CHAPTER 12. LIFE-CYCLE COST SUBGROUP ANALYSIS

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CHAPTER 12. LIFE-CYCLE COST SUBGROUP ANALYSIS

12.1 INTRODUCTION

Chapter 8 describes the Life-Cycle Cost (LCC) and Payback Period (PBP) Analysis that examines impacts of energy efficiency standards on the U.S. population. In analyzing the potential impact of new or amended standards on residential and commercial consumers, DOE further evaluates the impact on identifiable groups of consumers (i.e., subgroups) that may be disproportionately affected by a national standard level. The LCC subgroup analysis evaluates impacts by analyzing the LCC and PBPs for subgroups of households or commercial consumers. For cooking products, DOE identified two consumer subgroups that warranted further study: households composed of people 65 years of age or older (senior-only) and households at or below the poverty line (low-income).

DOE determined the impact on consumer subgroups for cooking products using the LCC Spreadsheet Model, which allows for the examination of particular consumer subgroups. The LCC analysis for the general population (described in Chapter 8) focuses on the households that use cooking products. DOE has the ability to use the LCC Spreadsheet Model to analyze the LCC for any subgroup by sampling only the data that apply to that subgroup. (Chapter 8 explains in detail the inputs to the model used in determining LCC and PBPs.) As described in section 12.3, the energy use and energy price characteristics of the two subgroups (senior-only and low-income households) are different than that for the general population.

This chapter describes the subgroup identification in further detail and gives the results of the LCC and PBP analyses for cooking products. Section 12.4 details the results for the cooking products (cooktops, ovens, and microwave ovens).

The technical support document (TSD) for DOE's notice of proposed rulemaking (NOPR) covered conventional cooking products (i.e., cooktops and ovens), microwave oven energy factor (EF), microwave oven standby power consumption, and commercial clothes washers (CCW).[1] This chapter presents information and results pertaining solely to conventional cooking products and microwave oven EF. The impact of more-efficient equipment on microwave oven standby power and CCWs will be addressed in subsequent TSDs.

12.2 SUBGROUP DEFINITIONS

DOE considered two subgroups for the LCC and PBP analyses for cooking products (cooktops, ovens, and microwave ovens). The two subgroups comprised: (1) households with senior-only occupants and (2) households with incomes at or below the poverty line. This section describes the subgroup identification process.

12.2.1 Senior-Only Households

Senior-only households have occupants who are all at least 65 years of age. Based on DOE's Energy Information Administration (EIA)'s Residential Energy Consumption Survey of 2001 (RECS 2001), senior-only households comprise 18 percent of the country's households.[2]

12.2.2 Low-Income Households

As defined in DOE's RECS 2001,[1] the "poverty line" varies with household size, head of household age, and family income. Table 12.2.1 summarizes the criteria given for selecting low-income households from the RECS 2001 sample.

Table 12.2.1 RECS 2001 Definitions of Low-Income Households

Household Size	Owner Age	Family Income
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

12.3 INPUTS TO THE SUBGROUP ANALYSIS FOR SENIOR-ONLY AND LOW-INCOME HOUSEHOLDS

DOE performed the consumer subgroup analysis by analyzing the LCC and PBP of senior-only or low-income households with the spreadsheet models used for the LCC and PBP analysis. With the exception of energy use and energy prices, DOE used the same inputs in the subgroup analysis as it used for the general population. Because the senior-only and low-income household samples are smaller than that for the general population, the energy use and energy price characteristics will be different.

Table 12.3.1 summarizes the household population, weighted-average annual cooking energy use, and energy prices for the senior-only and low-income households analyzed in the consumer subgroup analysis for electric and gas cooktops. Each of the above values is compared to the weighted-average values for the general population. In general, the annual cooking energy

use and energy prices for the two consumer subgroups are roughly the same as the general population.

Table 12.3.1 Electric and Gas Cooktops: Comparison of Input Values for All Households, Senior-Only Households, and Low-Income Households

Category	All Households	Senior-Only	Low-Income
Electric Cooktops			
Household Population Data			
Number of Household Records	2896	557	340
Sum of Weights (million households)	64,345,040	12,716,529	7,773,433
Percent of Household Population	-	19.8%	12.1%
Weighted-Average Annual Cooking Energy Use			
Electricity (kWh/year)	128.2	127.7	132.3
Weighted-Average Energy Prices (2006$)			
Electricity Price (¢/kWh)	10.5	11.6	10.2
Gas Cooktops			
Household Population Data			
Number of Household Records	1598	218	289
Sum of Weights (million households)	36,557,346	5,040,286	6,261,018
Percent of Household Population	-	13.8%	17.1%
Weighted-Average Annual Cooking Energy Use			
Natural Gas (MMBtu/year)	0.724	0.718	0.779
Weighted-Average Energy Prices (2006$)			
Natural Gas Price ($/therm)	14.99	15.16	14.95

Table 12.3.2 summarizes the household population, weighted-average annual cooking energy use, and energy prices for the senior-only and low-income households analyzed in the consumer subgroup analysis for electric and gas ovens. Each of the above values is compared to the weighted-average values for the general population. In general, the energy prices for the two consumer subgroups are roughly the same as the general population but there are significant differences in some of the annual cooking energy use values.

Table 12.3.2 Electric and Gas Ovens: Comparison of Input Values for All Households, Senior-Only Households, and Low-Income Households

Category	All Households	Senior-Only	Low-Income
Electric Standard Ovens			
Household Population Data			
Number of Household Records	1460	267	247
Sum of Weights (million households)	32,392,395	5,963,913	5,533,775
Percent of Household Population	-	18.4%	17.1%
Weighted-Average Annual Cooking Energy Use			
Electricity (kWh/year)	132.4	100.6	131.5
Weighted-Average Energy Prices (2006$)			
Electricity Price (¢/kWh)	10.4	10.2	10.4
Electric Self-Cleaing Ovens			
Household Population Data			
Number of Household Records	1302	254	72
Sum of Weights (million households)	28,637,032	5,781,754	1,707,285
Percent of Household Population	-	20.2%	6.0%
Weighted-Average Annual Cooking Energy Use			
Electricity (kWh/year)	116.6	120.8	133.9
Weighted-Average Energy Prices (2006$)			
Electricity Price (¢/kWh)	10.7	10.1	10.9
Gas Standard Ovens			
Household Population Data			
Number of Household Records	1082	121	233
Sum of Weights (million households)	24,414,838	2,760,101	5,053,019
Percent of Household Population	-	11.3%	20.7%
Weighted-Average Annual Cooking Energy Use			
Gas (MMBtu/year)	0.82	0.66	0.77
Weighted-Average Energy Prices (2006$)			
Natural Gas Price ($/therm)	15.00	15.07	15.50
Gas Self-Cleaning Ovens			
Household Population Data			
Number of Household Records	373	56	29
Sum of Weights (million households)	8,709,722	1,369,743	635,749
Percent of Household Population	-	15.7%	7.3%
Weighted-Average Annual Cooking Energy Use			
Gas (MMBtu/year)	0.68	0.50	0.54
Weighted-Average Energy Prices (2006$)			
Natural Gas Price ($/therm)	15.03	15.00	14.97

Table 12.3.3 summarizes the household population, weighted-average annual cooking energy use, and energy prices for the senior-only and low-income households analyzed in the consumer subgroup analysis for microwave ovens. Each of the above values is compared to the weighted-average values for the general population. In general, the energy prices for the two consumer subgroups are roughly the same as the general population. The annual cooking energy use for the low-income subgroup is significantly greater than the general population.

Table 12.3.3 Microwave Ovens: Comparison of Input Values for All Households, Senior-Only Households, and Low-Income Households

Category	All Households	Senior-Only	Low-Income
Household Population Data			
Number of Household Records	4150	689	496
Sum of Weights (million households)	92,147,608	15,533,938	11,013,087
Percent of Household Population	-	16.9%	12.0%
Weighted-Average Annual Cooking Energy Use			
Electricity (kWh/year)	131.0	128.5	149.2
Weighted-Average Energy Prices (2006$)			
Electricity Price (¢/kWh)	10.8	10.5	10.8

12.4 RESULTS FOR COOKING PRODUCT SUBGROUPS

Tables 12.4.1 through 12.4.6 below summarize the LCC results for low-income and senior-only households for each of the cooking products: cooktops, ovens, and microwave ovens. For each product two tables are displayed and candidate standard levels (CSL) and trial standard levels (TSL) are listed. The LCC results provide the average or mean LCC, the relative LCC savings or costs, and the percentage of consumers that are burdened with net costs, realize net savings, or incur no impact.

Table 12.4.1 Electric and Gas Cooktops: LCC and PBP Results for Low-Income Households

CSL	TSL	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		
Electric – Open Coil Elements										
Baseline	1	$272	$180	$452	-	-	-	-	-	-
1	2, 3, 4	$276	$172	$448	$4.2	31.9%	0.0%	68.1%	7.2	23.2
Electric – Smooth Elements										
Baseline	1, 2, 3	$309	$180	$489	-	-	-	-	-	-
1	4	$550	$177	$727	-$238.2	100.0%	0.0%	0.0%	1,490.9	4,807.7
Gas Cooktops										
Baseline	-	$310	$561	$871	-	-	-	-	-	-
1	1, 2, 3	$335	$245	$580	$21.5	0.2%	90.2%	9.6%	4.5	3.6
2	4	$364	$239	$603	-$1.1	90.5%	0.0%	9.5%	64.2	153.5

* "No impact" means that the base case forecast cooktop 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 12.4.2 Electric and Gas Cooktops: LCC and PBP Results for Senior-Only Households

CSL	TSL	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		
Electric – Open Coil Elements										
Baseline	1	$273	$150	$422	-	-	-	-	-	-
1	2, 3, 4	$276	$144	$419	$2.9	42.0%	0.0%	58.0%	8.9	20.7
Electric – Smooth Elements										
Baseline	1, 2, 3	$309	$150	$459	-	-	-	-	-	-
1	4	$551	$148	$698	-$239.1	100.0%	0.0%	0.0%	1,835.3	4,284.4
Gas Cooktops										
Baseline	-	$310	$558	$868	-	-	-	-	-	-
1	1, 2, 3	$332	$237	$569	$15.8	0.0%	93.6%	6.4%	4.0	3.0
2	4	$361	$231	$592	-$7.2	93.6%	0.0%	6.4%	69.8	146.7

* "No impact" means that the base case forecast cooktop 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 12.4.3 Electric and Gas Ovens: LCC and PBP Results for Low-Income Households

CSL	TSL	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		
Electric – Standard Oven										
Baseline	1	$414	$225	$639	-	-	-	-	-	-
1	-	$416	$216	$632	$6.3	39.1%	0.0%	60.9%	7.7	46.7
2	2, 3	$421	$208	$629	$10.0	48.3%	0.0%	51.7%	11.6	70.4
3	-	$426	$205	$631	$7.5	54.5%	0.0%	45.5%	17.6	106.4
4	-	$484	$201	$685	-$46.3	92.6%	0.0%	7.4%	83.4	505.5
5	4	$489	$201	$689	-$50.9	93.4%	0.0%	6.6%	87.5	530.4
Electric – Self-cleaning Oven										
Baseline	1, 2, 3	$484	$250	$734	-	-	-	-	-	-
1	-	$490	$249	$740	-$101.3	73.8%	0.0%	26.2%	152.4	997.2
2	4	$548	$245	$793	-$154.5	79.1%	0.0%	20.9%	206.6	1,352.1
Gas Standard Oven										
Baseline	-	$430	$400	$831	-	-	-	-	-	-
1a	1, 2, 3	$465	$258	$723	$8.7	5.7%	82.3%	12.0%	9.4	7.3
1	-	$461	$494	$955	-$32.6	17.7%	82.3%	0.0%	11.4	8.8
2	-	$466	$486	$952	-$48.7	69.8%	0.0%	30.2%	14.0	74.5
3	-	$468	$484	$952	-$48.9	71.0%	0.0%	29.0%	14.2	83.1
4	-	$500	$481	$981	-$77.8	92.1%	0.0%	7.9%	23.9	522.8
5	-	$502	$480	$983	-$79.5	92.3%	0.0%	7.7%	24.5	1,390.8
6	4	$508	$479	$987	-$83.9	93.4%	0.0%	6.6%	26.9	747.4
Gas Self-Cleaning Oven										
Baseline	1, 2	$551	$583	$1,135	-	-	-	-	-	-
1	3	$567	$570	$1,137	-$2.5	66.9%	0.0%	33.1%	16.7	180.2
2	-	$574	$569	$1,143	-$8.5	72.8%	0.0%	27.2%	23.9	290.8
3	4	$575	$569	$1,144	-$9.6	73.5%	0.0%	26.5%	26.5	923.8

* "No impact" means that the base case forecast cooktop 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 12.4.4 Electric and Gas Ovens: LCC and PBP Results for Senior-Only Households

CSL	TSL	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		
Electric – Standard Oven										
Baseline	1	$413	$192	$605	-	-	-	-	-	-
1	-	$416	$185	$600	$4.6	42.8%	0.0%	57.2%	10.6	46.9
2	2, 3	$420	$178	$598	$6.7	53.6%	0.0%	46.4%	16.0	70.8
3	-	$426	$176	$601	$3.6	61.3%	0.0%	38.7%	24.2	107.0
4	-	$483	$173	$656	-$50.8	95.8%	0.0%	4.2%	114.9	508.4
5	4	$488	$172	$661	-$55.5	96.5%	0.0%	3.5%	120.6	533.5
Electric – Self-cleaning Oven										
Baseline	1, 2, 3	$484	$267	$751	-	-	-	-	-	-
1	-	$491	$266	$757	-$151.9	80.6%	0.0%	19.4%	152.0	1,134.3
2	4	$548	$262	$810	-$204.9	85.6%	0.0%	14.5%	206.1	1,537.9
Gas Standard Oven										
Baseline	-	$431	$398	$829	-	-	-	-	-	-
1a	1, 2, 3	$464	$250	$714	$8.8	4.7%	84.2%	11.2%	9.5	6.9
1	-	$459	$479	$938	-$26.8	15.8%	84.2%	0.0%	10.9	7.8
2	-	$464	$471	$935	-$43.0	70.6%	0.0%	29.4%	15.0	88.7
3	-	$466	$470	$936	-$43.3	71.8%	0.0%	28.2%	16.4	99.0
4	-	$498	$466	$964	-$71.8	92.4%	0.0%	7.7%	29.8	938.7
5	-	$501	$465	$966	-$73.6	92.6%	0.0%	7.4%	30.9	319.5
6	4	$506	$464	$970	-$78.0	93.5%	0.0%	6.5%	33.2	518.0
Gas Self-Cleaning Oven										
Baseline	1, 2	$551	$578	$1,129	-	-	-	-	-	-
1	3	$567	$565	$1,132	-$2.5	71.8%	0.0%	28.2%	34.6	512.2
2	-	$573	$564	$1,138	-$8.5	76.9%	0.0%	23.1%	47.6	400.8
3	4	$575	$564	$1,139	-$9.6	77.5%	0.0%	22.5%	49.8	325.2

* "No impact" means that the base case forecast cooktop 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 12.4.5 Microwave Ovens: LCC and PBP Results for Low-Income Households

CSL / TSL	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		
Baseline	$220	$140	$360	-	-	-	-	-	-
1	$233	$135	$367	-$7.0	88.3%	0.0%	11.7%	29.9	115.4
2	$246	$134	$381	-$20.1	96.1%	0.0%	4.0%	58.1	224.0
3	$267	$133	$400	-$39.7	98.5%	0.0%	1.5%	82.8	319.5
4	$294	$132	$426	-$65.8	99.8%	0.0%	0.2%	116.6	449.9

* "No impact" means that the base case forecast cooktop 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 12.4.6 Microwave Ovens: LCC and PBP Results for Senior-Only Households

CSL / TSL	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		
Baseline	$220	$130	$350	-	-	-	-	-	-
1	$232	$125	$357	-$7.5	91.5%	0.0%	8.5%	28.9	76.3
2	$246	$125	$370	-$20.7	97.9%	0.0%	2.1%	56.1	148.0
3	$267	$123	$390	-$40.4	99.1%	0.0%	0.9%	80.0	211.1
4	$294	$122	$416	-$66.6	99.7%	0.0%	0.3%	112.7	297.3

* "No impact" means that the base case forecast cooktop 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.

The low-income and senior-only consumer subgroups show the same trend in average LCC differences and consumer impacts (i.e., percentage of consumers significantly or insignificantly impacted) as the overall sample. For all three cooking products, the average LCC costs, savings and payback periods for low-income and senior-only households mirror the savings for the general population.

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