

## CHAPTER 10: CONSUMER SUB-GROUP ANALYSIS

### 10.1 INTRODUCTION

The intent of the consumer sub-group analysis is to evaluate impacts to any identifiable groups or consumers who may be disproportionately affected by any national energy efficiency standard-level. This is accomplished in part by analyzing the life-cycle cost and payback periods for those households that fall into any identifiable groups or consumers.

### 10.2 SUB-GROUP ANALYSIS DEFINED

The consumer sub-group analysis evaluated those central air conditioner and heat pump households with low-income levels. As defined by the 1997 Residential Energy Consumption Survey (RECS)<sup>1</sup>, low-income households are considered to be 100% of the “poverty line”. The “poverty line” varies with household size, household owner age, and family income. Table 10.1 summarizes 100% of the “poverty line” as defined by the 1997 RECS.

**Table 10.1 1997 RECS Definitions of Low-Income Households at 100% of Poverty Line**

| 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 |

#### 10.2.1 Inputs to the Life-Cycle Cost and Payback Period Sub-Group Analysis

The consumer sub-group analysis was accomplished by analyzing the life-cycle cost and payback periods of households considered to be low-income with the spreadsheet models used for the LCC Analysis. The same inputs as used in the Life-Cycle Cost and Payback Period Analysis (as described in

Chapter 5) were used in the sub-group analysis, with the exception that only those central air conditioner and heat pump households considered to be low-income were analyzed.

Table 10.2 summarizes the *weighted-average* input values for the low-income households analyzed in the consumer sub-group analysis and compares them to the *weighted-average* input values for all households in the 1997 RECS utilizing central air conditioners and heat pumps. Other than the sample size, the low-income sub-group differs significantly from the overall sample in that the average and marginal electricity prices are both significantly lower. In addition, for those households with heat pumps, the low-income sub-group households have significantly lower space-cooling and space-heating energy consumption than the overall sample.

**Table 10.2 Comparison of Input Values for All Households and Low-Income Households**

| Category  | Central Air Conditioners |            | Heat Pumps     |            |
|---|--------------------------|------------|----------------|------------|
|   | All Households           | Low-Income | All Households | Low-Income |
| <b>Household Population Data</b>                              |                          |            |                |            |
| Number of Households  | 1218                     | 93         | 308            | 32         |
| Sum of Weights  | 23,420,428               | 1,574,922  | 6,271,340      | 571,001    |
| Percent of AC or HP Household Population                      | -                        | 6.7%       | -              | 9.1%       |
| <b>Weighted-Average Annual Energy Use and Efficiency Data</b> |                          |            |                |            |
| Stock Space-Cooling Energy Use (kWh/yr)                       | 2132                     | 2256       | 2585           | 1983       |
| Stock Space-Cooling Efficiency (SEER)                         | 9.13                     | 8.99       | 9.32           | 9.48       |
| Baseline Space-Cooling Energy Use                             | 1947                     | 2025       | 2409           | 1881       |
| Stock Space-Heating Energy Use (kWh/yr)                       | -                        | -          | 3921           | 3705       |
| Stock Space-Heating Efficiency (HSPF)                         | -                        | -          | 6.77           | 6.82       |
| Baseline Space-Heating Energy Use                             | -                        | -          | 3904           | 3713       |
| <b>Weighted-Average Electricity Prices</b>                    |                          |            |                |            |
| Average Electricity Price (¢/kWh)                             | 8.90                     | 8.58       | 7.39           | 7.48       |
| Marginal Electricity Price (¢/kWh)                            | 8.62                     | 8.21       | 6.86           | 6.84       |

The input variables shown in Table 10.2 here are those determined by data in the 1997 RECS. Other input variables described in Chapter 5 for the LCC and Payback Period Analysis such as lifetime and discount rate are held constant for the sub-group analysis.

### 10.2.2 Life-Cycle Cost and Payback Period Consumer Sub-Group Results

Tables 10.3 through 10.6 below summarize the LCC results for low-income households for each of the four primary product classes, as well as comparing them to the results for the total sample of households and commercial buildings used in the overall LCC Analysis. For efficiency-levels of 11 through 13 SEER and 18 SEER (“maxtech”), the LCC results provide the average or mean LCC, the relative LCC

savings or costs, and the percentage of consumers that achieve *significant* net costs, *significant* net savings, or no *significant* impacts. As described in Chapter 5 (Section 5.2.4.4, *LCC Results based on ±2% Threshold*), *significant* is defined as those consumers experiencing net LCC savings or costs which are greater than 2% of the baseline LCC.

**Table 10.3 Split A/C: LCC Result Comparisons between Low-Income Households and Overall Sample**

| Efficiency SEER | Low-Income Households |                         |                   |                   |                 | All Households and Commercial Buildings |                         |                   |                   |                 |
|-----------------|-----------------------|-------------------------|-------------------|-------------------|-----------------|---|-------------------------|-------------------|-------------------|-----------------|
|                 | Average LCC           | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) | Average LCC                             | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) |
| 10              | \$4,906               | -                       | -                 | -                 | -               | \$5,170                                 | -                       | -                 | -                 | -               |
| 11              | \$4,887               | (\$19)                  | 17%               | 66%               | 17%             | \$5,126                                 | (\$44)                  | 23%               | 68%               | 9%              |
| 12              | \$4,903               | (\$3)                   | 20%               | 29%               | 51%             | \$5,125                                 | (\$45)                  | 27%               | 34%               | 39%             |
| 13              | \$5,007               | \$101                   | 17%               | 14%               | 69%             | \$5,199                                 | \$29                    | 25%               | 17%               | 58%             |
| 18              | \$5,598               | \$692                   | 10%               | 2%                | 88%             | \$5,725                                 | \$555                   | 15%               | 4%                | 81%             |

**Table 10.4 Split Heat Pump: LCC Result Comparisons between Low-Income Households and Overall Sample**

| Efficiency SEER | Low-Income Households |                         |                   |                   |                 | All Households and Commercial Buildings |                         |                   |                   |                 |
|-----------------|-----------------------|-------------------------|-------------------|-------------------|-----------------|---|-------------------------|-------------------|-------------------|-----------------|
|                 | Average LCC           | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) | Average LCC                             | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) |
| 10              | \$8,965               | -                       | -                 | -                 | -               | \$9,679                                 | -                       | -                 | -                 | -               |
| 11              | \$8,890               | (\$75)                  | 16%               | 84%               | 0%              | \$9,529                                 | (\$150)                 | 30%               | 70%               | 0%              |
| 12              | \$8,862               | (\$103)                 | 27%               | 64%               | 9%              | \$9,437                                 | (\$242)                 | 42%               | 55%               | 3%              |
| 13              | \$8,948               | (\$17)                  | 25%               | 40%               | 35%             | \$9,464                                 | (\$215)                 | 39%               | 39%               | 22%             |
| 18              | \$9,610               | \$645                   | 11%               | 8%                | 81%             | \$9,955                                 | \$276                   | 23%               | 11%               | 66%             |

**Table 10.5 Package A/C: LCC Result Comparisons between Low-Income Households and Overall Sample**

| Efficiency SEER | Low-Income Households |                         |                   |                   |                 | All Households and Commercial Buildings |                         |                   |                   |                 |
|-----------------|-----------------------|-------------------------|-------------------|-------------------|-----------------|---|-------------------------|-------------------|-------------------|-----------------|
|                 | Average LCC           | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) | Average LCC                             | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) |
| 10              | \$5,327               | -                       | -                 | -                 | -               | \$5,629                                 | -                       | -                 | -                 | -               |
| 11              | \$5,371               | \$44                    | 11%               | 42%               | 47%             | \$5,649                                 | \$20                    | 16%               | 47%               | 37%             |
| 12              | \$5,341               | \$14                    | 20%               | 27%               | 53%             | \$5,600                                 | (\$29)                  | 26%               | 30%               | 44%             |
| 13              | \$5,568               | \$241                   | 12%               | 9%                | 79%             | \$5,804                                 | \$175                   | 18%               | 11%               | 71%             |
| 18              | \$6,158               | \$831                   | 10%               | 2%                | 88%             | \$6,370                                 | \$741                   | 12%               | 4%                | 84%             |

**Table 10.6 Package Heat Pump: LCC Result Comparisons between Low-Income Households and Overall Sample**

| Efficiency SEER | Low-Income Households |                         |                   |                   |                 | All Households and Commercial Buildings |                         |                   |                   |                 |
|-----------------|-----------------------|-------------------------|-------------------|-------------------|-----------------|---|-------------------------|-------------------|-------------------|-----------------|
|                 | Average LCC           | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) | Average LCC                             | Avg LCC (Savings) Costs | Net Savings (>2%) | No Signif. Impact | Net Costs (>2%) |
| 10              | \$9,149               | -                       | -                 | -                 | -               | \$9,626                                 | -                       | -                 | -                 | -               |
| 11              | \$9,057               | (\$92)                  | 21%               | 78%               | 1%              | \$9,492                                 | (\$134)                 | 28%               | 72%               | 0%              |
| 12              | \$8,973               | (\$176)                 | 35%               | 53%               | 12%             | \$9,372                                 | (\$254)                 | 44%               | 49%               | 7%              |
| 13              | \$9,145               | (\$4)                   | 25%               | 27%               | 48%             | \$9,514                                 | (\$112)                 | 33%               | 31%               | 36%             |
| 18              | \$9,619               | \$470                   | 18%               | 8%                | 74%             | \$9,922                                 | \$296                   | 24%               | 10%               | 66%             |

The low-income consumer sub-group shows the same trend in average LCC differences and consumer impacts (i.e., percentage of consumers significantly or insignificantly impacted) as the overall sample. But in general, the benefits of moving to a higher efficiency-less are less in the case of the low-income sub-group. For those efficiency levels which achieve average LCC savings for the overall sample, the average LCC savings for the low-income subgroup are lower or become LCC costs. Also, the combined percentage of low-income consumers who achieve significant net savings and no significant impacts are less than in the overall sample. This can be explained by examining the average and marginal electricity prices. For low-income households, the average and marginal electricity prices are lower than the overall sample. Although this leads to life-cycle costs which are lower than in the overall sample, the amount of electricity savings achievable through an efficiency increase are less. Thus, the size of the LCC savings are also less.

An analysis on the effects on payback period by the low-income sub-group are shown below for each of the four primary product classes in Figures 10.1 through 10.4. In agreement with the LCC results, both the mean and median payback periods for the low-income sub-group are somewhat longer than for the overall population. The primary reason for the longer payback periods is the same as for the LCC analysis, namely, electricity savings are lower due to the lower marginal electricity costs in the low-income sub-group.

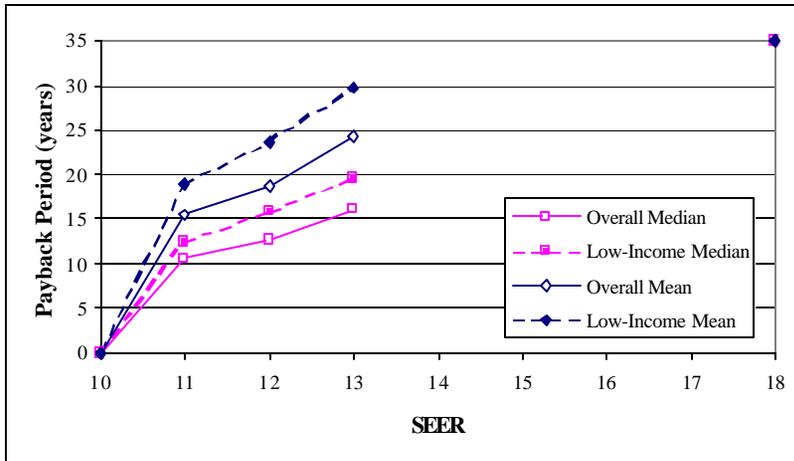


Figure 10.1 Split A/C: Comparison of Median and Mean Payback Periods between Low-Income Households and the Overall Sample

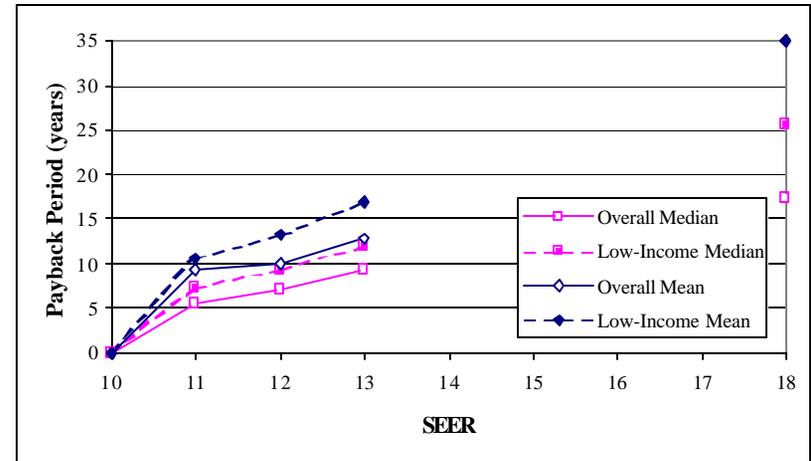


Figure 10.2 Split HP: Comparison of Median and Mean Payback Periods between Low-Income Households and the Overall Sample

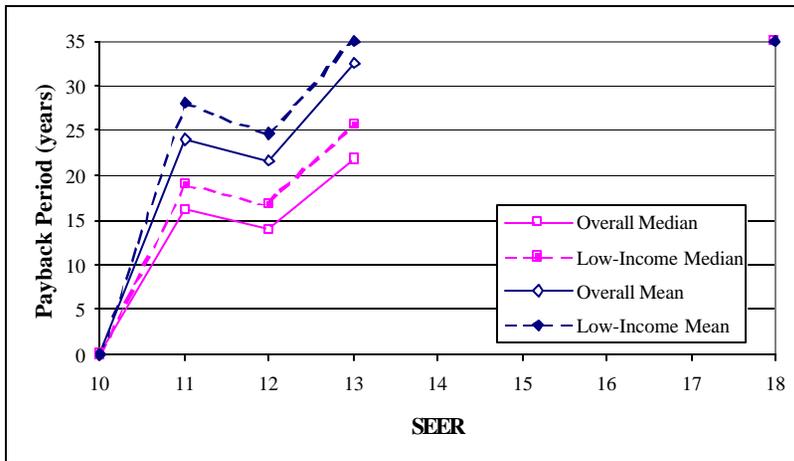


Figure 10.3 Package A/C: Comparison of Median and Mean Payback Periods between Low-Income Households and the Overall Sample

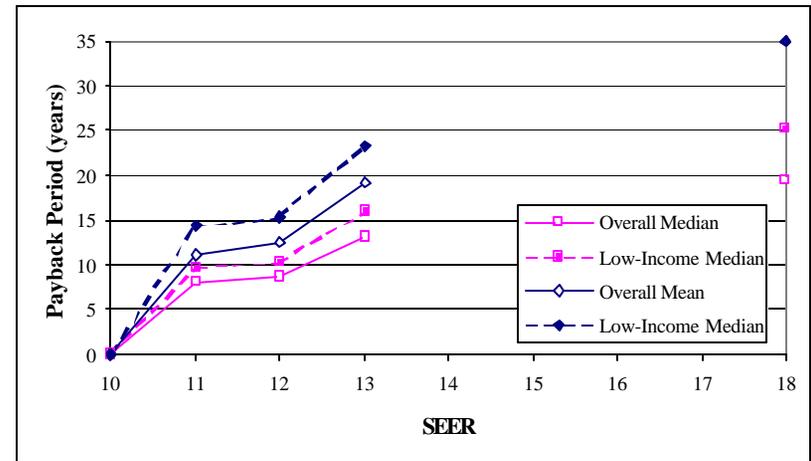


Figure 10.4 Package HP: Comparison of Median and Mean Payback Periods between Low-Income Households and the Overall Sample

## REFERENCES

1. U.S. Department of Energy-Energy Information Administration, *A Look at Residential Energy Consumption in 1997, 1999*. Washington, DC. Report No. DOE/EIA-0632(97).  
EIA website: <<http://www.eia.doe.gov/pub/pdf/consumption/063297.pdf>>