# The NIST "Building Life-Cycle Cost" (BLCC) Program (Version 3.0) User's Guide and Reference Manual

**Stephen R. Petersen**

**U.S. DEPARTMENT OF COMMERCE**
**National Institute of Standards**
**and Technology**
**Office of Applied Economics**
**Computing and Applied Mathematics**
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**NIST**

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# ABSTRACT

The NIST Building Life-Cycle Cost computer program (BLCC 3.0) provides economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems. It is especially useful for evaluating the costs and benefits of energy conservation projects in buildings. Two or more alternative designs can be evaluated to determine which has the lowest life-cycle cost. Economic measures, including net savings, savings-to-investment ratio, and adjusted internal rate of return, can be calculated for any design alternative relative to the designated base case. BLCC can be used for evaluating both Federal and private-sector projects. It complies with ASTM standards related to building economics as well as FEMP and OMB A-94 guidelines for economic analysis of Federal building projects. BLCC is designed to run on an IBM-PC or compatible microcomputer with approximately 640K of random access memory, with or without a hard disk. The BLCC program supersedes both the FBLCC and NBSLCC computer programs previously released by NIST (NBS).

PREFACE

The Building Life-Cycle Cost computer program, version 3.0, has been prepared as an aid to implementing life-cycle cost evaluations of potential energy conservation and renewable energy projects in new and existing Federal buildings.  It can also be used for evaluating similar projects in the private sector and at the state and local government levels.  BLCC 3.0 supersedes and incorporates both the Federal Building Life-Cycle Cost (FBLCC) and the National Bureau of Standards Life-Cycle Cost (NBSLCC) programs.  For the economic analysis of energy conservation investments in Federal buildings, BLCC complies with NBS Handbook 135, <u>Life-Cycle Costing Manual for the Federal Energy Management Program</u>.  For other investments in Federal buildings, BLCC complies with OMB Circular A-94, "Discount Rate to Be Used in Evaluating Time-distributed Costs and Benefits," March 27, 1972.  BLCC complies with the American Society for Testing and Materials (ASTM) standard practices for building economics, including E917 (Practice for Measuring Life-Cycle Costs of Buildings and Building Systems), E964 (Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems), E1057 (Practice for Measuring Internal Rates of Return for Investments in Buildings and Building Systems), and E1074 (Practice for Measuring Net Benefits for Investments in Buildings and Building Systems).

BLCC is the third of a four-volume set of reports which together provide a comprehensive set of methods, data, and computational tools for economic evaluation of such projects.  Included in the four-volume set are the following:

(1) <u>Life-Cycle Costing Manual for the Federal Energy Management Program</u>, National Institute of Standards and Technology, Handbook 135 (revised 1991).

Handbook 135 is a guide to understanding life-cycle costing and related methods of economic analysis as they are applied to Federal decisions.  It describes the required procedures and assumptions, defines and explains how to apply and interpret economic performance measures, gives examples of Federal decision problems and their solutions, explains how to use the energy price indices and discount factors which are updated annually in the supplement (2), and provides worksheets and other computational aids and instructions for calculating the required measures.


(2) <u>Energy Prices and Discount Factors for Life-Cycle Cost Analysis</u>, National Institute of Standards and Technology, (Annual Supplement to NIST Handbook 135 and NBS Special Publication 709), NISTIR 85-3273 (updated annually).

This report, which is updated annually, gives the energy price and discount factor multipliers needed to estimate the present value of energy and other future costs.  The data are based on energy price projections developed by the Energy Information Administration of the U.S. Department of Energy. Request the latest edition.

(3) The NIST "Building Life-Cycle Cost" (BLCC) Computer Program (version 3.0), National Institute of Standards and Technology, 1990.

The NIST Building Life-Cycle Cost computer program (BLCC 3.0) provides economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems. It is especially useful for evaluating the costs and benefits of energy conservation projects in buildings. Two or more alternative designs can be evaluated to determine which has the lowest life-cycle cost. Economic measures, including net savings, savings-to-investment ratio, and adjusted internal rate of return, can be calculated for any design alternative relative to the designated base case. BLCC can be used for evaluating both Federal and private-sector projects. It complies with ASTM standards related to building economics as well as FEMP and OMB A-94 guidelines for economic analysis of Federal building projects. BLCC is designed to run on an IBM-PC or compatible microcomputer with approximately 640K of random access memory, with or without a hard disk. The BLCC program supersedes both the FBLCC and NBSLCC computer programs previously released by NIST (NBS).


(4) DISCOUNT--A Program for Discounting Computations in Life-cycle Cost Analyses (version 3.0), NISTIR 4513, National Institute of Standards and Technology, 1991.

The DISCOUNT program computes discount factors and related present values, future values, and periodic payment values of cash flows occurring at known points in time. DISCOUNT is especially useful for solving life-cycle cost analysis problems which do not require the comprehensive summation and reporting capabilities provided by the BLCC program. DISCOUNT performs all of the functions of standard discounting tables, computing present values of future amounts, future values of present amounts, present and future values of periodic payments, periodic payments corresponding to present and future amounts, and corresponding discount factors. In addition, DISCOUNT computes the present value of periodic payments which increase at known rates over time, and the present value of energy costs which increase at rates projected by the U.S. Department of Energy for use in Federal life-cycle cost analyses. DISCOUNT provides the added flexibility of accepting non-integer discount rates, time periods, and escalation rates in its computations. DISCOUNT runs on most IBM PC and compatible microcomputers with no special equipment requirements. The user's guide and reference manual is included on the program diskette.

Both the BLCC and DISCOUNT computer programs access DOE energy prices projections from the same two disk files included with these programs (currently ENCOST90.SEQ and ENCOST90.RAN). These files are updated and released at the same time that NISTIR 85-3273, Energy Prices and Discount Factors for Life-Cycle Cost Analysis, is released each year. These disk files ensure that BLCC and DISCOUNT are compatible with computations performed using the factors in NISTIR 85-3273.

For representatives of Federal government agencies and contractors to the Federal government, these publications can be ordered from:

    Advanced Sciences, Inc.
    2000 North 15th Street
    Suite 407
    Arlington, VA 22201
    (703) 243-4900

Please request the publications by name and number.

For others interested in obtaining the BLCC or DISCOUNT computer programs, please contact one of the following organizations:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

PC Software Interest Group
1030D East Duane Avenue
Sunnyvale, CA 94086
(408) 730-9291

MTS Software
5 Oak Court
Saint Charles, MO 63302
(314) 441-1022

Workshops on the life-cycle costing method and energy analysis are conducted at locations around the country each year. The workshops include training and software for both BLCC and an energy analysis computer program called "A Simplified Energy Analysis Method" (ASEAM). A schedule of workshops can be obtained from the Office of Applied Economics, National Institute of Standards and Technology, Bldg. 101, Room A415, Gaithersburg, MD 20899, (301) 975-6132.

An introduction to the workshop is provided in a video training film, "Least-Cost Energy Decisions: An Introduction to Life-Cycle Cost Analysis." The video film and companion workbook can be ordered from Video Transfer, Inc., 5709-B Arundel Avenue, Rockville, MD 20852, (301) 881-0270. Additional training films in the series are in preparation.

Further information on the Federal Energy Management Program can be obtained from the Federal Energy Management Program Staff, Office of the Assistant Secretary for Conservation and Renewable Energy, U.S. Department of Energy. Please direct communication to: FEMP, CE 10.1, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, D.C. 20585.

## ACKNOWLEDGMENTS

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# 1. INTRODUCTION

The NIST Building Life-Cycle Cost computer program (BLCC 3.0) provides economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems. It is especially useful for evaluating the costs and benefits of energy conservation projects in buildings. Two or more alternative building designs that have the same general purpose can be evaluated to determine which has the lowest life-cycle cost. Economic measures, including net savings, savings-to-investment ratio, and adjusted internal rate of return, can be calculated for any design alternative relative to the designated base case. BLCC runs on most IBM-PC and compatible microcomputers with approximately 640K RAM. No graphics capability, math coprocessor, or other special equipment are needed.

BLCC 3.0 supersedes and incorporates both the Federal Building Life-Cycle Cost (FBLCC) and the National Bureau of Standards Life-Cycle Cost (NBSLCC) programs. Table 1 lists a number of BLCC features which improve upon or differ significantly from those programs.

Five types of LCC analyses can be performed with the BLCC program:

(1) Federal Analysis:  Energy Conservation Projects
(2) Federal Analysis:  Projects subject to OMB's A-94 guidelines
(3) Private Sector:  Projects with tax analysis
(4) Private Sector:  Owner-occupied houses (tax deductions on interest and property taxes only)
(5) Generic LCC Analysis:  No tax analysis (e.g., state & local government)

BLCC complies with the American Society for Testing and Materials (ASTM) standard practices for building economics, including E917 (Practice for Measuring Life-Cycle Costs of Buildings and Building Systems), E964 (Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems), E1057 (Practice for Measuring Internal Rates of Return for Investments in Buildings and Building Systems), and E1074 (Practice for Measuring Net Benefits for Investments in Buildings and Building Systems). For the economic analysis of energy conservation investments in Federal buildings, BLCC complies with NBS Handbook 135, Life-Cycle Costing Manual for the Federal Energy Management Program. For other investments in Federal buildings, BLCC complies with OMB Circular A-94, "Discount Rate to Be Used in Evaluating Time-Distributed Costs and Benefits," March 27, 1972.

> Note:  BLCC is a public domain program, not subject to copyright. It can be freely copied and distributed. However, it is requested that attribution be given to the National Institute of Standards and Technology.

Table 1.  New or Enhanced BLCC Features

---

o  All program modules are contained in a single executable file.

o  Data files and reports can now be saved to and retrieved from any drive.
   Use "Setup" in the main BLCC menu to specify the target drive.

o  LCC computations are automatically made when the input data file is
   saved.

o  New cash flow report details all dollar amounts (not discounted) year-
   by-year over the entire study period.

o  Up to nine alternative projects can be compared simultaneously to
   determine which has the lowest LCC.  Simply tag the LCC files for each
   alternative to be considered and press <Enter>.

o  Only questions relevant to current analysis are displayed on screen.

o  Standard depreciation tables can be read from depreciation files in the
   current directory to minimize data entry.

o  Depreciation variables are now entered separately for replacements.
   Project capital costs can be entered as aggregate investment-related
   costs or divided into as many as six components.

o  Operating and maintenance (O&M) costs, replacement costs, and depre-
   ciation data are specified separately for each component if capital
   costs are divided into components.  (Energy and mortgage costs are
   entered for the overall project and are not component specific.)

o  Price escalation rates for non-annually recurring O&M costs are now
   assumed to be the same as specified for annually-recurring O&M costs.

o  Price escalation rates for initial capital assets, O&M, and energy
   prices must include general inflation if the analysis is conducted in
   current dollars (private sector and designated generic analyses only).
   Previously all escalation rates were entered in real terms.

o  Up to four energy types can now be included in an input data file.

o  Energy usage from year to year can be assumed constant or adjusted with
   annual energy usage indexes.

BLCC retrieves the U.S. Department of Energy's (DOE) projections of energy price escalation rates from the ENCOST90.SEQ and ENCOST90.RAN files on the disk. These DOE projections are needed for Federal energy conservation analyses but can be used with other LCC analyses as well.

This user's guide provides an overview of BLCC capabilities, tells the user how to install and run it, and defines all of the variables needed to conduct an LCC analysis. Detail regarding the computational methodology used in BLCC can be found in Appendix H of <u>Comprehensive Guide for Least-Cost Energy Decisions</u>, by Rosalie T. Ruegg and Stephen R. Petersen, NBS Special Publication 709, National Bureau of Standards, Gaithersburg, MD, 1987. The BLCC program was developed at the National Institute of Standards and Technology (formerly the National Bureau of Standards). For further information, write to:

> National Institute of Standards and Technology
> Applied Economics Group
> Bldg. 101, Room A415
> Gaithersburg, MD 20899

## 2. INSTALLING AND RUNNING BLCC

BLCC can be run from a hard disk or directly from the BLCC diskette. To install BLCC on a hard disk, use the following steps:

(1) Make a subdirectory called BLCC on the drive of your choice (say C:).
    To make a subdirectory called "BLCC", type "MD \BLCC" at the ready
    prompt.
(2) Type "CD \BLCC" to make this the current directory.
(3) Insert the BLCC disk into the A drive and copy all of the files from the
    BLCC disk to the BLCC subdirectory by typing "COPY A:*.*".
(4) Type "BLCC" at the ready prompt to start BLCC.

To run BLCC directly from the BLCC diskette, use the following steps:

(1) Make a back-up copy of the BLCC diskette. If you are going to run BLCC
    in a high-density (1.2 MB) disk drive, copy BLCC to a high-density
    diskette formatted on that drive.

     IMPORTANT: BLCC writes temporary and permanent files to the disk. If
     you use the original double-density (360K) diskette in a high-density
     drive, you may destroy the original disk during the write process.

(2) Insert your new copy of the BLCC diskette into the A drive.
(3) Make the A drive the current drive by typing "A:".
(4) Type "BLCC" at the ready prompt to start BLCC.

If you run BLCC from the diskette rather than from a hard disk, space for file
storage is limited and you should therefore save your own input and output
files to a second diskette in another drive. BLCC data entry screens and
reports will be displayed somewhat more slowly when BLCC is run directly from
the diskette. This is because screen and report formatting files must be
accessed from the disk as data input and analysis are underway.

The executable program, BLCC.EXE, and the following supporting files must be
available in the current directory to run BLCC:

| | | | |
|---|---|---|---|
| MORT.SCR | DEPDATA.SCR | COMPARE.FLD | HELP.1 |
| CAPDATA.SCR | ARCDATA.SCR | CASHFLOW.FLD | ENCOST90.SEQ |
| ENDATA.SCR | ESCDATA.SCR | PRINTDAT.FLD | ENCOST90.RAN |
| PROJ.SCR | | PRINTLCC.FLD | SETUP.FIL |

There are also several demonstration files on the diskette for use in learning
how to use the program. These are files:

| | | | | |
|---|---|---|---|---|
| DEMO1.DAT | DEMO1.LCC | DEMO3.DAT | DEMO3.LCC | TABLE1.DEP |
| DEMO2.DAT | DEMO2.LCC | DEMO4.DAT | DEMO4.LCC | |

## 3.  CONDUCTING A BLCC ANALYSIS

### 3.1 The Main BLCC Menu

When you enter "BLCC" at the DOS ready prompt, the BLCC logo appears on the
screen.  Press any key to display the Main BLCC Menu, shown in figure 1.  This
menu shows the major functions of the BLCC program.  Use the up/down arrows to
highlight the desired function and press the <Enter> key.  As each function is
highlighted, a brief description of that function will be displayed at the
bottom of the screen.  Alternatively, simply press the highlighted character
for the function desired.

```
Create New Input Data File
Edit Existing Input Data File
Print Input Data File Report
Print Detailed LCC Report
Compute Cash-Flow Analysis
Lowest LCC
Comparative Economic Analysis
Information on BLCC
Setup
Quit/Go To DOS
```

Figure 1.  Main BLCC menu.

The first time you run BLCC, select the "setup" option on the master menu.
This option allows you to define the type of monitor you are using, the
directory or subdirectory location of the data files and output files that are
created and saved while running BLCC, and the common filename of the DOE
energy price files on the BLCC disk (currently ENCOST90).  These responses are
saved to a file called SETUP.FIL in the BLCC subdirectory, and are retrieved
each time you run BLCC.

### 3.2  Creating or Editing Input Data Files for a Project Alternative

To use BLCC, you must have an input data file for each alternative building or
system design to be evaluated.  The input data file for any project
alternative contains assumptions for the LCC analysis, initial costs,
operating and maintenance costs, replacement costs, energy costs, resale
value, and (where relevant) data related to taxes and financing analysis.  The
input data file is retrieved when editing the input data file, computing the
LCC of a project alternative, computing a cash flow analysis for the
alternative, or printing an input data file report.  Read section 5 of this
manual for additional information on the input data requirements and BLCC
input data file structure.  Section 8 provides definitions of all variables
requested on the data input screens.

If you are going to create a new input data file, select "Create New Input Data File" from the Main BLCC Menu.  If you are going to edit an existing input data file, select "Edit Existing Input Data File" from the menu and a list of the existing input data files in your current directory will be displayed.  To designate the file to be edited, use the cursor keys to highlight the desired filename, and then press <Enter> to begin.  All input data files are automatically tagged with the filename extension ".DAT".


                                   NOTE

         You must make a separate input data file for each project
         alternative to be evaluated.  Don't try to combine several
         alternatives into a single input data file by using multiple
         components.

         After creating and saving an initial file for one project
         alternative, it is usually easier to modify that file in the edit
         mode with data for a related alternative and save it under a new
         name than to create a new file from the beginning.



When creating a new input data file, you must select the type of LCC analysis to be conducted Federal energy conservation from the following:

    (1)  Federal Analysis:  Energy Conservation Projects
    (2)  Federal Analysis:  Projects subject to OMB's A-94 guidelines
    (3)  Private Sector:  Projects with tax analysis
    (4)  Private Sector:  Owner-occupied houses
    (5)  Generic LCC Analysis:  No tax analysis

Once this analysis type is specified, and the first data entry screen is completed, it cannot be changed.  (This is the only variable in BLCC that cannot be changed, since it determines how the data file is set up.)

If the analysis is for Federal buildings, the LCC analysis will be conducted in CONSTANT DOLLARS.  This requires that the discount rate and price escalation rates be entered in real terms, i.e., net of general inflation.  If the analysis is designated as private sector, the LCC analysis will be conducted in CURRENT DOLLARS.  This requires that the discount rate, price escalation rates, and mortgage interest rates (if any) be entered in nominal terms, i.e., including general inflation.  If a generic LCC analysis is selected, the user must designate whether this analysis will be performed in constant or current dollars and enter all rates accordingly.

From most screen displays in BLCC, you can back up to the previous screen by pressing <Esc>.  From data input screens you can move backward or forward by pressing <PgUp> or <PgDn>, respectively.  However, if the cursor is located at a mandatory input variable, you must fill in a valid response before moving

backward to a previous screen. You cannot move forward to the next screen
until all required data fields are filled with valid responses. If you are
editing an existing data file, you can move to the "save data" menu by
pressing F10 at any point.

After completing the data entry or review, the "save data" menu is displayed,
as shown in figure 2. Be sure to save your input data file if you intend to
use it for BLCC analysis. You can review the data file in the edit mode if
you select this option from the menu. If you are editing an existing file,
you can save it under a new file name or default to the old file name; in the
latter case it will replace the old file. Filenames must follow the DOS file-
naming convention (i.e., up to eight alpha-numeric characters).

Data entry is now complete.

```
┌────────────────────────────┐
│ Save Input Data File       │
│ Review Input Data File     │
│ Exit without Saving        │
└────────────────────────────┘
```

Figure 2. The "Save Data" Menu.

Any input data file can be printed for documentation purposes by selecting
"Print Input Data Report" from the main BLCC menu. As with all BLCC reports,
this report can be displayed to the screen, sent to the printer, or saved to
an ASCII file in a designated subdirectory. Figure 3 shows the input data
file report for demonstration file DEMO1.DAT, which is included on the BLCC
disk.

For first-time users of BLCC, it is suggested that you select "Edit Existing
Input Data File" from the main menu, and then retrieve file DEMO1.DAT. This
is one of four demonstration input data files on the BLCC diskette. The data
in all of these demonstration files are for "generic" LCC analyses (without
income tax considerations). Press the <PgDn> key after examining each of the
input data screens in order to familiarize yourself with the data entry
process. Refer to section 8 for definitions of all input variables. When
data review has been completed, the menu shown in figure 3 will be displayed.
Save the output file under its default name (DEMO1.LCC) and select the screen
display of the summary LCC file.

7

```
FILE NAME: DEMO1
FILE LAST MODIFIED ON 01-10-1991/16:29:55
PROJECT TITLE: demo1
COMMENT: This is a BLCC demonstration file

GENERAL DATA:
-------------
ANALYSIS TYPE: Generic LCC Analysis: No Tax Analysis
BASE DATE FOR LCC ANALYSIS: 1990
STUDY PERIOD:  20 YEARS
PLANNING/CONSTRUCTION PERIOD:  2 YEARS
OCCUPANCY DATE: 1992
DISCOUNT AND INTEREST RATES Real (exclusive of general inflation)
DISCOUNT RATE:  5.0%

CAPITAL ASSET COST DATA:
------------------------
INITIAL COST ($)                      10,000
EXPECTED COMPONENT LIFE(YRS)              20
RESALE VALUE FACTOR                    0.00%
AVG PRICE ESC RATE(PLAN/CONST)         0.00%
AVG PRICE ESC RATE (OCCUPANCY)         0.00%
Escalation rates do not include general inflation
NUMBER OF REPLACEMENTS                      1

COST-PHASING SCHEDULE BY YEAR OF CONSTRUCTION AND AT OCCUPANCY:
                                1    33.00%
                                2    33.00%
                    AT OCCUPANCY    34.00%


REPLACEMENTS TO CAPITAL ASSETS:
-------------------------------

REPLACEMENT NUMBER                         1
YEAR OF REPLACEMENT                       10
COST OF REPLACEMENT ($)               5,000
EXPECTED REPL. LIFE (YRS)                 10
RESALE VALUE FACTOR                    0.00%


OPERATING AND MAINTENANCE COST DATA:
------------------------------------
ANNUAL RECUR O&M COST ($):   1,000
ESCALATION RATE FOR O&M:     0.00%
Escalation rates do not include general inflation


NON-AN RECURRING O&M COSTS ($):
  YR    AMOUNT
  10    $1,000
  20    $1,000
```

---

Figure 3.  Input Data File Report for DEMO1.

```
ENERGY COST DATA:
-----------------
NUMBER OF ENERGY TYPES = 1
User entered energy price escalation rates used with Energy Type(s) 1

                              TYPE 1
ENERGY TYPE:             Electricity
AVG ANNUAL CONSUMPTION:      100,000
UNITS:                       KWH
PRICE PER UNIT ($):          0.10
ANNUAL DEMAND CHARGE ($):    0.00
ESCALATION RATES BY YEAR:   Escalation rates do not include general inflation

        1990      2.00                    2000      2.00
        1991      2.00                    2001      2.00
        1992      2.00                    2002      2.00
        1993      2.00                    2003      2.00
        1994      2.00                    2004      2.00
        1995      2.00                    2005      2.00
        1996      2.00                    2006      2.00
        1997      2.00                    2007      2.00
        1998      2.00                    2008      2.00
        1999      2.00                    2009      2.00

ENERGY TYPE:  Electricity
ENERGY USE INDEXES BY YEAR:

        1992     100.00                   2001     100.00
        1993     100.00                   2002     110.00
        1994     100.00                   2003     110.00
        1995     100.00                   2004     110.00
        1996     100.00                   2005     110.00
        1997     100.00                   2006     110.00
        1998     100.00                   2007     110.00
        1999     100.00                   2008     110.00
        2000     100.00                   2009     110.00
```

Figure 3.  Input Data File Report for DEMO1 (continued).

## 3.3 Calculating Life-Cycle Costs and Cash-Flow Analyses

At the time that a new or existing input data file is saved, the corresponding LCC computations are automatically performed and saved in an LCC output file. The default filename for the LCC output file is the same as that assigned to the input data file, with the filename extension ".LCC" automatically tagged. You can change the filename to any other valid DOS filename (up to eight alpha-numeric characters) if you wish, but it is usually easier to keep track of pairs of corresponding input and output files when they have the same filename. This LCC output file is retrieved when printing a detailed LCC report, conducting comparative LCC analyses, or determining which of several mutually-exclusive project alternatives has the lowest LCC.

At the time that the LCC computations are performed, a summary report of the LCC computations is generated. This summary can be printed to the screen, printer, or a disk file (for later retrieval). An example of this summary file is shown in figure 4 for the DEMO1 example file. To regenerate the summary report at any time, retrieve the corresponding input data file in the file edit mode and resave the file.

|  | PRESENT VALUE | ANNUAL VALUE |
|---|---|---|
| INITIAL COST (AT OCCUPANCY) | $9,527 | $764 |
| ANNUALLY RECURRING O&M COSTS | $10,603 | $851 |
| NON-AN. RECURRING O&M COSTS | $557 | $45 |
| ENERGY COSTS | $135,406 | $10,865 |
| REPLACEMENT COSTS | $2,784 | $223 |
| LESS: REMAINING VALUE | ( $0) | ( $0) |
| TOTAL LCC | $158,876 | $12,749 |

Figure 4. BLCC Summary for DEMO1.

To generate a detailed LCC analysis for a project alternative once its input data file and LCC output files have been saved, select "Print Detailed LCC Report" from the main menu and use the cursor keys to highlight the LCC output file to be used for this report. An example of the detailed BLCC report for the DEMO1 example file is shown in figure 5.

A year-by-year cash flow report can also be generated and printed from the input data file by selecting "Compute Cash Flow Analysis" from the main menu. An example of the cash flow report for file DEMO1 is shown in figure 6. For LCC analyses which require depreciation calculations, the depreciation schedules used in the analyses are included at the end of the cash flow report.

PART I - INITIAL ASSUMPTIONS AND COST DATA

```
Project name: demo1
Run date:01-10-1991 16:35:18
Comment: This is a BLCC demonstration file
Input data file: DEMO1.BCF, last modified: 01-10-1991/16:29:55
LCC output file: DEMO1.LCC, created: 01-10-1991 16:30:03
Study period:       20 years (1990 through 2009)
Plan/constr. period:  2 years (1990 through 1991)
Occupancy period:    18 years (1992 through 2009)
Discount rate:   5.0% Real (exclusive of general inflation)
Run type: Generic LCC Analysis: No Tax Analysis
BLCC uses end-of-year discounting convention
```

INITIAL CAPITAL INVESTMENT COSTS (NOT DISCOUNTED)
(ADJUSTED FOR PRICE CHANGES DURING PLAN/CONST. PERIOD, IF ANY)

|  | YEAR | COST PHASING | YEARLY COST | TOTAL COST |
|---|---|---|---|---|
|  | 1990 | 33.0% | $3,300 |  |
|  | 1991 | 33.0% | $3,300 |  |
| AT OCCUPANCY: | 1992 | 34.0% | $3,400 |  |
| TOTAL INITIAL COST (ACTUAL) |  |  |  | $10,000 |

ENERGY-RELATED COSTS

| ENERGY TYPE | UNITS/ YEAR | PRICE ($/UNIT) | DEMAND COST | TOTAL P.V. COST |
|---|---|---|---|---|
| Electricity | 100,000 | $0.10 | $0 | $135,406 |

PART II  -  LIFE-CYCLE COST ANALYSIS

|  | PRESENT VALUE (1990 DOLLARS) | ANNUAL VALUE (1990 DOLLARS) |
|---|---|---|
| A. CASH REQUIREMENTS AS OF OCCUPANCY |  |  |
|    DURING CONSTRUCTION | $6,443 | $517 |
|    AT OCCUPANCY | $3,084 | $247 |
|    SUBTOTAL | $9,527 | $764 |
| C. OPERATING, MAINTENANCE & RELATED COSTS: |  |  |
|    ANNUALLY RECURRING COSTS (NON-ENERGY) | $10,603 | $851 |
|    NON-ANNUALLY RECURRING COSTS | $557 | $45 |
|    ENERGY COSTS | $135,406 | $10,865 |
|    SUBTOTAL | $146,565 | $11,761 |
| D. REPLACEMENTS TO INITIAL CAPITAL ASSETS | $2,784 | $223 |
| F. REMAINING VALUE AT END OF OCCUPANCY | ( $0) | ( $0) |
| G. TOTAL LIFE-CYCLE PROJECT COST | $158,876 | $12,749 |

Figure 5.  Detailed BLCC report (example).

```
PROJECT NAME: demo1
COMMENT: This is a BLCC demonstration file
RUN DATE: 01-11-1991 08:50:55
INPUT DATA FILE: DEM01.BCF, LAST MODIFIED
STUDY PERIOD:        20 YEARS (1990 THROUGH 2009)
PLAN/CONSTR. PERIOD: 2 YEARS (1990 THROUGH 1991)
OCCUPANCY PERIOD:    18 YEARS (1992 THROUGH 2009)
ANALYSIS TYPE: Generic LCC Analysis: No Tax Analysis
```

INITIAL CAPITAL COSTS
(AS INCURRED DURING PLANNING/CONSTRUCTION PERIOD AND AT OCCUPANCY)

|        | TOTAL (BY YEAR) |
|--------|-----------------|
| YEAR   | ---------       |
| 1990   | 3300            |
| 1991   | 3300            |
| 1992   | 3400            |
| TOTAL: | ---------       |
|        | 10000           |

CAPITAL INVESTMENT COSTS

| YEAR | INIT CAPITAL INVESTMENT | CAPITAL REPLACEMTS | CAPITAL DISPOSAL | TOTAL CAP. INVESTMENT |
|------|-------------------------|--------------------|------------------|-----------------------|
| 1990 | 3,300  | 0     | 0 | 3,300  |
| 1991 | 3,300  | 0     | 0 | 3,300  |
| 1992 | 3,400  | 0     | 0 | 3,400  |
| 1993 | 0      | 0     | 0 | 0      |
| 1994 | 0      | 0     | 0 | 0      |
| 1995 | 0      | 0     | 0 | 0      |
| 1996 | 0      | 0     | 0 | 0      |
| 1997 | 0      | 0     | 0 | 0      |
| 1998 | 0      | 0     | 0 | 0      |
| 1999 | 0      | 0     | 0 | 0      |
| 2000 | 0      | 0     | 0 | 0      |
| 2001 | 0      | 5,000 | 0 | 5,000  |
| 2002 | 0      | 0     | 0 | 0      |
| 2003 | 0      | 0     | 0 | 0      |
| 2004 | 0      | 0     | 0 | 0      |
| 2005 | 0      | 0     | 0 | 0      |
| 2006 | 0      | 0     | 0 | 0      |
| 2007 | 0      | 0     | 0 | 0      |
| 2008 | 0      | 0     | 0 | 0      |
| 2009 | 0      | 0     | 0 | 0      |
| TOTAL | 10,000 | 5,000 | 0 | 15,000 |

Figure 6.  Cash flow report for file DEM01.

OPERATING-RELATED COSTS DURING OCCUPANCY

| YEAR | --OPERATING AND MAINTENANCE COSTS--- | | | TOTAL |
| | AN RECURRING | NON-AN REC | ENERGY | OPER. COST |
| ---- | --- | --- | --- | --- |
| 1992 | 1,000 | 0 | 10,612 | 11,612 |
| 1993 | 1,000 | 0 | 10,824 | 11,824 |
| 1994 | 1,000 | 0 | 11,041 | 12,041 |
| 1995 | 1,000 | 0 | 11,262 | 12,262 |
| 1996 | 1,000 | 0 | 11,487 | 12,487 |
| 1997 | 1,000 | 0 | 11,717 | 12,717 |
| 1998 | 1,000 | 0 | 11,951 | 12,951 |
| 1999 | 1,000 | 0 | 12,190 | 13,190 |
| 2000 | 1,000 | 0 | 12,434 | 13,434 |
| 2001 | 1,000 | 1,000 | 12,682 | 14,682 |
| 2002 | 1,000 | 0 | 14,230 | 15,230 |
| 2003 | 1,000 | 0 | 14,514 | 15,514 |
| 2004 | 1,000 | 0 | 14,805 | 15,805 |
| 2005 | 1,000 | 0 | 15,101 | 16,101 |
| 2006 | 1,000 | 0 | 15,403 | 16,403 |
| 2007 | 1,000 | 0 | 15,711 | 16,711 |
| 2008 | 1,000 | 0 | 16,025 | 17,025 |
| 2009 | 1,000 | 0 | 16,345 | 17,345 |
| TOTAL | 18,000 | 1,000 | 238,332 | 257,332 |

SUM OF ALL CASH FLOWS

| YEAR | CAPITAL INVESTMENT | OPERATING COSTS | TOTAL COST |
| ---- | --- | --- | --- |
| 1990 | 3,300 | 0 | 3,300 |
| 1991 | 3,300 | 0 | 3,300 |
| 1992 | 3,400 | 11,612 | 15,012 |
| 1993 | 0 | 11,824 | 11,824 |
| 1994 | 0 | 12,041 | 12,041 |
| 1995 | 0 | 12,262 | 12,262 |
| 1996 | 0 | 12,487 | 12,487 |
| 1997 | 0 | 12,717 | 12,717 |
| 1998 | 0 | 12,951 | 12,951 |
| 1999 | 0 | 13,190 | 13,190 |
| 2000 | 0 | 13,434 | 13,434 |
| 2001 | 5,000 | 14,682 | 19,682 |
| 2002 | 0 | 15,230 | 15,230 |
| 2003 | 0 | 15,514 | 15,514 |
| 2004 | 0 | 15,805 | 15,805 |
| 2005 | 0 | 16,101 | 16,101 |
| 2006 | 0 | 16,403 | 16,403 |
| 2007 | 0 | 16,711 | 16,711 |
| 2008 | 0 | 17,025 | 17,025 |
| 2009 | 0 | 17,345 | 17,345 |
| TOTAL | 15,000 | 257,332 | 272,332 |

Figure 6.   Cash flow report for file DEM01 (continued).

3.4  Lowest LCC and Comparative Economic Analysis

After an LCC analysis has been computed for two or more mutually-exclusive project alternatives, the life-cycle cost calculations for each alternative can be compared to determine which has the lowest LCC.  Select "Find Lowest LCC" from the main menu.  Highlight and tag the LCC output file for each alternative to be included in the analysis.  Up to nine files can be tagged for a lowest LCC analysis.  The alternatives will be displayed in order of increasing initial cost, and the alternative with the lowest LCC will be flagged.  An example of the lowest LCC calculation for files DEMO1, DEMO2, DEMO3, and DEMO4 is shown in figure 7.

Note that for a comparative analysis to be performed, alternatives must have been evaluated over the same study period and planning/construction period (if any), using the same discount rate and the same analysis type (e.g., Federal energy conservation projects, private sector taxable projects).  In general, comparison of life-cycle costs is only meaningful when these costs are representative of mutually-exclusive design alternatives in the same operating context.  For example, the comparison of two alternative office building designs with different shapes and orientation (and thus having different energy consumption requirements), but with the same amount of usable space and the same potential rental income, is a legitimate use of LCC analysis.  Comparison of the life-cycle cost of an office building with that of a hospital is not likely to be useful in a decision-making context.

COMPARATIVE PRESENT-VALUE COSTS OF ALTERNATIVE PROJECTS
(Shown in ascending order of initial cost, * = lowest LCC)

| PROJECT NAME | LCC FILENAME | INITIAL COST (PV) | LIFE CYCLE COST (PV) |
|---|---|---|---|
| demo1 | DEMO1 | $9,527 | $158,876 |
| demo2 | DEMO2 | $10,479 | $145,451 |
| demo3 | DEMO3 | $11,432 | $139,382* |
| demo4 | DEMO4 | $14,290 | $139,532 |

Figure 7.  Lowest LCC analysis for files DEMO1, DEMO2, DEMO3, and DEMO4.

A comprehensive comparative economic analysis of any two project alternatives can be performed by selecting the "Comparative Economic Analysis" option on the main menu.  Tag the two LCC output files corresponding to the project alternatives to be compared.  The project alternative with the lower initial cost is automatically designated as the base case; the project alternative with the higher initial cost is designated as the alternative case for which the economic measures are computed.  A summary of the major cost elements (in

present-value dollars) for the two alternatives will be displayed side by side, and the difference shown. The net savings, savings-to-investment ratio (SIR), and adjusted internal rate of return (AIRR) are shown for the alternative case relative to the designated base case.

In general, if a project alternative is to be considered cost effective on a life-cycle cost basis, it must have a lower LCC than the base case, positive net savings, an SIR greater than 1.0, and an AIRR greater than the opportunity cost of capital (i.e., the discount rate). These are all consistent measures of economic analysis; that is, they will all show that a given project alternative is either cost effective or not cost effective relative to the specified base case.

If a single project is to be evaluated with BLCC to determine whether or not it is economically justified, it must be compared against a "do-nothing" base case. An input data file must be created for the do-nothing case as well as for the project. This input data file will not generally include initial costs, but will include replacement costs, O&M costs, and energy costs reflecting the existing (before capital improvement) situation. The same base year, study period, and discount rate must be used for both cases. For example, to evaluate the cost effectiveness of storm windows added to an existing house, a separate input data file is required for the base case (no storm windows) without capital investment costs and with higher annual energy costs over the period of analysis than the storm window alternative.

## 4. REPORTS GENERATED BY BLCC

Six different type of reports can be generated by the BLCC program. These reports can be displayed directly to the screen, sent to the printer, or saved to a disk file in the directory designated in the "Setup" option. Table 2 shows the six report types and the corresponding filename extension automatically tagged to the file when the reports are saved to a disk file.

Table 2. Reports Generated by BLCC

| Report Types | Filename Extension |
|---|---|
| Input Data File report | .DTS |
| Summary LCC report | .SUM |
| Detailed LCC report | .RPT |
| Cashflow report | .CFR |
| Comparative LCC analysis | .CMP |
| Lowest LCC report | .LOW |

The longer reports generated by BLCC, including the input data summary report, detailed LCC report, cash flow report, and comparative economic analysis report, do not have page breaks for printing purposes. Instead, the reports are printed continuously, assuming fan-fold paper output. If you wish to print these reports in presentation quality, save them to the disk and retrieve them into a word processor as a text file. You can then format them for your specific printing requirements. A form-feed control character is sent to the printer at the end of each report to force a new page at that point.

## 5. GENERALIZED INPUT DATA FILE STRUCTURE FOR BLCC

When creating or modifying an input data file for life-cycle cost analysis, data input is accomplished by choosing among options from a menu or by entering data into a "form" displayed on the screen. Figure 8 shows an example of such a form for the general project data.

PROJECT DATA:

```
Project title: Storm windows
Base year (1990-2000): 1991
Study period (2-60): 20 Years
Planning/Construction period (0-9): 0 Year(s)
Discount rate: 7.00%
Comment: This run is for demonstration purposes only
```

Figure 8. Project data input form.

Input data is generally requested in the order shown in table 3. Definitions for each of the variables requested while creating or modifying an input data file are provided in section 8 of this User's Guide. If your response is above or below the allowable range, the allowable range will be displayed at the bottom of the screen. If the input requested is mandatory, you will not be allowed to continue until a valid response has been entered.

The project type and the inflation treatment can be specified only when creating an input data file. These two variables are fixed. That is, they cannot be changed in the file edit mode.

Note that percentages are entered as percentages, not as decimals (e.g., 7.0, not 0.07). Do not include signs such as $ or % with your entries. Do not use commas for marking off thousands or millions.

Table 3.  Input Data File Structure

---

Fixed Data:
  Type of Analysis
  Inflation Treatment (Constant dollars or Current dollars)

Project-Level Data:
  General LCC Assumptions
  Tax-Related Data (private sector only)

Capital-Asset Data (may be divided into six major components):

  Initial Cost Data
  Cost Phasing (if Planning/Construction period specified)
  Depreciation Data (project with full tax analysis only)
  Annually Recurring O&M Costs
  Non-annually Recurring O&M Costs
  Replacements:
    Timing and Cost
    Depreciation Data (project with full tax analysis only)

Energy-related Data:
  Types, Annual Usage, and Cost
  Escalation Rate Projections
  Energy Use Indexes

Mortgage Data (non-Federal only):
  Temporary Construction Financing (if Planning/Construction period
        is specified)
  Permanent Financing at Occupancy

---

# 6. STANDARD DEPRECIATION TABLES

When creating or modifying an input data file that requires depreciation data, several types of depreciation calculations can be specified, including straight-line, sum-of-years digits, accelerated depreciation, and standard table computations. If the standard table option is specified, the depreciation computations are based on depreciation factors retrieved from a disk file previously prepared for this purpose. This allows you to access standard depreciation tables without having to re-enter them for each component and each project. (IRS publishes such tables for different classes of depreciable assets.) Standard depreciation tables can be used repeatedly without typing in lengthy schedules for each component in each project. The same tables can be used with both initial capital components and capital replacements.

Before running BLCC, you must create a file of depreciation factors using a text editor (or word processor in the text mode) and save it as an ASCII file. Files with a depreciation factors must have the filename extension ".DEP". This file must be accessible from the BLCC directory (not the data file subdirectory specified in the "setup" option).

Depreciation tables have the following format:

```
        n
        factor 1
        factor 2
           .
           .
        factor n
```

   where:
        n = number of factors in file (i.e., the number of years over
            which the asset is to be depreciated), and
   factor i = percent of asset cost allowed as depreciation in year i, i = 1
            to n, in decimal form (e.g., 10% = .1). The sum of these
            factors must equal 1.0.

Figure 9 shows an example of such a file. This file contains the number of years that an asset is to be depreciated and the percent (in decimal terms) of its depreciation basis that is allowed as depreciation in each of those years. Separate tables must be created for each depreciation schedule to be retrieved. Note: the actual depreciation schedules used in the BLCC analysis are printed at the end of the cash flow report for any project.

```
                        5
                        .2
                        .2
                        .2
                        .2
                        .2
```

Figure 9. Example of an ASCII file of standard depreciation factors.

## 7. COMPUTATIONAL CONVENTIONS USED IN BLCC

All time periods in BLCC are assumed to be integer (whole) years, including the study period, planning/construction period, and occupancy period. Initial costs and property taxes (if any) are assumed to be incurred at the beginning of the designated year. All other costs are assumed to occur at the end of the designated year and are discounted from that time, with one exception: mortgage payments with more than one payment per year are assumed to occur at times which correspond to the number of payments per year designated. (That is, if 12 payments per year are designated for a mortgage loan, a mortgage payment is assumed to be made at the end of each month in the year and each payment is discounted from that time.) All tax savings (if any) are assumed to occur at the end of the designated year, regardless of when that savings was generated.

Extensive documentation of the computational methods used in BLCC can be found in Appendix H of Comprehensive Guide for Least-Cost Energy Decisions, by Rosalie T. Ruegg and Stephen R. Petersen, NBS Special Publication 709, National Bureau of Standards, Gaithersburg, MD, 1987.

# 8. DEFINITIONS AND ACCEPTABLE RANGES OF INPUT VARIABLES USED IN THE BLCC PROGRAM

General LCC assumptions:

o  Type of analysis--Choose the type most appropriate to your project:

   (1) Federal Analysis:  FEMP (Federal Energy Management Program) projects related to energy conservation in federal facilities.
   (2) Federal Analysis:  OMB A-94 projects (most other federal government construction projects, but not water resource projects).
   (3) Private Sector:  Taxable projects such as commercial and industrial buildings and residential rental properties.
   (4) Private Sector:  Owner-occupied houses (where only mortgage interest and property taxes are tax-deductible from federal and state income tax).
   (5) Generic LCC Analysis:  LCC projects which do not need to conform to Federal rules and do not require income tax analysis.

o  Exclude Inflation or Include Inflation (Generic LCC analysis only)--If the analysis is to be performed in constant dollars, the discount rate, mortgage interest rates, and all price escalation rates must be entered in real terms (i.e., excluding general inflation).  If the analysis is to be performed in current dollars, these rates must be entered in nominal terms (i.e., including general inflation).  For Federal projects, the analysis is always performed in constant dollars and thus these rates are entered in real terms.  For private sector analyses (taxable and owner-occupied house), the analysis is always performed in current dollars and thus these rates are entered in nominal terms.  Note:  Regardless of whether the analysis is performed in constant or current dollars, all cost data must be entered in base-year dollars.

Project-level Data:

o  Project Title--The user may supply any name desired to identify the project to be evaluated.  Up to 12 characters may be used.  A distinct project title should be assigned to each project to be evaluated since the comparative analysis will list the costs of each project under this title.

o  Base Year--The year in which the study period begins.  This must be an integer between 1990 and 2000.  All cost data must be entered in constant dollars as of this date.  All costs will be discounted back to this date.

o  Study Period (Years)--The number of years over which project-related costs will be summed.  The Study Period includes both the planning/construction period, if any, and the Occupancy Period.  (Integer between 2 and 60)

o     Planning/Construction Period--The number of years from the beginning of
      the Study Period to the beginning of occupancy.  Initial costs can be
      phased in during the Planning/Construction Period, but operating and
      maintenance costs (including energy), replacement costs, and
      appreciation (if any), are not incurred during this period.  (Integer
      between 0 and 9)

o     Discount Rate (%)--The discount rate is used to convert cash flows
      occurring at different points in time to present value (as of the base
      date) and its equivalent annual value.  Use the nominal (i.e., inclusive
      of inflation), after-tax discount rate for private sector projects or a
      Generic LCC analysis designated as using current dollars.  Use a real
      (i.e., exclusive of inflation) discount rate for Federal projects and
      Generic LCC analyses designated as using constant dollars.  (0 to 25)

o     Comment--Additional information to identify this project can be included
          in the data file and printed out with the various BLCC reports.
          Optional.  (Up to 50 characters)


Tax-related Data (Private sector analyses only):

o     Marginal Federal Income Tax Rate (%)--The Federal income tax rate
      applied to the last dollar of income to the investor.  (0 to 50)

o     Marginal State Income Tax Rate (%)--The state tax rate applied to the
      last dollar of income to the investor.  If income taxes are imposed by
      local jurisdiction, this can be included in the analysis by replacing
      the state tax rate with a composite state and local rate.  Note:  BLCC
      computes a composite income tax rate from the marginal Federal and state
      income tax rates, based on the assumption that state and local income
      taxes are deductible from Federal income tax.  All tax deductions are
      assumed to be the same for both Federal and state taxes.  (0 to 20)

o     Property Tax Rate (Nominal, %)--This is the quoted property tax rate for
      this type of property in this location.  Note that the property tax rate
      is assumed to be the same for all capital components, but that the
      percentage of each component that is subject to this property tax rate
      (i.e., the assessment rate) can be specified separately for each
      component.  (0 to 20)

o     Capital Gains Adjustment Factor (%)--Use 100 percent if there is no
      capital gains preference.  At the end of the study period, if the resale
      value of the project is greater than its initial cost, the difference is
      assumed to be taxable as long-term capital gains.  The effective capital
      gains tax may be lower than the ordinary income tax rate (although this
      was not the case at the time of this writing.)  The Capital Gains
      Adjustment Factor adjusts the ordinary income tax rate to an effective
      capital gains tax rate.  (For example, in the early 1980's this factor
      was 40 percent for individuals; that is, the marginal tax rate of the
      individual was multiplied by 40 percent to arrive at an effective
      capital gains tax rate.)  Note:  For owner-occupied houses, the capital

gains tax is usually deferred indefinitely if another house is purchased within a specified amount of time. To defer capital gains taxes indefinitely, enter a zero for this factor. (0 to 100)

o   Depreciation Recapture Code--At the end of the study period, if the resale value of the project is greater than its depreciated book value (i.e., the remaining undepreciated portion of its actual cost at occupancy), the difference (up to the total amount of depreciation claimed) may be subject to a depreciation recapture tax. This depreciation recapture tax can be computed in one of several different ways, as designated by the following input codes:

    0--no depreciation recapture
    1--recapture as capital gain
    2--recapture as ordinary income
    3--depreciation calculated at straight-line rates, recaptured as capital gains; any excess depreciation (due to accelerated calculation procedures), recaptured as ordinary income

Note: IRS rules for recapture vary with the type of property involved, method of depreciation used, and date of asset acquisition. If there is no capital gains preference (i.e., the capital gains adjustment factor is 100 percent), codes 1,2, and 3 all produce the same results.

o   Depreciation Basis Adjustment Factor (%)--If an investment (or energy) tax credit is claimed for any component, this may reduce the original cost basis for depreciation calculations by a specific percentage of the tax credit. For example, if one half of the tax credit must be deducted from the original cost basis for depreciation, enter 50. If no investment tax credit is to be claimed for capital assets (as described below), enter 0. (0 to 100)

Capital Asset data:

o   Capital components--The user must specify whether the capital assets of this project will be subdivided into specific components or systems (e.g., land, building, HVAC equipment, etc.). If the capital assets are to be subdivided, initial costs, operating and maintenance costs (O&M), replacement costs, and depreciation (if any) must be assigned to the corresponding component. In general, for analyses which include depreciation calculations, capital assets should be differentiated by the type and length of depreciation schedule that is to be used. (For example, land, which cannot be depreciated, should be entered as a separate component.) Price escalation rates for initial costs and O&M costs are specified separately for each component. Thus, if these rates are expected to differ significantly among the various capital assets of the project, these assets can be divided into separate components. Up to six capital components can be specified for any project. (Integer from 1 to 6)

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(Note:  Energy and mortgage financing costs are assigned to the overall
project and not to specific components.)


o    Component names--if the capital assets are to be subdivided into
     components, a name must be assigned to each component before data entry
     for those components can begin.  Components can also be added or deleted
     at this point.  (Names can have up to 12 characters.)


     The following variables are to be specified for each component or for
     the overall project if not subdivided into components:

o    Initial Cost ($)--The total installed cost of the component, unadjusted
     for price escalation during construction.  If the Planning/Construction
     Period is one year or more, the "Cost-Phasing Schedule" and the "Average
     Price Escalation Rate During the Planning/Construction Period"
     (discussed below) are used to determine the actual component cost
     incurred in each year of the Planning/Construction Period and at
     occupancy.  (0-99999999)

o    Expected Life (Years)--The useful life of the component (in years)
     anticipated by the investor.  This is intended to be a realistic
     assessment of the component life, independent of the depreciation life
     assigned to the component for income tax purposes, if any. (Integer
     between 2 and 100)

o    Resale Value Factor (% of initial cost)--This is the percent of the
     initial component cost which remains at the end of the study period (or
     at the end of the component life, if this comes first), unadjusted for
     price escalation.  This factor is intended to reflect a decrease in
     value due to wear, deterioration, or obsolescence, but not inflation or
     price escalation.  In computing the actual resale value of the
     component, BLCC uses the Average Price Escalation Rate During Occupancy
     (see below) to adjust for price changes during the Study Period.  The
     resale value is treated as a negative cost element in the life-cycle
     cost equation even if the investor does not intend to dispose of the
     property at the end of the Study Period.

o    Average Price Escalation Rate During the Planning/Construction Period
     (%)--This is the average annual rate at which the cost of this component
     increases during the Planning/Construction Period, if any.  No
     adjustment is made to component costs phased in during the first year of
     construction since component costs are assumed to be incurred on the
     first day of the assigned year.  All component costs phased in after the
     first year of the Planning/Construction Period are adjusted using this
     rate.  If the study is performed in constant dollars (Federal analyses
     and designated Generic LCC analyses), this rate should not include
     general inflation.  (-5 to 20)

o   Average Price Escalation Rate During Occupancy (%)--This is the average annual rate at which the cost of this type of capital component is expected to change during the occupancy period. This variable is used in calculating replacement costs for this component, and in establishing the resale value of this component after adjustments for wear, deterioration, and obsolescence. If the study is performed in constant dollars (Federal analyses and designated Generic LCC analyses), this rate should not include general inflation. (-5 to 20)

o   Tax Credit Factor (% of initial cost)--This factor represents the percent of the initial cost of the component (or project, if no components are specified) which can be claimed as an income tax credit in the first year of occupancy. (If the tax credit is taken, the depreciation basis may need to be reduced by some percentage of this credit. The percentage of the tax credit by which the depreciation basis is to be reduced can be specified using the Depreciation Basis Adjustment Factor, described above.) (0 to 20)

o   Property Tax Assessment Factor (%)--This is the percentage of the initial component cost to which the Property Tax Rate specified above for the project is applied in order to calculate the actual property tax obligation. Property taxes are calculated only during occupancy years, and are assumed to be paid at the beginning of each year, based on the assessed value of that component at that time. In computing the assessed value of the component for each year of occupancy, the initial component cost is decreased annually--in straight-line fashion--to its estimated resale value (unadjusted for price changes) at the end of the study period (or at the end of the component life, if this occurs before the end of the study period). These values are then adjusted for price changes using the "Average Price Escalation Rate During Occupancy," and then adjusted by the Property Tax Assessment Factor to determine the amount to which the Property Tax Rate is applied. Note that this is necessarily an approximation technique; the actual assessment depends on the taxing authority's own assessment methods. (0 to 100)

o   Depreciation Method Code--The method to be used for depreciating each capital component is determined by the following codes:

        0--no depreciation calculated
        1--straight line
        2--declining balance (accelerated)
        3--sum of years digits
        4--depreciation table

o   Cost phasing by year--if a Planning/Construction Period is used, a specified percentage of initial capital costs can be allocated to each year and to the first day of occupancy. If these factors do not add up to 100 percent, the unallocated percentage will automatically be assigned to the first day of occupancy. (0 to 100 for each year, with total for all years = 100)

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Depreciation data when Depreciation Method Code 1, 2, or 3 is specified (See section 6 of this report for information regarding the depreciation table method):

o    Depreciation Life (Years)--The number of years over which the component will be depreciated.  (2-45)

o    Depreciation Acceleration Rate (%)--If Depreciation Method Code 2, the declining balance method, is selected, the Acceleration Rate must be specified.  For example, for 125 percent declining balance, enter 125. (100 to 300)

o    Salvage Value Factor (% of initial cost)--If the IRS depreciation rules require that salvage value be deducted from the initial asset cost before calculating depreciation, a Salvage Value Factor must be specified.  Otherwise enter zero.  The Salvage Value Factor is specified as a percentage of the initial component cost.  Negative values are not allowed.  Note:  The Salvage Value Factor is specified only for depreciation purposes here; this is not the same as the Resale Value Factor.  (0 to 50)

o    Additional First Year Depreciation Factor--If additional first year depreciation is allowed, enter this factor as a percent of the actual component cost.  Additional first year depreciation is deducted from the original depreciation basis before the depreciation schedule is set up for this component and added to the first year of the depreciation schedule.  (0 to 20)


Operating and Maintenance (O&M) Costs (other than energy costs) are specified for each component if capital assets are subdivided into components. Otherwise these costs are allocated to the overall project.  There are two types of O&M costs, annually recurring costs (ARCs) and non-annually recurring costs (NARCs):

(1) Annually-recurring O&M costs occur in substantially the same amount every year or change at a relatively constant rate over the study period (in base year dollars).  Two data entries are needed:

o      Amount (in base year dollars).

o      Average Annual Rate of Increase--This is the average annual rate at which both annually-recurring O&M costs and non-annually-recurring O&M costs are expected to change over the study period. If Federal analysis or Generic LCC analysis in constant dollar terms, enter real rate (net of general inflation); otherwise enter nominal rate (including general inflation).  (-5 to 20)

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(2) Non-annually-recurring O&M costs do not follow a regular pattern. These costs must be specified individually for each occurrence. (More than one occurrence per year is permitted though all occurrences within a year are assumed to occur at the end of that year.) For each NARC, the following pair of data entries must be specified:

o    Year of Occurrence--The year during occupancy in which the NARC is incurred (e.g., 5 for the fifth year). If the year entered is beyond the end of the study period, the NARC will be ignored. (1 to 60)

o    Amount (in base-year dollars).


Capital Replacements:

o    Year of Replacement--The year during occupancy in which the replacement cost is incurred (e.g., 5 for the fifth year). If the year entered is beyond the end of the study period, the replacement cost will be ignored. (2 to 60)

o    Initial Cost of Replacement--The installed cost of the replacement (in base year dollars). The actual replacement cost will be calculated using the Average Price Escalation Rate During the Planning/Construction Period (if any) and the Average Price Escalation Rate During Occupancy assigned to the original component.

o    Expected Life (Years)--The useful life of the replacement (in years) anticipated by the investor. (2 to 99)

o    Resale Value Factor (% of initial replacement cost)--This is the percent of the initial replacement cost remaining at the end of the study period (or at the end of the expected useful life of the replacement, whichever is less) in base year dollars, i.e., unadjusted for inflation or price escalation. The Average Price Escalation Rate During the Planning/Construction Period (if any) and the Average Price Escalation Rate During Occupancy are used with this factor to compute the actual resale value. (0-200)

o    Property Tax Assessment Rate (%)--The percent of the initial replacement cost to which the nominal property tax rate will be applied. (0 to 100)

o    Depreciation Method Code--See Depreciation Codes for capital assets above. The same codes and depreciation tables are used for replacements. (0 to 4)

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Energy Costs

Annual energy costs are treated like annually recurring costs except that up to four individual energy types may be specified and the rate of price change can vary during the study period. In addition, annual consumption of each energy type can vary from year to year during occupancy, as a function of the energy use index for that year. (Energy costs are not calculated during the Planning/Construction Period, if any.) Annual energy costs consist of direct energy costs (i.e., those costs computed directly from annual energy consumption and corresponding unit prices) and indirect costs (e.g., demand-related or other energy costs that cannot be computed directly from the amount of annual energy consumption).

Energy-related variables are entered as follows:

o   Energy Type Code (designated units)--choose one:

   1--Electricity (kWh)
   2--Distillate Fuel Oil (gallons)
   3--Residual Fuel Oil (gallons)
   4--Natural Gas (therms, 100,000 Btu)
   5--Liquified Petroleum Gas (pounds)
   6--Coal (tons)
   7--Other (unspecified)

   Note: The same energy type can be entered more than once for a given project. For example, electricity usage subject to winter kWh rates might be entered separately from electricity usage subject to summer kWh rates.

o   Annual Energy Consumption (in designated units)--The base annual energy consumption of the specified energy type (unadjusted by the Energy Use Indexes).

o   Energy price ($/Unit)--The price per designated unit to be used in calculating direct energy costs for the project. This price should be entered in base-year dollars.

o   Annual Demand (or Other Fixed) Energy Charge ($/yr)--Annual costs related to energy consumption but not directly accounted for in the energy prices used to compute direct energy costs. Example: Charges for peak kilowatt demand, summed over the entire year. This cost should be entered in base-year dollars. This cost is assumed to increase annually at the same escalation rate specified for the energy price.

o   Price Escalation Method--The user has two alternatives for specifying rates of energy price increases:

   (1)   Escalation rates will be entered by the user.
   (2)   Escalation rates will be automatically retrieved from ENCOSTXX.RAN, a disk file with DOE projections of energy price

escalation rates that is distributed with BLCC. (XX represents the year in which the file is released, e.g., ENCOST90.RAN was released in 1990.) Once escalation rates have been retrieved from ENCOSTXX.RAN, they can be modified by the user by backing up to the energy data screen (press <PgUp>) and respecifying the Price Escalation Method as 1. The DOE projections will still be active until modified.

If energy price escalation rates are to be entered by the user, up to 50 discrete escalation rates and the number of years of duration for each rate can be specified.

o    Duration (Years)--The number of consecutive years that the corresponding energy price escalation rate is to be used. Note: For each energy type, the sum of these duration periods must equal or exceed the study period. (0-60)

o    Energy Price Escalation Rate (%)--This is the average annual rate of price increase for this energy type during the designated duration period. If the analysis is to be performed in real terms (Federal analyses and some generic LCC analyses, this rate should be in real terms, i.e., net of general inflation.) (-10 to 20)

    Note:  Only 50 Energy Price Escalation Rates can be displayed on the screen. If each rate is given a duration of one year (as in the case when DOE rates are used), and the study period exceeds 50 years, the last years will all be given the same rate used for the 50th year.

If DOE projected Energy Price Escalation rates are to be retrieved from the disk, the following input variables are needed to select the appropriate data from the file:

o    Rate schedule type--The type of utility rate schedule used for the project. Choose one:

        (1) residential     (2) commercial     (3) industrial

o    State abbreviation (2 characters)--The official U.S. Postal Service abbreviation for the state in which the project is to be located. This code is used to determine in which of the (currently) four DOE regions the project will be located.

o    General Inflation Rate--The projected rate of general price inflation over the study period. This is required only when the LCC analysis is performed in current dollars (private sector and designated Generic LCC analyses only). This rate is used to convert DOE projections of future energy price increases from real (excluding inflation) to nominal rates. However, it should be consistent with the user's projection of general inflation implicit in the discount rate, escalation rates used for capital assets and O&M costs, and mortgage interest rates, if any.

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Annual Energy Consumption Patterns--After energy price escalation rates are entered (or retrieved from the disk), the pattern of annual energy consumption can be specified as constant or variable. If energy consumption is expected to be approximately the same from year to year, specify "constant". If the amount is expected to change in some predictable manner (e.g., anticipated switch in heating fuels in the year 2000), specify "variable". If "variable" is selected, up to 50 discrete energy use indexes and the number of years of duration for each index can be specified separately for each energy type:

o    Duration (Years)--The number of consecutive years that a corresponding Energy Use Index is to be used. For each energy type, the sum of these duration periods must equal or exceed the occupancy period. Note: These duration periods begin with occupancy (since energy consumption calculations begin with occupancy), while the duration periods for energy price escalation rates begin with the start of the study period (since all prices are entered in base year dollars). (0 to 60)

o    Energy Use Index (%)--This is the average rate of energy use during the corresponding duration period, as a percent of the Annual Energy Consumption specified for that energy type. An index of 100 percent leaves the Annual Energy Consumption unchanged for the corresponding years. (0 to 999)

Finance-related data (non-Federal projects only). If borrowing costs are an integral part of the project economics, these can be incorporated into the LCC analysis. If there is a Planning/Construction Period, temporary financing can be specified. Temporary financing is assumed to expire at occupancy. Permanent financing begins with occupancy; one or two permanent mortgage loans can be specified. Data for temporary financing during Planning/Construction Period (if any) and for permanent financing are entered on separate screens.

Note: Adjustable-rate mortgages (ARMs) cannot be computed by BLCC. However, since the underlying rate of general inflation is assumed to be constant throughout the study period, the assumption of a constant interest rate over the same period of time is reasonable.

Data requirements for temporary and permanent mortgages are essentially the same, except that the life of the loan does not need to be specified for temporary financing. (It is assumed to end at the date of occupancy.)

Financing-related variables (non-Federal projects only):

o    Percent of Initial Project Cost Borrowed--Initial project cost is the sum of all component costs (if any), including inflation adjustments during construction. During the Planning/Construction Period, this factor is assumed to be the same in each year. For permanent financing, the sum of these factors for two loans cannot exceed 100 percent.

o   Loan Type Codes (choose one):
    (1) fully amortized loan with periodic payments of equal amount
    (permanent financing only),

    (2) interest only loan with periodic interest payments and repayment of
    principal at end of loan life, and

    (3) both interest payments and principal repayment deferred to end of
    financing period.

o   Annual Interest Rate (%)--If the analysis is to be performed in constant
    dollars (designated Generic LCC analyses only), the annual interest rate
    should be entered in real terms (net of general inflation).  A nominal
    interest rate should be specified, without compounding effects or loan
    placement costs considered (i.e., the interest rate to be used is not
    the effective interest rate or "APR").  (0 to 25)

o   Number of Payments per Year--This is the number of equal payments made
    at periodic intervals through the year.  (Integer between 1 and 52)

o   Points Paid (% of loan amount)--This is a loan placement fee assessed as
    a percentage of the loan amount (i.e., one "point" equals one percent of
    the loan amount).  (0 to 6)

o   Life of Loan (Years)--The loan life can be longer or shorter than the
    study period.  If it is longer, any remaining principal and accrued
    interest at the end of the study period are assumed to be paid at the
    end of the study period.  (Integer between 2 and 40)

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| NIST-114A<br>(REV. 3-90) | U.S. DEPARTMENT OF COMMERCE<br>NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY | 1. PUBLICATION OR REPORT NUMBER<br>NISTIR 4481 |
|---|---|---|
| | | 2. PERFORMING ORGANIZATION REPORT NUMBER |
| | **BIBLIOGRAPHIC DATA SHEET** | 3. PUBLICATION DATE<br>JANUARY 1991 |

**4. TITLE AND SUBTITLE**

THE NIST "BUILDING LIFE-CYCLE COST" (BLCC) COMPUTER PROGRAM

**5. AUTHOR(S)**

Stephen R. Petersen

| 6. PERFORMING ORGANIZATION (IF JOINT OR OTHER THAN NIST, SEE INSTRUCTIONS)<br>U.S. DEPARTMENT OF COMMERCE<br>NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY<br>GAITHERSBURG, MD 20899 | 7. CONTRACT/GRANT NUMBER |
|---|---|
| | 8. TYPE OF REPORT AND PERIOD COVERED |

**9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (STREET, CITY, STATE, ZIP)**

U.S. Department of Energy
Federal Energy Management Program
Washington, DC 20585

**10. SUPPLEMENTARY NOTES**

**11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)**

The NIST Building Life-Cycle Cost (BLCC) computer program provides economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems. It is especially useful for evaluating the costs and benefits of energy conservation projects in buildings. Two or more alternative designs can be evaluated to determine which has the lowest life-cycle cost. Economic measures, including net savings, savings-to-investment ratio, and adjusted internal rate of return, can be calculated for any design alternative relative to the designated base case. BLCC can be used for evaluating both Federal and private sector projects. It complies with ASTM standards related to building economics as well as FEMP and OMB A-94 guidelines for economic analysis of Federal building projects. BLCC is designed to run on a IBM-PC or compatible microcomputer with approximately 640K of random access memory, with or without a hard disk. A 20 page user's guide is included which provides operating instructions and definitions of all data input requirements. The BLCC program supercedes both the FBLCC and NBSLCC computer programs previously released by NIST (NBS).

**12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)**

adjusted internal rate of return; building design; building economics; cost-benefit analysis; economic analysis; energy conservation; engineering economics; Federal Energy Management Program; financial analysis; microcomputer program; net savings; savings-to-investment ratio

| 13. AVAILABILITY | 14. NUMBER OF PRINTED PAGES |
|---|---|
| [X] UNLIMITED | 43 |
| [ ] FOR OFFICIAL DISTRIBUTION. DO NOT RELEASE TO NATIONAL TECHNICAL INFORMATION SERVICE (NTIS). | |
| [ ] ORDER FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, DC 20402. | 15. PRICE<br>A03 |
| [X] ORDER FROM NATIONAL TECHNICAL INFORMATION SERVICE (NTIS), SPRINGFIELD, VA 22161. | |

ELECTRONIC FORM