

**APPENDIX 6A. USER INSTRUCTIONS FOR THE LIFE-CYCLE COST ANALYSIS  
SPREADSHEET FOR COMPUTER ROOM AIR CONDITIONERS**

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## **APPENDIX 6A. USER INSTRUCTIONS FOR THE LIFE-CYCLE COST ANALYSIS SPREADSHEET FOR COMPUTER ROOM AIR CONDITIONERS**

### **6A.1 USER INSTRUCTIONS**

The results obtained in this analysis can be examined and reproduced using the Microsoft Excel spreadsheets available on the U.S. Department of Energy's (DOE's) ASHRAE Equipment rulemaking website:

[http://www1.eere.energy.gov/buildings/appliance\\_standards/commercial/ashrae\\_products\\_docs\\_meeting.html](http://www1.eere.energy.gov/buildings/appliance_standards/commercial/ashrae_products_docs_meeting.html). From that page, follow the links to the notice of proposed rulemaking phase and then to Analytical Tools.

### **6A.2 STARTUP**

DOE's spreadsheet enables users to perform life-cycle cost (LCC) and payback period (PBP) analyses for each equipment class. One spreadsheet exists for all computer room air conditioning (CRAC) equipment classes.

To examine the spreadsheet, DOE assumes that the user has access to a personal computer with a hardware configuration capable of running Windows XP or later. All LCC spreadsheets require Microsoft Excel 2003 or later installed under the Windows operating system. Because certain variables inside the spreadsheets are defined as distributions, a copy of Crystal Ball (a commercially available add-on program) is required to view them.

### **6A.3 DESCRIPTION OF LIFE-CYCLE COST WORKSHEETS**

For all of the furnace product classes, DOE created a single spreadsheet containing a collection of worksheets. Each worksheet represents a conceptual component within the LCC calculation. To facilitate navigability and identify how worksheets are related, each worksheet contains an area on the extreme left showing variables imported to and exported from the current worksheet. Table 6A.3.1 lists the worksheets contained in the LCC spreadsheet.

**Table 6A.3.1 Key Worksheets in LCC Workbook**

<b>Worksheet</b>	<b>Description</b>
Labels	This is used as a go-between for user inputs and the rest of the worksheets. Do not modify this sheet.
LCC Summary	Contains the input selections and a summary table of energy and water use, operating costs, LCCs and PBP.
Crystal Ball	Contains outputs for each equipment class from the Crystal Ball/Monte Carlo analysis.
NIA Output	Not used. This sheet is hidden.
Econ Trends	Contains electricity and water price forecasts in a more organized table. Also contains price learning data inputs.
Markups	Contains data used to derive industry baseline and incremental markups.
Engineering	Contains the manufacturer price data for units at each efficiency level. Also contains data on harvest rates, utilization rates, energy and water consumption, and summarizes other engineering derived data.
Discounted Costs	Contains annual operating costs in cash flow tables.
Discount Rate	Contains all data used to calculate discount rates for each building type and an aggregate discount rate for the United States.
Electricity Prices	Contains <i>AEO2011</i> population-weighted electricity prices by state, <i>AEO2011</i> electricity price projections, electricity price ratios derived for the various building types using the 2003 Commercial Building Energy Consumption data.
Water Prices	Contains population-weighted water/wastewater prices by state, and water/wastewater price projections. Note: no water savings analysis is being done currently for this equipment. Not Used. This sheet is hidden
Installation Costs	Contains multipliers to vary the installation cost by state. Derived from data published by RS Means Publishers and Consultants.
Sales Tax	Contains data on sales tax rates by state and population data by state.
EnergyConsumption	Contains data on unit energy consumption for each CRAC equipment class for all estates at each efficiency level.
Population	Contains 2010 census data on population by state.
Maintenance and Repair Costs	Contains inputs for different schedules of maintenance and repair costs and summarizes the data in an annualized format.
Economizer	Contains selected market data to allocate the use of economizers to specific market segments
TSD Tables	Contains selected summary input and output information.
CB Results (multiple dates)	Contains Output Data from Selected Crystal Ball runs of the model.
Results for NIA	Contains Output Data formatted for use by the NIA model.

## 6A.4 BASIC INSTRUCTIONS FOR OPERATING THE LIFE-CYCLE COST SPREADSHEET

Basic instructions for operating the LCC spreadsheet are as follows.

<b>Step</b>	<b>Description</b>
1.	Once you have downloaded the LCC file from the DOE Appliances and Commercial Equipment Standards website, open the file using Excel. Select Yes when asked if you want to enable macros. At the bottom of the Excel window, click the tab for the Summary sheet. Note that if you plan to run the Monte Carlo routine, you will need to have Crystal Ball loaded as an add-in and activated.
2.	Use Excel's View/Zoom commands at the top menu bar to size the display to your monitor.
3.	You can interact with the spreadsheet by clicking choices or entering data using the graphical interface on the LCC Summary tab. Select choices from the various dropdown input boxes throughout the LCC Summary tab.
4.	From the user-defined input options, select from the buttons and boxes for the following: (1) assumed baseline level; (2) equipment class; (3) analysis year (year of purchase); (4) economic growth case; (5) year to discount costs to; (6) standard efficiency level; (7) building type; (8) state or region to analyze; (9) conservation program to model; (10) installation cost escalation; (11) repair cost escalation; (12) analysis type; (13) price learning toggle; and (14) discounting toggle. You can start a complete Crystal Ball simulation by clicking the Monte Carlo button. All inputs, with the exception of some conservation program inputs, are either dropdown option boxes or toggle boxes (checked boxes make the statement true).
4A.	Equipment classes are defined as particular combinations of equipment families and cooling method. Currently there 15 equipment classes. They can be selected individually in sensitivity mode and all classes can be run in Monte Carlo mode. Selecting a combination of equipment families, cooling methods, harvest rate bins, and ice-making processes results in a potential equipment class that has not been analyzed by DOE (because few or no shipments have been identified), and the Annual Electricity Bill shown on the Summary tab will be \$0 or blank.
4B.	There is room for up to eight possible efficiency levels, including the baseline efficiency level. All equipment classes currently have the baseline and four additional representative levels populated. If an equipment class contains fewer than eight levels, the calculated output cells of the extra levels will have no values on the LCC Summary tab.
5.	This spreadsheet gives the user two types of calculation methods: Sensitivity and Monte Carlo mode, using Crystal Ball.

- 5A. If base and sensitivity analysis is chosen, then all calculations are performed for a set of single input values, usually an average. The new results are shown on the Summary tab as soon as the input values are changes through a dropdown or toggle box.
- 5B. Alternatively, if the Monte Carlo option is chosen or if the button is clicked, the spreadsheet generates a set of results from calculations for each equipment class. For a number of inputs, the Crystal Ball software has custom distributions that it uses to set the level of the input. The model runs each of the studied classes in turn, performing 5,000 model runs for each. At the end of each equipment class run, the model records to the Crystal Ball tab a large number of outputs that you can then work with for further analyses. The Monte Carlo button executes a macro written in Visual Basic for applications to loop through all equipment classes and selected efficiency levels. The Monte Carlo analysis usually takes 1 to 1.5 hours to complete for all 15 equipment classes.