

**APPENDIX P. USER INSTRUCTIONS FOR LIFE-CYCLE COST (LCC) AND  
PAYBACK PERIOD (PBP) SPREADSHEETS**

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## APPENDIX P. USER INSTRUCTIONS FOR LIFE-CYCLE COST (LCC) AND PAYBACK PERIOD (PBP) SPREADSHEETS

### P.1 User Instructions for Tariff-Based Spreadsheet

It is possible to examine and reproduce the detailed results of the tariff-based LCC and PBP analyses using a Microsoft Excel® spreadsheet available on the U.S. Department of Energy's website at: [http://www.eere.energy.gov/buildings/appliance\\_standards/commercial/ac\\_hp.html](http://www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html).

The spreadsheet is called "comm-ac\_tariff.xls" and it allows the user to perform tariff-based LCC analyses of either 7.5-ton air conditioners (representing the  $\geq 65,000$  Btu/h to  $< 135,000$  Btu/h equipment class) or 15-ton air conditioners (representing the  $\geq 135,000$  Btu/h to  $< 240,000$  Btu/h equipment class). To fully execute the spreadsheet requires both Microsoft Excel® and Crystal Ball® software. Both applications are commercially available. Crystal Ball® is available at <http://www.decisioneering.com>.

The spreadsheet posted on the DOE website represents the latest version of the applicable model and has been tested with Microsoft Excel® 2000. The tariff-based LCC spreadsheet or workbook consists of the following worksheets:

<b>Summary</b>	Contains the input selections and a summary table of energy use, operating costs, LCC, and Payback.
<b>Engineering</b>	Contains the manufacturer price data for 7.5-ton and 15-ton systems at each efficiency level. Also includes the wholesale, general contractor, mechanical contractor, and national accounts markups, the sales tax, the installation price, and the repair and maintenance costs.
<b>Bldg Records with Annual Bills</b>	For each commercial building simulated, contains the annual energy expense at each efficiency level. Also includes data showing the annual air conditioner energy expense, annual air conditioner energy use, and average and marginal electricity prices. Summary information for each building record is also provided.
<b>Installation Cost by State</b>	Contains multipliers to vary the installation cost by State.
<b>Energy Price</b>	Contains projections of future energy prices from the <i>AEO2003</i> .
<b>Discount Rate</b>	Contains data from which an average discount rate and a distribution of discount rates are determined.

**Lifetime**                      Contains the survival function for commercial unitary air conditioners and the average commercial unitary air conditioner lifetime in years.

**Setup**                              This is used as an interface between user inputs and the rest of the worksheets -- do not modify this sheet.

Basic instructions for operating the LCC spreadsheets are as follows:

1. Once you have downloaded the LCC file from the Web, open the file using Excel. At the bottom, click on the tab for sheet **Summary**.
2. Use Excel's "View/Zoom" commands at the top menu bar to change the size of the display to make it fit your monitor.
3. The user interacts with the spreadsheet by clicking choices or entering data using the graphical interface that comes with the spreadsheet. Select choices from the various inputs listed under "User Options" heading.

Under the "User Options" heading, select choices from the selection buttons and boxes for the following: (1) type of calculation (Sample or Crystal Ball<sup>®</sup>), (2) energy price projection, (3) start year, (4) equipment class, (5) installation cost projection, and (6) repair cost projection. A new discount rate or lifetime can also be entered if a value other than the default value or default distribution is wanted; however, this changes the code. As a result, the Department does not recommend saving the spreadsheet after the code is changed.

4. To change inputs listed under "User Options", select the input you wish to change by either clicking on the appropriate button or selecting the appropriate input from the input box.
5. This spreadsheet gives the user two types of calculation methods:
  - a. If the "Sample Calculation" is selected, then all calculations are performed for single input values, usually an average. The new results are shown on the same sheet as soon as the new values are entered.
  - b. Alternately, if the "Crystal Ball Calculation" is selected, the spreadsheet generates results that are distributions. Some of the inputs are also distributions. The results from the LCC distribution are shown as single values and refer only to the results from the last Monte Carlo sample and are therefore not meaningful. To run the distribution version of the spreadsheet, the Microsoft Excel<sup>®</sup> add-in software called Crystal Ball<sup>®</sup> must be enabled.

To produce sensitivity results using Crystal Ball<sup>®</sup>, simply select **Run** from the **Run** menu (on the menu bar). To make basic changes in the run sequence, including altering the number of trials, select **Run Preferences** from the **Run** menu. After each simulation run, the user needs to select **Reset** (also from the **Run** menu) before **Run** can be selected again. Once Crystal Ball<sup>®</sup> has completed its run sequence it will produce a series of distributions. Using the menu bars on the distribution results, it is possible to obtain further statistical information. The time taken to complete a run sequence can be reduced by minimizing the Crystal Ball<sup>®</sup> window in Microsoft Excel<sup>®</sup>. A step-by-step summary of the procedure for running a distribution analysis is outlined below:

1. Find the Crystal Ball toolbar (at top of screen)
2. Click on **Run** from the menu bar
3. Select **Run Preferences** and choose from the following choices:
  - a. Monte Carlo<sup>a</sup>
  - b. Latin Hypercube (recommended)
  - c. Initial seed choices and whether you want it to be constant between runs
  - d. Select number of Monte Carlo Trials (the Department suggests 10,000).
4. To run the simulation, follow the following sequence (on the Crystal Ball toolbar)

**Run**

**Reset**

**Run**

5. Now wait until the program informs you that the simulation is completed.

The following instructions are provided to view the output generated by Crystal Ball<sup>®</sup>.

1. After the simulation has finished, to see the distribution charts generated, click on the Windows tab bar that is labeled Crystal Ball<sup>®</sup>.
2. The life-cycle cost savings and payback periods are defined as **Forecast** cells. The *frequency* charts display the results of the simulations, or trials, performed by Crystal Ball<sup>®</sup>. Click on any chart to bring it into view. The charts show the low and high

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<sup>a</sup> Because of the nature of the program, there is some variation in results due to random sampling when Monte Carlo or Latin Hypercube sampling is used.

endpoints of the forecasts. The *View* selection on the Crystal Ball® toolbar can be used to specify whether you want cumulative or frequency plots shown.

3. To calculate the probability that a particular value of LCC savings will occur, either type 0 in the box by the left arrow, or move the arrow key with the cursor to 0 on the scale. The value in the *Certainty* box shows the likelihood that the LCC savings will occur. To calculate the certainty of payback period being below a certain number of years, choose that value as the high endpoint.
4. To generate a printout report, select *Create Report* from the **Run** menu. The toolbar choice of *Forecast Windows* allows you to select the charts and statistics in which you are interested. For further information on Crystal Ball® outputs, please refer to *Understanding the Forecast Chart* in the Crystal Ball® manual.

## **P.2 User Instructions for Hourly Based Spreadsheet**

It is possible to examine and reproduce the detailed results of the hourly based LCC and PBP analysis using a Microsoft Excel® spreadsheet available on the U.S. Department of Energy's website at: [http://www.eere.energy.gov/buildings/appliance\\_standards/commercial/ac\\_hp.html](http://www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html).

The spreadsheet is called "comm-ac\_hourly.xls" and allows the user to perform hourly based LCC and PBP analyses of either 7.5-ton air conditioners (representing the  $\geq 65,000$  Btu/h to  $< 135,000$  Btu/h equipment class) or 15-ton air conditioners (representing the  $\geq 135,000$  Btu/h to  $< 240,000$  Btu/h equipment class). To execute the spreadsheet fully requires both Microsoft Excel® and Crystal Ball® software. Both applications are commercially available. Crystal ball® is available at <http://www.decisioneering.com>.

The spreadsheet posted on the DOE website represents the latest version of the applicable model and has been tested with Microsoft Excel® 2000. The hourly based LCC spreadsheet or workbook consists of the same worksheets as the tariff-based LCC spreadsheet with the exception that the hourly based spreadsheet contains an additional worksheet called **Cost Formula**. The **Cost Formula** worksheet contains the necessary parameters for converting generation cost and peak demand savings into customer expense savings.

The user instructions for the hourly based LCC spreadsheet are identical to those for the tariff-based LCC spreadsheet.