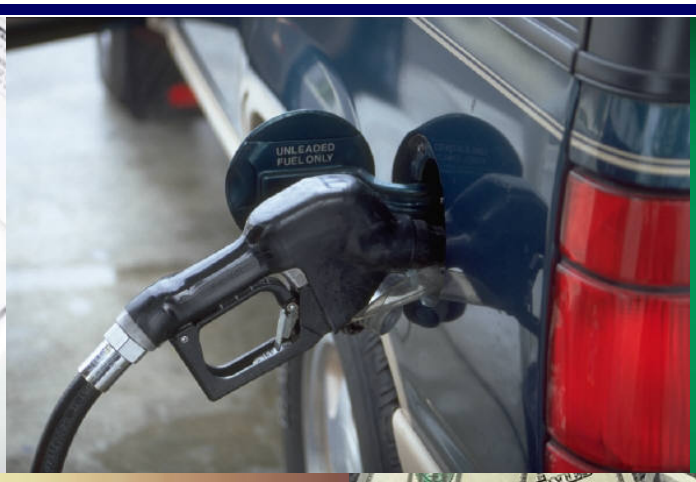
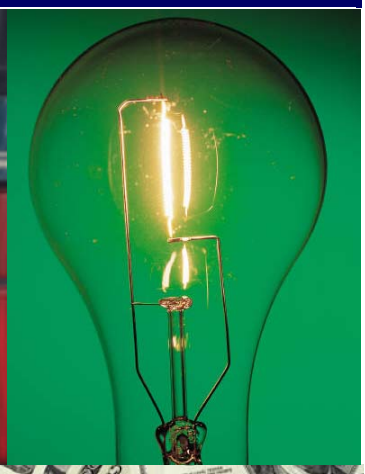
JOINT ECONOMIC COMMITTEE
Senator Charles E. Schumer, Chairman
Congresswoman Carolyn Maloney, Vice Chair

ENERGY EFFICIENCY IS A BRIGHT IDEA

Shedding Light on the Benefits of Increasing Energy and Fuel Efficiency to American Families and Our Environment





JUNE 2007

Introduction

Each time a family decides to change a light bulb, upgrade a heating or cooling system, or buy a new appliance or a new car, that family is making a decision that impacts both its pocketbook and the environment. High energy prices and rising awareness of the consequences of global warming have led more consumers to factor energy and environmental costs into their decisions to invest in new homes, appliances and vehicles. Even so, many Americans remain unaware of the private and social benefits of energy-efficient technologies and practices. Energy efficiency translates into lower household energy costs, less pollution and fewer greenhouse gas emissions for all of us. Additionally, increasing household energy efficiency can work to reduce U.S. reliance on foreign fuel sources.

Energy Efficiency Means a Lifetime of Lower Energy Bills

Residential spending on energy is one of the largest sectors of energy spending in the United States. According to the U.S. Department of Energy, residential spending on energy in 2005 (the last year for which data are available) was approximately $215 billion, or about 21 percent of total U.S. energy expenditure. (See Chart A, Page 5.)[2] The average household now spends an estimated $1,900 in electric and gas utility bills each year.[3]

The American Council for an Energy-Efficient Economy (ACEEE), a leading provider of energy efficiency data and analysis, estimates that the average energy-efficient household spends approximately 40 percent less on the energy it uses than the average household that is not energy efficient.[4] In some states, governments and utilities add to the savings by offering rebates on energy efficient appliances and products.[5] Moreover,

ECONOMIC COMMENTARY
Investing in Energy Efficiency

When consumers decide whether to purchase an energy-efficient appliance or product, they weigh the potential benefits of the product (the savings in energy costs over the life of the product) against its purchase price. The purchase price of the product is the first (and most tangible) cost they will incur, and since the prices of energy-efficient products are often higher than the prices of less efficient, comparable alternatives, the purchase price alone could dissuade some consumers from investing in the more energy-efficient product. But other cost differentials, such as operating and maintenance costs over the service life of the appliance, should be factored in. The timing of the costs and benefits also matters; because appliances provide services over many years, the future costs and benefits relevant to consumer's decision are the "discounted" dollar costs and benefits.[1]

Much of the discussion in this report highlights the potential savings to consumers stemming from the lower energy costs of operating efficient appliances, and it is important to recognize that consumers can enjoy a high rate of return on their investment in many types of energy-efficient products. In other words, even though consumers may have to pay more up front to buy an energy-efficient appliance, they are likely in many cases to recoup the extra up-front costs fairly early in the product's service life because the future energy savings tend to be substantial. (See Box A, Page 3.)

there is some evidence that energy-efficient appliances and practices can add to the market value of a home.[6]

Although important gains have been made in energy-efficient technologies and practices, too many American families remain unaware of the potential energy savings that they can gain through energy-efficient living. In 2006, only 31 percent of the 2,251 households surveyed by the Consortium for Energy Efficiency (CEE) knowingly purchased an ENERGY STAR-labeled product.[7]

The following discussion uses data provided by ACEEE to illustrate the potential for cost savings that can result from energy-efficient purchases and practices in the home.

Heating and Cooling

According to the ACEEE, reducing heating energy use is the single most effective way for families to save money on their energy expenditures.[8] Home heating currently accounts for approximately 30 percent, or about $610, of the average household's energy costs. In the Northeast and Midwest, where the winter months tend to be colder than elsewhere, heating accounted for about 40 percent of the average household's energy costs, or about $830.[9] Cooling a home can also be very costly, particularly for families in warmer parts of the country. On average, households across the nation spend an estimated $270 a year on cooling, while households in warmer states in the West spend approximately $320 a year on average.[10]

Households that heat and cool their homes efficiently pay about 30 percent less a year in utility bills than less-efficient households.[11] Efficient heating and cooling alternatives include energy-efficient boilers, furnaces, or air conditioners, as well as ENERGY STAR-qualified windows. The alternatives also include efficient R-38 ceiling insulation and better-sealed windows and heating/cooling air ducts.[12]

Appliances

Households with energy-efficient appliances will also enjoy energy savings. Appliances account for about 30 percent of total household energy use, which amounts to approximately $550 per year.[13] The energy cost of appliances can vary substantially based upon the age and model of the appliance. For example, according to the Natural Resources Defense Council (NRDC), refrigerators purchased today consume 75 percent less energy than those used in the 1970s.[14] Today, households with ENERGY STAR refrigerators and washing machines are spending approximately $100 less annually, on average, than households with less-efficient refrigerators and washing machines.[15]

Water Heating

The average household spends an estimated $220 on water heating each year. According to NRDC, a water heater that is more than 10 years old is likely to be half as efficient as when it was new.[16] The ACEEE estimates that a household with an energy-efficient water heater is spending nearly $100 a year less to heat water than its less-efficient counterpart.[17]

BOX A: Return on Investment in Selected Energy-Efficient Appliances Over the Life Cycle of the Product

ENERGY STAR Unites Versus Comparable Conventional Units (Dollars)

	ENERGY STAR Qualified Unit	Comparable Conventional Unit	Savings with ENERGY STAR
		OIL BOILER	
Annual Operating Costs[1]			
Energy Cost	$3,827	$4,114	$287
Life Cycle Costs [2]			
Energy Operating Costs	$52,016	$55,917	$3,901
Cost of Purchase	**$4,000**	**$2,700**	**-$1,300**
Total	**$56,016**	**$58,617**	**$2,601**
	Simple Payback of Initial Additional Cost (Years)[3]		**4.5**
		PROGRAMMABLE THERMOSTAT	
Annual Operating Costs[1]			
Energy Cost	$1,130	$1,378	$248
Life Cycle Costs [2]			
Energy Operating Costs	$12,562	$15,319	$2,757
Cost of Purchase	**$100**	**$40**	**-$60**
Total	**$12,662**	**$15,359**	**$2,697**
	Simple Payback of Initial Additional Cost (Years)[3]		**0.2**
		AIR CONDITIONER	
Annual Operating Costs[1]			
Energy Cost	$139	$153	$14
Life Cycle Costs [2]			
Energy Operating Costs	$1,123	$1,238	$115
Cost of Purchase	**$300**	**$270**	**-$30**
Total	**$1,423**	**$1,508**	**$85**
	Simple Payback of Initial Additional Cost (Years)[3]		**2.1**
		REFRIGERATOR	
Annual Operating Costs[1]			
Energy Cost	$46	$54	$8
Life Cycle Costs [2]			
Energy Operating Costs	$455	$536	$81
Cost of Purchase	**$1,100**	**$1,070**	**-$30**
Total	**$1,555**	**$1,606**	**$51**
	Simple Payback of Initial Additional Cost (Years)[3]		**3.7**

Source: ENERGY STAR, U.S. Environmental Protection Agency and U.S. Department of Government, Life Cycle Cost Estimates, available at http://www.energystar.gov/index.cfm?fuseaction=find_a_product.

[1] Annual costs exclude the initial purchase price and assume that annual costs of maintaining both units are equal. Annual operating costs for the oil boiler and programmable thermostat assume use in Detroit, Michigan; annual operating costs for the air conditioner assume use in Atlanta, Georgia.

[2] Life cycle costs are discounted over the products' average lifetime using a real (inflation-adjusted) discount rate of 4 percent.

[3] A simple payback period of zero years means that the payback is immediate.

Lighting

Lighting currently accounts for about 5 to 10 percent of total energy use in the average American household. The typical household using 20-watt ENERGY STAR compact fluorescent light bulbs (CFLs), which use less energy and last up to seven times longer, is spending nearly $13 a year less per bulb (assuming 8 hours of use) than a similar household using 75-watt incandescent light bulbs.[18] Replacing five 60-watt incandescent light bulbs with 13-watt ENERGY STAR CFLs can save households about $30 a year in lighting expenses, assuming the lights are in use for four hours a day. The total savings only increase as usage increases. (See Appendix A.)

Illustrative Household Energy Scenarios

The following table is prepared from data provided by ACEEE and illustrates the potential for in-use savings from energy efficiency. Household A (the "Martin" family) spends approximately $1,820 on utilities annually and represents typical household energy use. Household B (the "Bailey" family) has already made several upgrades to its house that have improved its overall energy-efficiency. The Baileys spend 40 percent, or approximately $730, less per year on in-home energy use than the Martins. These updates include improvements in heating and cooling, and updating to ENERGY STAR-qualified refrigerators, washing machines, light bulbs and windows. (See Table A.) (The Bailey's energy efficiency upgrades are itemized in Appendix B.)

Fuel Efficient Vehicles Mean Paying Less at the Pump

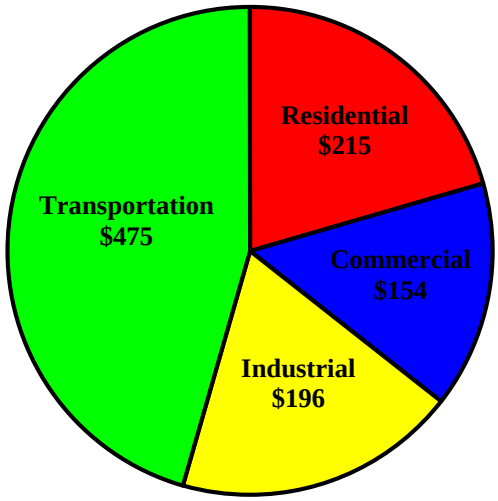
Transportation is the single largest sector of consumer spending on energy, representing $475 billion, or 46 percent of total spending in 2005 (the latest year for which data are available).[19] (See Chart A, Page 5.) Transportation accounts for 68 percent of our nation's oil usage.[20] In 2005, U.S. cars and trucks consumed 174 billion gallons of

TABLE A: An Illustration of Potential Energy Savings From Use of Efficient Appliances and Practices
The Martins vs. The Baileys

	Average Annual Household Spending		Annual Energy Savings
	Martins	**Baileys**	**Difference**
Household Energy Expense			
Heating	$613	$279	$334
Cooling	$271	$93	$178
Water heating	$218	$122	$96
Lighting	$165	$138	$27
Appliances	$553	$453	$100
Total	$1,820	$1,086	$734
Total Savings		**40%**	**$734**

Source: Based on data provided by the American Council for an Energy-Efficient Economy.

CHART A: U.S. Energy Expenditures by Sector (Billions, 2005 Dollars)



Source: Energy Information Administration, U.S. Department of Energy, *Annual Energy Outlook 2007*

.

gasoline, accounting for more than two-thirds of U.S. consumption of petroleum-related products and contributing significantly to our dependence on foreign-produced oil.[21] If gasoline prices remain at current levels, the typical American household with two vehicles will spend nearly $3,700 on gasoline this year, according to the American Automobile Association (AAA).[22]

To illustrate the potential for gasoline savings from fuel efficiency, the following table compares the energy costs of two households that already own two cars of comparable size and age. Each household drives their cars about 14,600 miles apiece each year. However, household A (the "Martin" family) gets poorer gas mileage on each of its cars than household B (the "Bailey" family). The Martin family gets an average of 25.4 miles per gallon (mpg) out of its cars (the average efficiency for the U.S. fleet in 2006), while the Baileys get 35.0 mpg.[23] As a result, the Martins will spend about $3,200 on gasoline to fuel their cars this year, while the Baileys will spend only about $2,320 on gasoline. That is, the Martins spend approximately $880 more than the fuel-efficient Baileys.[24] In short, a household that operates vehicles with an average fuel efficiency of 35.0 miles per gallon (mpg) can expect to spend 27 percent less on fuel than a household that operates vehicles with an average fuel efficiency of the national fleet average of 25.4 mpg. (See Table B.)

Consumers often underestimate the economic benefits of purchasing more fuel-efficient vehicles available on the market today, such as hybrids. In addition to the savings from gasoline consumption, consumers that purchase certain types of hybrid vehicles may be eligible for significant tax credits from the federal government. For example, a consumer who purchases a hybrid

TABLE B: An Illustration of Potential Gasoline Savings From Use of Fuel Efficient Vehicles The Martins vs. The Baileys

	Martins	Baileys	Difference in Gasoline Spending Per Year
Average Fuel Efficiency (mpg)	25.4	35.0	
Annual Fuel Costs	**$3,196**	**$2,319**	**$877**

Source: JEC calculations based on data from the Department of Transportation and the Department of Energy.

Note: Calculations assume an annual average gasoline price of $2.78 per gallon, the Energy Information Administration's 2007 projection for the retail price of a gallon of regular grade gasoline.

sports utility vehicle instead of a standard-engine sports utility vehicle (from the same model year) can receive a tax credit of as much as $3,000 to help offset the difference in the initial purchase price of the hybrid.[25] The tax credit, coupled with fuel savings, may allow the consumer to recoup the increased price paid for the hybrid in just over two years.[26]

Energy Efficiency Also Has Important Social Benefits

The benefits of energy efficiency also extend far beyond the direct savings for individual households. The operation of energy-efficient homes, appliances and vehicles might also reduce the nation's need for new power facilities, reduce the level of pollutants in the air we breathe, and provide a healthier indoor environment for families.

According to the EPA, the average single-family home adds more than twice as much greenhouse gas emissions to the atmosphere as the average passenger vehicle.[27] The process of heating and cooling homes in the U.S. emits 150 million tons of carbon dioxide into the atmosphere each year. Such emissions also generate about 12 percent of the nation's sulfur dioxide emissions and 4 percent of the nation's emissions of nitrogen oxides —the main components of acid rain.[28] Energy-efficient households can emit approximately 8,900 fewer pounds of CO_2 into the air each year, according to ACEEE.[29] The use of an ENERGY STAR refrigerator and washing machine alone could lessen household carbon emissions by 1,200 pounds of CO_2 each year.[30] And if every American home replaced just one light bulb with a more efficient (ENERGY STAR-qualified) bulb, we would save enough energy to light more than 3 million homes for a year and prevent greenhouse gases equivalent to the emissions of more than 800,000 cars according to the EPA and the U.S. Energy Department.[31]

According to the U.S. Department of Energy, energy-efficient homes can also provide a healthier indoor environment. The health risks associated with contaminants such as combustion by-products and radon, mold, pollen and dust mites can be reduced by upgrading to energy-efficient products and technologies.[32] Further benefits include reduced noise, greater fire safety, and improved building stability.[33]

Greater fuel efficiency in vehicles would also help curb greenhouse gases. The EPA reports that the transportation sector–which is dominated by automobile usage–has significantly increased its contribution of carbon emissions over the past forty years, ballooning from one-quarter of all emissions to one-third (33 percent).[34]

Conclusion

There can be substantial private and social benefits for households to invest in greater energy efficiency–from both a private savings and a social benefits perspective. To increase awareness of these advantages, policymakers can promote measures to make it easier for consumers to factor in both the energy savings and the reduced carbon emissions over the life of the appliances and vehicles they may buy to assist them in their purchase decisions. Energy efficient technologies

are available today, and thus the decision to be more energy efficient can have an immediate positive impact on our environment and energy security. Helping more American families to realize the potential benefits of energy-efficient technologies and practices can go a long way toward achieving our national goals for energy policy.

Endnotes

[1] Discounting future costs and benefits is required because a dollar to be received in the future is worth less today than a dollar actually received today.

[2] U.S. Department of Energy, Annual Energy Outlook 2007, at p. 141, available at http://www.eia.doe.gov/oiaf/aeo/index.html.

[3] Environmental Protection Agency, *Energy Efficiency: Reduce Bills, Protect the Environment*, last updated April 2007, available at http://www.epa.gov/solar/pdf/napee_consumer.pdf.

[4] Unpublished data from the American Council for an Energy-Efficient Economy, "Home Energy and Carbon Calculations 2007."

[5] ENERGY STAR, U.S. Environmental Protection Agency/U.S. Department of Energy, "Special Offers and Rebates from Energy Star Partners," available at http://www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator.

[6] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2007, at p. 42; *Building Design+Construction*, "Green Buildings and the Bottom Line," November 2006. According to the trade journal, *Building Design+Construction*, builders can add to the value of homes by upgrading insulation, HVAC systems, windows, and doors in their projects (and also specify energy-efficient, Energy Star appliances). The study cites McStain Neighborhoods of Denver, a property group that follows guidelines established by the Built Green Colorado program, which includes among many things the stipulation that "House(s) meets the EPA Energy Star Program criteria." The company CEO says these homes have a resale value about 4-10% higher than traditional homes.

[7] EPA Office of Air and Radiation, Climate Protection Partnerships Division, *National Awareness of ENERGY STAR for 2006: Analysis of 2006 CEE Household Survey, U.S.* Environmental Protection Agency, 2007.

[8] American Council for an Energy-Efficient Economy, *Consumer Guide to Home Energy Savings*, 8th Edition, 2003 available at http://www.aceee.org/consumerguide/topfurn.htm.

[9] Unpublished data from the American Council for an Energy-Efficient Economy, "Home Energy and Carbon Calculations 2007." ACEEE estimates based on data from the Department of Energy's Energy Information Administration's 2001 Residential Energy Consumption Survey and 2004 regional price data.

[10] *Ibid.*

[11] *Ibid.*

[12] R-38 is a commonly recommended ceiling insulation in many parts of the United States.

[13] See Endnote 9.

[14] Natural Resources Defense Council, *Efficient Appliances Save Energy – and Money*, available at http://www.nrdc.org/air/energy/fappl.asp.

[15] See Endnote 9.

[16] National Resource Defense Council, "Efficient Appliances Save Energy—and Money," available at http://www.nrdc.org/air/energy/fappl.asp.

[17] See Endnote 9.

[18] Unpublished data from the American Council for an Energy-Efficient Economy (See Appendix B.)

[19] U.S. Department of Energy, Annual Energy Outlook 2007, at p. 141, available at http://www.eia.doe.gov/oiaf/aeo/index.html.

[20] Government Accountability Office, "Passenger Vehicle Fuel Economy: Preliminary Observations on Corporate Average Fuel Economy Standards," March 6, 2007, at p. 1.

[21] *Ibid.*

[22] Geoff Sunderstrom, "Testimony Before the Senate Committee on Energy and Natural Resources," May 15, 2007. Estimates based on a gas price of $3.073 per gallon and assumes household uses 1,200 gallons of gasoline per year.

[23] The average fuel efficiency for the entire fleet of U.S. passenger vehicles was 25.4 miles per gallon in 2006. (U.S. Department of Transportation, *Summary of Fuel Economy Performance*, NHTSA, NVS-220, October 2006, at p. 4, available at http://dmses.dot.gov/docimages/pdf99/426721_web.pdf.

[24] Calculations assume an annual average gasoline price of $2.78 per gallon, the Energy Information Administration's 2007 projection for the retail price of regular grade gasoline.

[25] Internal Revenue Service, "Hybrid Cars and Alternative Motor Vehicles," March 19, 2007, available at http://www.irs.gov/newsroom/article/0,,id=157632,00.html.

[26] Joint Economic Committee calculation of simple payback period assuming purchase of a 2008 hybrid SUV (four-door, front-wheel drive) versus comparable, conventional model, $3,000 federal tax credit, and gas prices based on EIA's 2007 Annual Energy Outlook. Present value calculation assumes annual discount rate of 12 percent over 13 years, the estimated life of the vehicle, and no difference in maintenance costs.

[27] Unit Conversions, Emissions Factors, and Other Reference Data, United States Environmental Protection Agency, November 2004, available at http://www.epa.gov/cppd/pdf/brochure.pdf.

[28] U.S. Department of Energy, Energy Efficiency and Renewable Energy, "Energy Savers: Tips on Saving Energy & Money at Home," available at http://www1.eere.energy.gov/consumer/tips/heating_cooling.html.

[29] See Endnote 9.

[30] *Ibid.*

[31] ENERGY STAR, U.S. Environmental Protection Agency/U.S. Department of Energy, Compact Fluorescent Light Bulbs, available at: http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.

[32] Office of Building Technology, U.S. Department of Energy, "Technology Fact Sheet: Energy Efficiency Pays," March 1999.

[33] *Ibid.*

[34] Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005," April 2007. Se also Government Accountability Office, "Automobile Fuel Economy: Potential Effects of Increasing the Corporate Average Fuel Economy Standards," August 2000.

APPENDIX A: Potential Savings from Replacing a 60-Watt Incandescent with a 13-Watt Compact Fluorescent Light Bulb

	1st year	2nd year	3rd year	5th year	10th year
Light on 2 hrs/day	$1.76	$5.52	$9.28	$16.31	$32.59
Light on 4 hrs/day	$5.52	$12.53	$20.06	$32.59	$66.69
Light on 8 hrs/day	$12.53	$27.08	$39.61	$66.69	$135.38
Light on12 hrs/day	$20.06	$39.61	$59.67	$100.78	$201.57

Source: Data provided by American Council for an Energy Efficient Economy; Calculations take into account initial purchase price of the lightbulbs.

Note: Savings calculations based on comparing an incandescent light bulb costing $.50 providing 850 lumens of light, for 1000 hours at an electricity cost of $.095 per kilowatt hour, versus a fluorescent bulb costing $2.00, providing 850 lumens of light for 6,000 hours at the same cost of electricity.

APPENDIX B: Home Energy and Carbon Calculations 2007 - ACEEE Staff Analysis

Annual Household Spending on Energy

	US Average		Region							
			Northeast		Midwest		South		West	
	Dollars	Energy	Dollars	Energy	Dollars	Energy	Dollars	Energy	Dollars	Energy
Heating (therms unless noted)	$613	595	$827	517	$712	730	$585	450	$468	520
Cooling (kWh)	$271	2,796	$174	1,420	$152	1,772	$292	3,467	$323	3,392
Water heating (therms)	$218	197	$225	180	$201	206	$270	208	$168	187
Lighting (kWh)	$93	946	$68	710	$86	896	$103	1,027	$98	994
Appliances, etc.(kWh)	$553	5,908	$591	4,979	$518	6,251	$517	6,142	$555	5,839
TOTAL	$1,820		$1,999		$1,741		$1,831		$1,666	

Potential Energy Cost Savings

	Dollars	CO2(lb)	Dollars	CO2(lb)	Dollars	CO2(lb)	Dollars	CO2(lb)	Dollars	CO2(lb)
Install Energy Star Windows	$110	1,335	$125	1,378	$108	1,365	$110	1,317	$99	1,305
Install R-38 ceiling insulation	$97	1,175	$110	1,212	$95	1,201	$96	1,159	$87	1,149
Seal major air leaks	$44	534	$50	551	$43	546	$44	527	$40	522
Seal heating/cooling air ducts	$133	1,602	$150	1,653	$130	1,638	$132	1,581	$119	1,566
Energy Star thermostat	$44	534	$50	551	$43	546	$44	527	$40	522
Energy Star bulbs (5)	$27	321	$33	363	$39	493	$46	553	$36	476
Low-flow showerheads (2)	$63	761	$64	708	$50	634	$67	804	$46	612
Energy Star refrigerator	$43	515	$54	594	$48	603	$41	498	$41	537
Energy Star Washer	$58	697	$73	803	$65	816	$56	674	$55	726
Efficient Water Heater	$33	395	$34	371	$29	369	$44	529	$20	269
Efficient boiler/furnace	$80	966	$146	1,606	$93	1,173	$76	917	$61	806
Efficient air conditioner	$95	1,147	$61	671	$53	673	$102	1,228	$113	1,491
Subtotal--Heating	$334	4,038	$470	5,173	$388	4,903	$319	3,833	$255	3,370
Subtotal--Cooling	$178	2,147	$114	1,256	$100	1,260	$191	2,298	$211	2,791
Water Heating	$96	1,156	$98	1,079	$79	1,003	$111	1,333	$67	881
Lighting	$27	321	$34	370	$24	297	$23	277	$26	344
Appliances, other	$100	1,212	$127	1,396	$112	1,420	$98	1,172	$96	1,263
TOTAL SAVINGS	**$734**	**8,874**	**$843**	**9,274**	**$703**	**8,883**	**$742**	**8,913**	**$655**	**8,649**
Savings as a percent of spending	**40%**		**42%**		**40%**		**41%**		**39%**	

Note 1: Individual measure savings do not add up directly to end-use subtotals or whole-house totals because implementation of some measures reduces savings impact of others, e.g. replacing windows reduces savings impact of replacing furnace.

Note 2: Savings are based on an average-sized single family detached home, approx. 2000 square feet, two stories. Savings for smaller, larger, or multifamily homes will vary.

Note 3: Savings are not calculated on a life-cycle cost or net present value basis and therefore do not consider initial purchase prices.

Note 4: Underlying energy use and price data are based on the Department of Energy's 2001 Residential Energy Consumption Survey and 2004 regional price data.