

## CHAPTER 11. LIFE-CYCLE COST SUBGROUP ANALYSIS

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## **CHAPTER 11. LIFE-CYCLE COST SUBGROUP ANALYSIS**

### **11.1 INTRODUCTION**

The intent of the consumer subgroup analysis is to evaluate impacts to identifiable groups of consumers who may be disproportionately affected by revised national energy efficiency standards. This is accomplished in part by analyzing the life-cycle cost (LCC) and payback periods (PBPs) for those households that fall into identifiable groups of consumers.

In particular, DOE wishes to avoid negative impacts on identifiable population groups, such as senior-only and low-income households, that may not be able to afford significant increases in equipment price. For customers that are sensitive to price increases, increases in first costs of a product can preclude the purchase of a new model of that product. As a result, some customers may retain existing equipment longer than they otherwise would. These older products are generally less efficient to begin with, and their efficiency may deteriorate further if they are retained beyond their useful life.

DOE is also sensitive to the potential for revised national energy efficiency standards to have differential impacts on households in different regions of the country. Therefore, it evaluated the impacts of a revised standard for non-weatherized gas furnaces on northern (cold-climate) and southern (warm-climate) States.

DOE evaluated only non-weatherized gas furnaces for the consumer subgroup analysis, since these units comprise the predominant product class, with shipments much larger than the other product classes.

### **11.2 SENIOR AND LOW-INCOME HOUSEHOLDS**

#### **11.2.1 Subgroups Definition**

The consumer subgroup analysis evaluated households with senior-only occupants or low income levels using non-weatherized gas furnaces. Senior-only households have occupants who are all at least 65 years of age. As defined in DOE's Energy Information Administration (EIA)'s Residential Energy Consumption Survey of 2001 (RECS 2001),<sup>1</sup> low-income households are considered to be those at or below the "poverty line." The "poverty line" varies with household size, head of household age, and family income. Table 11.2.1 summarizes the criteria given for selecting low-income households from the RECS 2001 sample. DOE applied an additional criterion to select only those low-income households who own their home, since renters do not purchase furnaces.

**Table 11.2.1 RECS 2001 Definitions of Low-Income Households**

<b>Household Size</b>	<b>Owner Age</b>	<b>Family Income</b>
1	65 and over	less than \$7,525
1	64 and under	less than \$8,163
2	65 and over	less than \$9,491
2	64 and under	less than \$10,507
3	Any	less than \$12,516
4	Any	less than \$16,036
5	Any	less than \$18,952
6	Any	less than \$21,389
7	Any	less than \$24,268
8	Any	less than \$27,091
9 or more	Any	less than \$31,971

### **11.2.2 Inputs to the Subgroup Analysis for Senior-Only and Low-Income Households**

DOE performed the consumer subgroup analysis by analyzing the LCC and payback periods of senior-only or low-income households with the spreadsheet models used for the LCC analysis. DOE used the same inputs in the subgroup analysis as it used in the LCC and PBP analysis (as described in Chapter 8) for non-weatherized gas furnace households considered to be senior-only or low-income.

Table 11.2.2 summarizes the weighted-average input values for the senior-only and low-income households analyzed in the consumer subgroup analysis and compares them to the weighted-average input values for all households in RECS 2001 using non-weatherized gas furnaces. The inputs for the senior-only and low-income subgroups do not differ significantly from the overall sample.

**Table 11.2.2 Comparison of Input Values for All Households, Senior-Only Households, and Low-Income Households**

Category	Non-Weatherized Gas Furnace (NWGF)		
	All Households	Senior-Only	Low-Income
<b>Household Population Data</b>			
Number of Household Records	1880	337	152
Sum of Weights (million households)	43.5	7.8	3.4
Percent of NWGF Household Population	100%	17.9%	7.8%
<b>Weighted-Average Annual Energy Use for Baseline Furnace</b>			
Space-Heating Natural Gas Use (MMBtu)	56.6	55.3	51.5
Space-Heating Electricity Use (kWh)	496	508	488
<b>Weighted-Average Natural Gas Prices (2006\$)</b>			
Average Natural Gas Price (\$/therm)	1.14	1.15	1.19
Marginal Natural Gas Price (\$/therm)	1.01	1.06	1.05
<b>Weighted-Average Electricity Prices (2006\$)</b>			
Average Electricity Price (¢/kWh)	10.8	11.0	11.2
Marginal Electricity Price (¢/kWh)	10.7	10.4	10.5

### 11.2.3 Results for Senior-Only and Low-Income Households

Tables 11.2.3 and 11.2.4 summarize the LCC results for senior-only and low-income households with non-weatherized gas furnaces. These results can be compared to the overall results in Table 8.4.1 in Chapter 8. The tables provide the average or mean LCC and PBP, the LCC savings relative to the base case, and the percentage of consumers for whom the LCC will decrease compared to the base case forecast (positive benefit), those for whom the LCC will increase compared to the base case forecast (negative impact), and those for whom the LCC will not change because the specific design option is less efficient or the same as the base case forecast for that house (and therefore the standard has no impact).

The senior-only and low-income consumer subgroups show the same general pattern in average LCC savings and consumer impacts (i.e., percentage of consumers with net cost or benefit) as the overall population. For the 81 percent annual fuel utilization efficiency (AFUE) level, the average LCC savings and the percent of households that benefit for the subgroups is approximately the same as for all households with non-weatherized gas furnaces (see Table 8.4.1 in Chapter 8). For the 90 percent AFUE level, the average LCC savings and the percent of households that benefit is less favorable for senior and low-income households than for all households. This is due to the fact that the average baseline space-heating energy use is smaller for senior and low-income households than for all households (mainly because senior and low-income households tend to have smaller houses), so efficiency improvement yields less energy savings.

**Table 11.2.3 Non-Weatherized Gas Furnaces: LCC and PBP Results for Senior Households**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings				Payback Period (Years)**	
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$1,910	\$10,010	\$11,920						
80%	\$1,918	\$9,810	\$11,728	\$1	0%	99%	1%	0.7	0.8
80% Modulation (Two-Stage)	\$2,195	\$9,892	\$12,087	-\$246	67%	32%	1%	42	73
81%	\$1,989	\$9,713	\$11,702	\$11	32%	32%	36%	11	22
81% Modulation (Two-Stage)	\$2,266	\$9,796	\$12,062	-\$238	65%	32%	3%	39	73
90%	\$2,566	\$9,007	\$11,573	\$36	38%	32%	30%	12	18
92%	\$2,728	\$8,854	\$11,582	\$17	43%	26%	31%	13	20
92% Modulation (Two-Stage)	\$2,965	\$8,965	\$11,930	-\$323	80%	2.7%	17%	20	47
92% Modulation (Continuous)	\$3,004	\$9,090	\$12,094	-\$481	85%	2.7%	12%	22	59
96% Modulation (Continuous)	\$3,614	\$8,812	\$12,426	-\$806	88%	2.7%	10%	30	74

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

**Table 11.2.4 Non-Weatherized Gas Furnaces: LCC and PBP Results for Low-Income Households**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings				Payback Period (Years)**	
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$1,877	\$9,233	\$11,111						
80%	\$1,885	\$9,052	\$10,937	\$2	0%	98%	2%	1.4	2.4
80% Modulation (Two-Stage)	\$2,156	\$9,146	\$11,302	-\$260	69%	28%	3%	36	70
81%	\$1,955	\$8,965	\$10,920	\$11	35%	28%	37%	12	31
81% Modulation (Two-Stage)	\$2,226	\$9,058	\$11,285	-\$252	67%	27%	5%	34	71
90%	\$2,519	\$8,328	\$10,847	\$39	46%	27%	26%	17	29
92%	\$2,675	\$8,190	\$10,865	\$20	52%	20%	29%	17	32
92% Modulation (Two-Stage)	\$2,906	\$8,308	\$11,214	-\$324	80%	1.3%	18%	26	70
92% Modulation (Continuous)	\$2,944	\$8,426	\$11,370	-\$477	84%	1.3%	15%	29	92
96% Modulation (Continuous)	\$3,536	\$8,180	\$11,716	-\$821	86%	1.3%	12%	38	111

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

### 11.3 NORTHERN AND SOUTHERN HOUSEHOLDS

#### 11.3.1 Subgroups Definition

DOE analyzed the impact of standards for non-weatherized gas furnaces on households located in northern (cold-climate) and southern (warm-climate) regions. To conduct this analysis, DOE divided the States into northern and southern regions. It defined the southern region as comprising States with an average of fewer than 5,000 heating degree days (HDD), and the northern region as comprising states with an average of more than 5,000 HDD (Table 11.3.1). DOE also performed an analysis using a definition of the southern region as comprising States with an average of fewer than 6,000 HDD, and a definition of the northern region as comprising states with an average of more than 6,000 HDD (Table 11.3.2.).

**Table 11.3.1 Definition of Northern and Southern Regions using 5,000 HDD Criteria**

Region	Census Divisions and Four Large States	States Represented
Northern (cold-climate) States	New England	Connecticut, Maine, Massachusetts, New Hampshire, Vermont, and Rhode Island
	Middle Atlantic <sup>a</sup>	New Jersey and Pennsylvania
	East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
	Mountain (HDD>5,000) <sup>b</sup>	Colorado, Idaho, Montana, Nevada, Utah, and Wyoming
	Pacific <sup>c</sup>	Alaska, Oregon, and Washington
	New York	New York
Southern (warm-climate) States	South Atlantic <sup>d</sup>	Delaware, the District of Columbia, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
	East South Central	Alabama, Kentucky, Mississippi, and Tennessee
	West South Central <sup>e</sup>	Arkansas, Louisiana, and Oklahoma
	Mountain (HDD<5,000) <sup>b</sup>	Arizona and New Mexico
	California	California
	Texas	Texas
	Florida	Florida

(a) Not including New York, which is included separately as one of the four large States.

(b) DOE assumed that, using this criterion, most households in the northern region would come from Colorado, Idaho, Montana, Nevada, Utah and Wyoming, while most households in the southern region would come from Arizona and New Mexico.

(c) Not including California, which is included separately as one of the four large States..

(d) Not including Texas, which is included separately as one of the four large States. West Virginia is included in the southern region, even though it has an average of more than 5,000 HDDs.

(e) Not including Florida, which is included separately as one of the four large States.

**Table 11.3.2 Definition of Northern and Southern Regions using 6,000 HDD Criteria**

<b>Region</b>	<b>Census Divisions and Four Large States</b>	<b>States Represented</b>
northern (cold-climate) States	New England (HDD>6,000) <sup>a</sup>	Connecticut, Maine, Massachusetts, New Hampshire, and Vermont
	East North Central	Illinois, Michigan, and Wisconsin
	West North Central	Iowa, Minnesota, Nebraska, North Dakota, and South Dakota
	Mountain	Colorado, Idaho, Montana, Utah, and Wyoming
	Pacific <sup>b</sup>	Alaska
	New York	New York
southern (warm-climate) States	New England (HDD>6,000) <sup>a</sup>	Rhode Island
	Middle Atlantic <sup>c</sup>	New Jersey and Pennsylvania
	East North Central	Indiana and Ohio
	West North Central	Kansas and Missouri
	South Atlantic <sup>d</sup>	Delaware, the District of Columbia, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
	East South Central	Alabama, Kentucky, Mississippi, and Tennessee
	West South Central <sup>e</sup>	Arkansas, Louisiana, and Oklahoma
	Mountain(HDD<6,000) <sup>b</sup>	Arizona, Nevada, and New Mexico
	Pacific <sup>c</sup>	Hawaii, Oregon, and Washington
	California	California
Texas	Texas	
Florida	Florida	

(a) DOE assumed that, using this criterion, most households in the northern region would come from Connecticut, Maine, Massachusetts, New Hampshire, and Vermont, while most households in the southern region would come from Rhode Island. The same criterion applies to the other split divisions.

(b) Not including California, which is included separately as one of the four large States.

(c) Not including New York, which is included separately as one of the four large States.

(d) Not including Texas, which is included separately as one of the four large States.

(e) Not including Florida, which is included separately as one of the four large States.

### 11.3.2 Inputs to the Subgroup Analysis for Northern and Southern Households

DOE performed the consumer subgroup analysis by analyzing the LCC and PBP of northern and southern households with the spreadsheet models used for the LCC analysis. DOE used the same inputs in the subgroup analysis as it used in the LCC and PBP analysis (as described in Chapter 8) for non-weatherized gas furnace households considered to be northern or southern households.

Table 11.3.3 summarizes the weighted-average input values for the northern and southern households analyzed in the consumer subgroup analysis and compares them to the weighted-average input values for all households in RECS 2001 using non-weatherized gas furnaces. The northern households have, on average, higher energy use and lower energy prices than the southern households. Northern households have much greater average natural gas use than southern households.

**Table 11.3.3 Comparison of Input Values for All Households, Northern, and Southern Households**

Category	All Households	Northern Households		Southern Households	
		>5000	>6000	<5000	<6000
<b>Household Population Data</b>					
Number of Household Records	1880	1067	463	814	1417
Sum of Weights (million households)	43.5	24.1	9.6	19.4	33.9
Percent of NWGF Household Population	100%	55.4%	22.0%	44.6%	78.0%
<b>Weighted-Average Annual Energy Use for Baseline Furnace</b>					
Space-Heating Natural Gas Use (MMBtu)	56.6	71.0	73.0	38.7	51.9
Space-Heating Electricity Use (kWh)	496	619	639	346	456
<b>Weighted-Average Natural Gas Prices</b>					
Average Natural Gas Price (\$/therm)	1.14	1.06	1.04	1.24	1.16
Marginal Natural Gas Price (\$/therm)	1.01	0.92	0.92	1.08	1.05
<b>Weighted-Average Electricity Prices</b>					
Average Electricity Price (¢/kWh)	10.8	9.4	11.2	11.0	10.7
Marginal Electricity Price (¢/kWh)	10.7	8.5	9.0	12.0	11.1

### 11.3.3 Results for Northern and Southern Households

Tables 11.3.4 through 11.3.7 summarize the LCC results for the northern and southern households for non-weatherized gas furnaces, using the alternative definitions of northern and southern regions. These results can be compared to the overall results in Table 8.4.1 in Chapter 8. The tables provide the average or mean LCC and PBP, the LCC savings relative to the base case, and the percentage of consumers for whom the LCC will decrease compared to the base case forecast (positive benefit), those for whom the LCC will increase compared to the base case forecast (negative impact), and those for whom the LCC will not change because the specific design option is less efficient or the same as the base case forecast for that house (and therefore the standard has no impact).

The northern and southern consumer subgroups (using 5,000 HDD criteria) differ significantly in terms of average LCC savings and consumer impacts (i.e., percentage of

consumers with net cost or benefit). For the 90 percent AFUE level, in the northern households the average LCC savings is \$178 and the percent of households with net cost (negative impact) is 23 percent, while the southern households have an average LCC cost of \$82 and the percent of households with net cost is 55 percent. The higher LCC savings and lower economic impact in the northern households as compared to southern households is due to the much greater energy consumption in the north, which allows for more energy savings from higher furnace efficiency.

**Table 11.3.4 Non-Weatherized Gas Furnaces: LCC and PBP Results for Northern Households (greater than 5,000 HDD)**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings			Payback Period (Years)**		
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$2,045	\$13,098	\$15,143						
80%	\$2,054	\$12,829	\$14,883	\$2	0%	99%	1%	0.6	0.7
80% Modulation (Two-Stage)	\$2,360	\$12,890	\$15,251	-\$195	52%	47%	2%	40	73
81%	\$2,128	\$12,700	\$14,828	\$28	20%	47%	34%	9	14
81% Modulation (Two-Stage)	\$2,434	\$12,761	\$15,195	-\$169	49%	47%	4%	32	62
90%	\$2,751	\$11,740	\$14,491	\$178	23%	47%	31%	10	13
92%	\$2,930	\$11,536	\$14,466	\$184	33%	34%	33%	12	15
92% Modulation (Two-Stage)	\$3,195	\$11,634	\$14,829	-\$170	77%	2.6%	21%	18	35
92% Modulation (Continuous)	\$3,239	\$11,778	\$15,016	-\$353	83%	2.6%	14%	19	39
96% Modulation (Continuous)	\$3,918	\$11,404	\$15,322	-\$653	85%	2.6%	12%	30	60

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

**Table 11.3.5 Non-Weatherized Gas Furnaces: LCC and PBP Results for Southern Households (less than 5,000 HDD)**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings				Payback Period (Years)**	
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$2,021	\$8,418	\$10,439						
80%	\$2,030	\$8,255	\$10,285	\$2	0%	98%	2%	1.7	2.2
80% Modulation (Two-Stage)	\$2,331	\$8,374	\$10,706	-\$322	76%	23%	1%	62	102
81%	\$2,103	\$8,176	\$10,280	\$1	40%	23%	37%	15	29
81% Modulation (Two-Stage)	\$2,405	\$8,296	\$10,701	-\$330	77%	21%	2%	59	98
90%	\$2,715	\$7,629	\$10,345	-\$82	55%	21%	23%	18	26
92%	\$2,892	\$7,505	\$10,397	-\$130	60%	17%	23%	20	28
92% Modulation (Two-Stage)	\$3,151	\$7,657	\$10,808	-\$536	87%	1.4%	11%	30	61
92% Modulation (Continuous)	\$3,194	\$7,759	\$10,953	-\$679	90%	1.4%	9%	34	84
96% Modulation (Continuous)	\$3,860	\$7,529	\$11,389	-\$1,108	92%	1.4%	7%	44	101

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

Using a 6,000 HDD criteria yields somewhat different results. For the 90 percent AFUE level, in the northern households the average LCC savings is \$212 and the percent of households with net cost is 22 percent, while in the southern households the average LCC savings is \$5 and the percent of households with net cost is 42 percent.

**Table 11.3.6 Non-Weatherized Gas Furnaces: LCC and PBP Results for Northern Households (greater than 6,000 HDD)**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings				Payback Period (Years)**	
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$2,041	\$13,451	\$15,492						
80%	\$2,050	\$13,172	\$15,222	\$3	0%	98%	2%	0.7	0.7
80% Modulation (Two-Stage)	\$2,355	\$13,231	\$15,586	-\$188	51%	47%	3%	36	68
81%	\$2,124	\$13,037	\$15,161	\$32	20%	47%	34%	9	14
81% Modulation (Two-Stage)	\$2,429	\$13,096	\$15,525	-\$160	48%	47%	5%	29	59
90%	\$2,744	\$12,035	\$14,779	\$212	22%	47%	31%	11	13
92%	\$2,923	\$11,822	\$14,745	\$224	32%	35%	33%	12	15
92% Modulation (Two-Stage)	\$3,186	\$11,917	\$15,103	-\$126	77%	2.4%	21%	19	35
92% Modulation (Continuous)	\$3,230	\$12,063	\$15,293	-\$311	82%	2.4%	16%	20	43
96% Modulation (Continuous)	\$3,906	\$11,676	\$15,582	-\$598	84%	2.4%	13%	32	61

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

**Table 11.3.7 Non-Weatherized Gas Furnaces: LCC and PBP Results for Southern Households (less than 6,000 HDD)**

Design Option by AFUE	Life-Cycle Cost			Life-Cycle Cost Savings				Payback Period (Years)**	
	Average Installed Price	Average Operating Cost	Average LCC	Average Savings	Households with			Median	Average
					Net Cost	No Impact*	Net Benefit		
78%	\$2,035	\$10,223	\$12,257						
80%	\$2,044	\$10,021	\$12,065	\$1	0%	99%	1%	1.6	2.0
80% Modulation (Two-Stage)	\$2,348	\$10,115	\$12,463	-\$270	66%	33%	1%	53	87
81%	\$2,117	\$9,924	\$12,041	\$9	32%	33%	35%	13	24
81% Modulation (Two-Stage)	\$2,422	\$10,019	\$12,440	-\$266	65%	32%	2%	46	84
90%	\$2,735	\$9,226	\$11,962	\$5	42%	32%	26%	15	21
92%	\$2,913	\$9,073	\$11,986	-\$23	49%	24%	27%	16	23
92% Modulation (Two-Stage)	\$3,176	\$9,203	\$12,379	-\$408	83%	2.1%	15%	24	49
92% Modulation (Continuous)	\$3,219	\$9,324	\$12,543	-\$568	87%	2.1%	10%	27	66
96% Modulation (Continuous)	\$3,892	\$9,041	\$12,933	-\$952	90%	2.1%	8%	37	84

\* “No impact” means that the base case forecast furnace assigned to the household has greater efficiency than the level indicated, so the household is not affected.

\*\* Based on the payback calculation, a very small change in operating cost can result in a few extremely large paybacks, which will skew the average payback. In these cases, median is probably a better indicator.

## REFERENCES

1. U.S. Department of Energy - Energy Information Administration. *Residential Energy Consumption Survey: Household Energy Consumption and Expenditures 2001*. 2001. (Last accessed May 18, 2005.)  
<<http://www.eia.doe.gov/emeu/recs/recs2001/publicuse2001.html>>