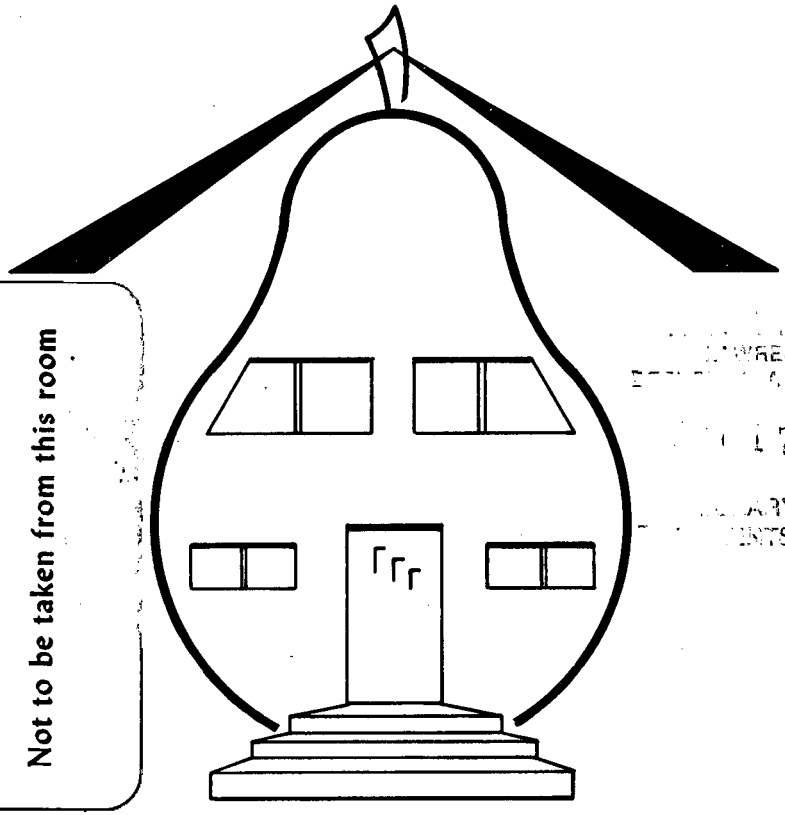
PEAR 2.1

(Program for Energy Analysis of Residences)



User's Manual

March 1987

Energy Analysis Program • Applied Science Division

Lawrence Berkeley Laboratory
University of California
Berkeley, CA 94720

Prepared for the U.S. Department of Energy under Contract DE-AC03-76SF00098

DISCLAIMER

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PROGRAM FOR ENERGY ANALYSIS OF RESIDENCES

MICROCOMPUTER PROGRAM

USER'S MANUAL

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FOREWORD

PEAR (**P**rogram for **E**nergy **A**nalysis of **R**esidences) was developed by Lawrence Berkeley Laboratory (LBL) as a simplified computer tool for estimating energy use in new residential buildings. PEAR accesses a large computer data base that was compiled by LBL in support of the "Affordable Housing through Energy Conservation" project sponsored by the U.S. Department of Energy.

A research team consisting of Joe Huang, Jim Bull, Steve Byrne, and Isaac Turiel, under the management of Ron Ritschard, conducted the analysis of residential energy use that serves as the technical basis for the PEAR program. The PEAR software program was written by Jim Bull and Alyosha Verzhbinsky. This user's guide was written by Joe Huang, with assistance from Ron Ritschard and Jim Bull.

We wish to acknowledge the cooperation of the staff at Steven Winter Associates and American Institute of Architects Foundation during the course of the DOE project, and thank Brian Pierman, Marvin Gorelick, and Jean Boulin at the Department of Energy for their support and guidance.

Any comments, observations, or thoughts about the PEAR program or the technical work upon which it is based will be gratefully received by the authors.

Ronald L. Ritschard,
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INTRODUCTION

This document provides descriptions of the data screens that make up PEAR (Program for Energy Analysis of Residences), together with step-by-step instructions for using the microcomputer program diskette.

PEAR is entirely contained on a single 5 1/4 inch diskette that can be used by IBM or all IBM-compatible personal computers having at least 128K memory. The program will operate on either a hard disk or a two disk drive system, with either a monochromatic or color monitor. However, a graphics adapter is needed to implement the Bar Chart Option.

It is strongly recommended that a backup copy of the PEAR program be made for everyday use and that the original program diskette be stored in a safe place. A diskette for data storage is not needed in order to run the PEAR program.

Overview :

PEAR is an interactive program for residential building energy analysis utilizing a comprehensive DOE-2.1 database for residential buildings. This database was compiled by Lawrence Berkeley Laboratory with over 10,000 computer simulations covering five residential buildings in 45 geographical locations.

This extensive database is used by PEAR to estimate the annual energy use of houses with typical conservation measures such as ceiling, wall, and floor insulation, different window types and glazing layers, infiltration levels, and equipment efficiency. It also allows the user to include the effects of roof and wall color, movable night insulation on the windows, reflective and heat absorbing glass, an attached sunspace, and use of a night setback. Regression techniques in PEAR permit adjustments for different building geometries, window areas and orientations, wall construction, and extension of the data to over 800 U.S. locations based on climate parameters.

PEAR is designed as a user-friendly program that can be used both as a research tool by energy policy analysts, and as a nontechnical energy calculation method by architects, homebuilders, homeowners, and others in the building industry. Technical documentation of the PEAR program and the database is given elsewhere (see References).

Structure of the PEAR Program :

PEAR is organized in a two-layered structure with an "Option Selection mode", which then branches to 7 different operating options (Figure 1).

The Option Selection mode serves only a utility function allowing the user to change from one option to another. Of the seven options, two (Input and

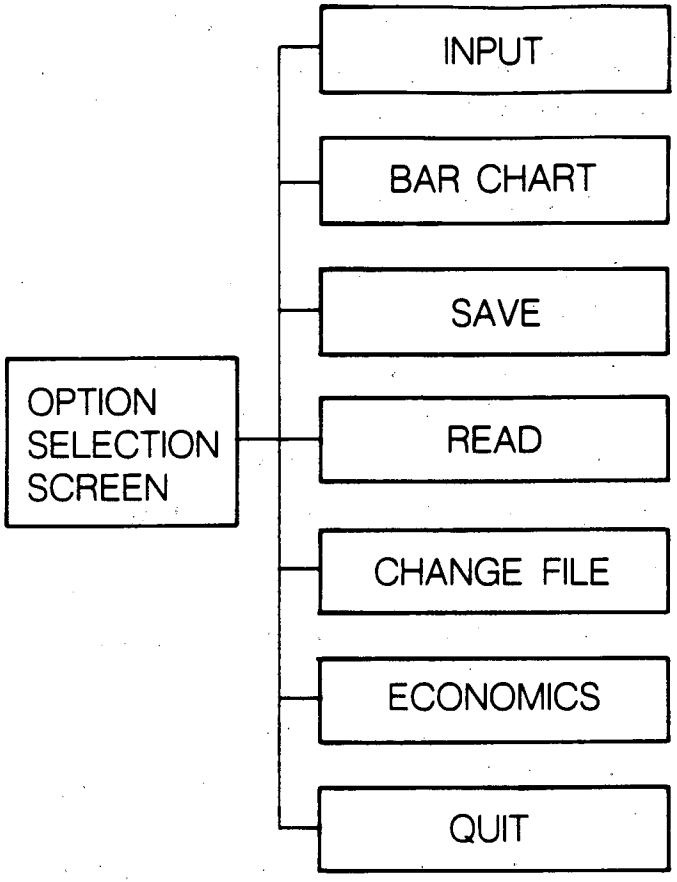

Figure 1. Structure of the PEAR Program

Economics) are used for data input and calculation, one (Bar Chart) for graphic display, three (Read, Save, and Change File) for file manipulation, and one (Quit) for exiting from the PEAR program.

To Start the Program :

1. Turn on the computer and boot the system using a MS-DOS diskette.
2. After the DOS prompt appears on the screen, insert the PEAR diskette in drive A.
3. Type PEAR and press *Return.*

The program Logo Screen is displayed (Figure 2) :

THE OPTION SELECTION SCREEN

To enter the Option Selection mode, press any key. The PEAR Option Selection screen is displayed (Figure 3) :

This outside screen appears whenever the PEAR program is in the Option Selection mode, and is identified by two thick horizontal white bars across the screen. The screen also lists two prompts at the top and the seven operation options at the bottom. The inside screen changes depending on the option selected.

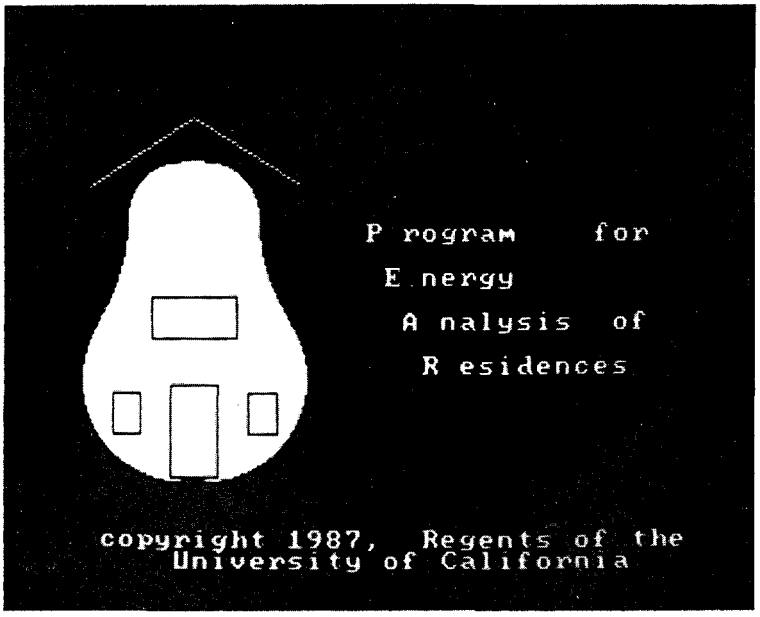

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Figure 2. PEAR Logo Screen

The Prompts :

The prompts across the top of the screen explain how to select and invoke the options listed across the bottom of the outside screen. The prompts are :

1. USE ARROW KEYS TO SELECT OPTION (><): The *Cursor* movement keys marked with directional arrows are used to move the *Cursor.*

2. ANY KEY TO INVOKE OPTION : To choose any of the seven options listed across the bottom

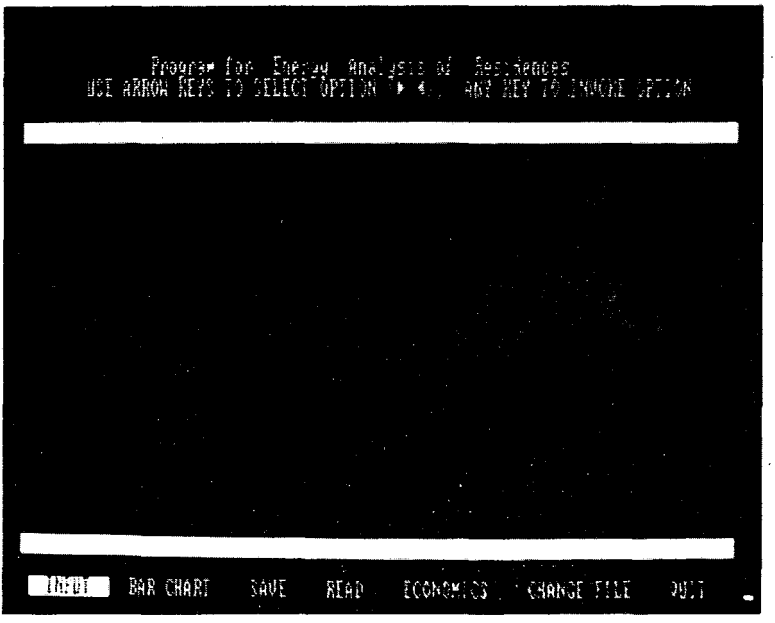

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Figure 3. Option Selection Screen

of the screen, position the *Cursor* over the desired option which will then be highlighted. To invoke the option covered by the *Cursor*, press any key.

The Seven Options :

There are seven options available when PEAR is in the Option Selection mode :

1. **Input :** This option consists of four data input screens that accept descriptions of the building,

conservation measures, equipment types, and fuel and economic costs. When data is entered on any of the screens, PEAR will automatically calculate the energy use of that building.

2. **Bar Chart :** This option provides a detailed analysis of the building configuration currently in the Input Option by dividing the structure's total energy use according to the separate contributions of the ceilings, walls, floors, infiltration, and windows.

3. **Save :** This option permits the user to save the results from a Run in a designated File for later retrieval or economic analysis.

4. **Read :** This is a menu of the Runs in the current File designated by the user. It allows the user to recall any Run in that File for use with the Input, Bar Chart, or Save options.

5. **Economics :** This option compares the economic cost-benefits of different Runs saved in a specified user data file.

6. **Change File :** This option allows users to change from the current user data File to a different File.

7. **Quit :** This option ends the program and returns the user to MS-DOS. The MS-DOS prompt (i.e.,

A>) is displayed at the bottom of the screen.

Runs and Files :

In using the PEAR program, a clear distinction should be made between files and runs. *File* refers to a standard MS-DOS file, while *Run* refers to a record within a file containing PEAR input for a particular building. A PEAR file carries the identifier [filename].SLD and contains one or more runs (.SLD is a default extention added by the PEAR program which can be renamed by the user). The first run saved in a new PEAR file is by default the *Base Case*, and used as the standard against which other runs are compared when the Economics Option is invoked. Therefore, the user should save onto the same file only those runs that logically could be compared to the Base Case.

The Save and Read options are used to manipulate run records within a selected file, such as adding new runs or changing the data in an existing run. The Change File Option is used if the user wishes to manipulate run data from a different file. To list the names of the existing PEAR files, the user must exit from PEAR and use standard MS-DOS command DIR *.SLD.

Data Input Format :

For alphanumeric input, PEAR does not distinguish between upper or lower case letters. For real number input, PEAR will automatically add a decimal point and trailing zeros to any integer.

THE INPUT OPTION

The Input Option allows the user to describe the building to be analyzed, or to change the building description for an existing Run recalled through the Read Option. The input operation consists of editing four screens of identical format (Figure 4).

The Prompts :

There are six prompts across the top of the screen which apply to all four Input screens. These are :

1. USE ARROW KEYS TO MOVE THE CURSOR (▶◀▲▼): The *Cursor* is positioned using the four keys marked with directional arrows.

2. <Space> TO EDIT : To edit data for any input line, move the *Cursor* to that line, and press the *Space Bar* to begin data entry.

3. ? for HELP : For an explanation of the data accepted on any input line, move the *Cursor* next

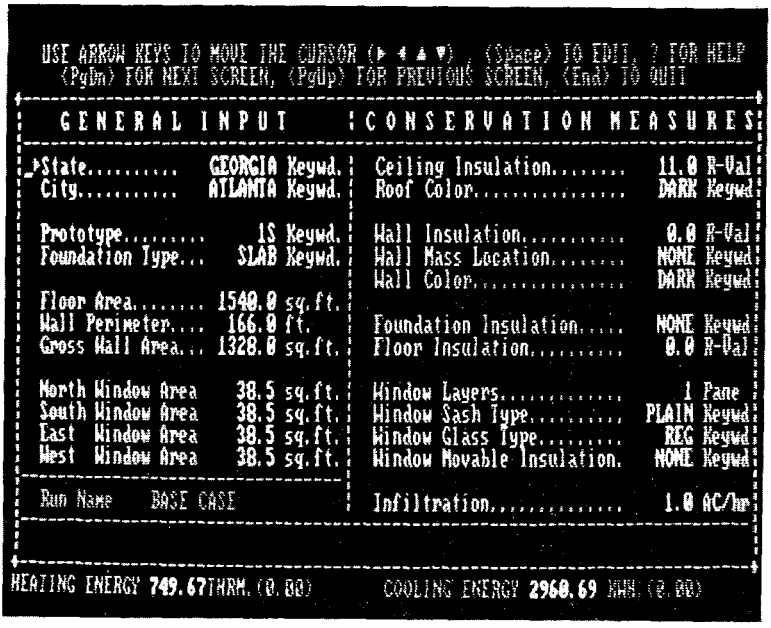

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Figure 4. First Input Screen

to that line and press the ? key.

4. <Pg Dn> FOR NEXT SCREEN : To display the following Input screen, press the *Pg Dn* key.

5. <Pg Up> FOR PREVIOUS SCREEN : To display the preceding Input screen, press the *Pg Up* key.

6. <End> TO QUIT : To exit the Input Option, press the *End* key.

To Enter Data in the Input Screens :

Note that the input data in PEAR are always filled. The first time PEAR is used, it will show sample data for a house in San Francisco. (This initial data always appears when the program is turned on.)

Move the *Cursor* using the arrow keys to position it to any input line that needs to be changed.

1. Press the *Space Bar.*

   The existing data is suppressed, indicating that new data can be input for that line.

2. Type the desired input data. The column immediately to the right of the data indicates whether the allowable format is an alphanumeric *Keyword* or a number. For explanations of the required input, press the *?* key.

   To erase data during input, press the *Backspace* key repeatedly until all unwanted data is erased, or hit *Return* and start over.

3. Press *Return.*

   If either the data format is incorrect or the number is outside the allowable range for that input, the program will display an error message "ERROR IN INPUT" and revert back to the

original input data.

If the input is acceptable, the new field entry is displayed on the Input screen, and the *Cursor* returns to its position in front of the input line. This information, however, is *not* saved in any File at this time. To save permanently the results of any changes, the user must exit from Input and invoke the Save Option.

As each entry is changed, PEAR automatically calculates the HEATING ENERGY and COOLING ENERGY for the modified house description and displays them at the bottom of the screen. For easy comparison, the previous heating and cooling energies are moved into the parenthesis on the right.

If data are not revised for any field, the PEAR calculations will be done using the *current* values shown on the screen.

To Read the Help Information For Any Input Item :

1. Move the *Cursor* to the input line.
2. Press the *?* key.

An explanation of the type and range of acceptable data will be displayed at the bottom of the screen. More details on the required data is given in **Tables 1**

through **5**. Press any key to continue input.

To Finish Input :

Press the *End* key. The Option Selection screen will appear, with the seven PEAR options shown at the bottom of the screen. This indicates that PEAR is now back in the Option Selection mode.

Description of Input Data :

The left half of all four Input screens are the same, with data entries for the location and prototype of the house, its foundation type, as well as floor, wall, and window dimensions. These data are carried over from screen to screen and can be edited on any of the four input screens. **Table 1** contains an item-by-item description of these data entries, and their required inputs.

The right side of the **first** Input screen contains data entries for basic conservation measures such as ceiling insulation, roof color, wall insulation, wall color, wall heat capacity, foundation and floor insulation, and window configurations. **Table 2** gives an item-by-item description of these data entries and their required inputs.

The right half of the **second** Input Screen (Figure 5) contains data entries for optional conservation

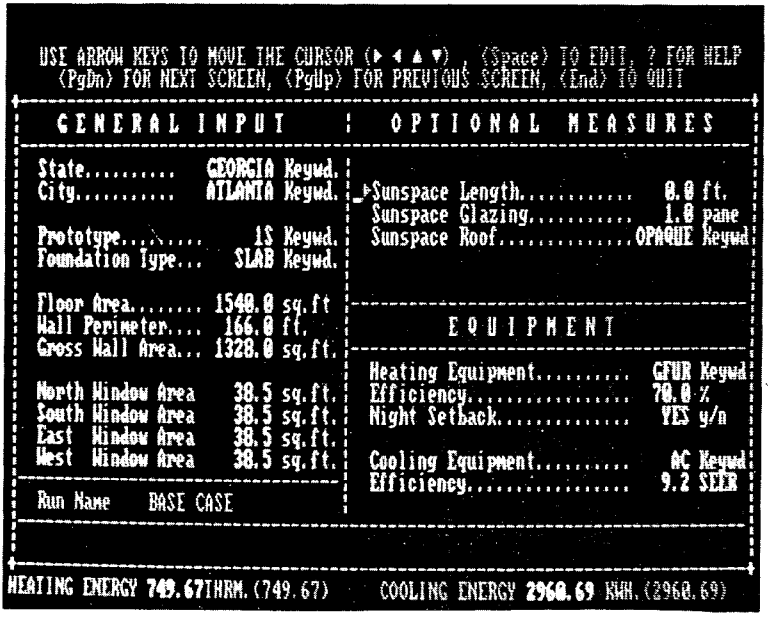

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Figure 5. Second Input Screen

measures such as an attached sunspaces, and the heating and cooling equipment characteristics. **Table 3** contains an item-by-item description of these data entries, and their required inputs.

The right half of the **third** Input Screen (Figure 6) contains data entries for appliances such as the domestic hot water system, refrigerator, dishwasher, and clothes washer, and for the reference electric and gas prices. **Table 4** shows an item-by-item description of these data entries and their required inputs.

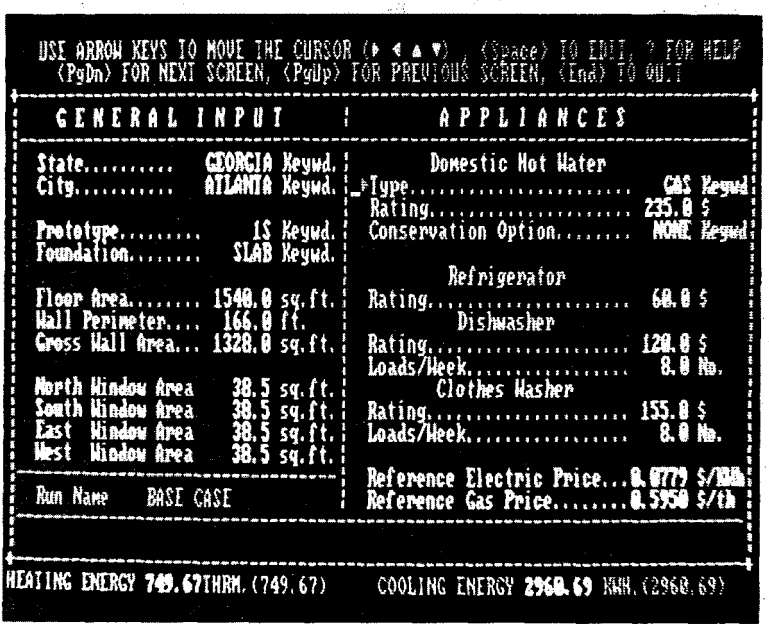

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Figure 6. Third Input Screen

The right half of the **fourth** Input Screen (Figure 7) contains data entries for the cost of fuel and for economic assumptions such as fuel escalation rates and costs of measures compared to the user-specified Base Case. **Table 5** contains an item-by-item description of data entries, and their required inputs.

Using the Input Option :

PEAR automatically calculates the changes in the heating and cooling energy use as the input data is

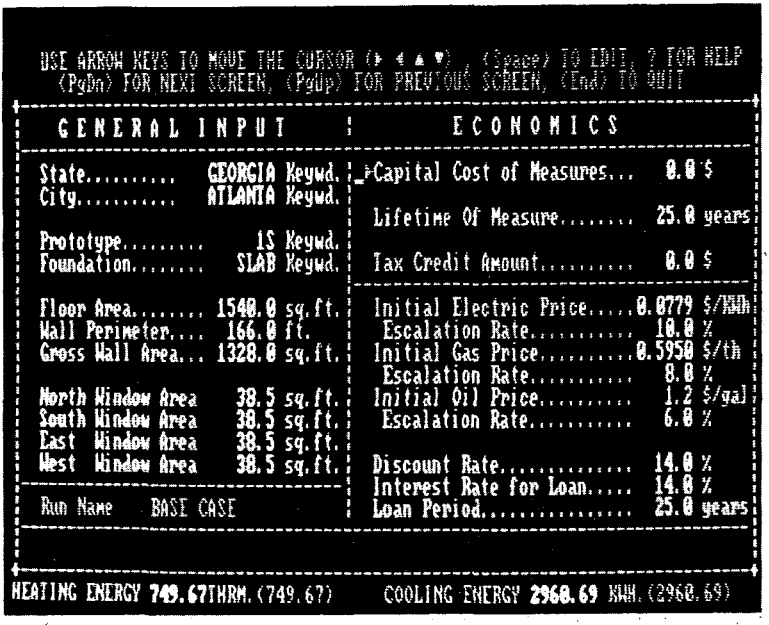

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Figure 7. Fourth Input Screen

changed. Therefore, if only the energy use for different house designs are needed, the user can remain in the Input Option, and note the changes in heating and cooling energy use at the bottom of the screen as the input data is changed.

For a diagnostic view of the contributions of each building component to the building energy use for the current building input description, the user exits from the Input Option and selects the Bar Chart Option. (This option works only on systems with a graphics

adapter).

If an economic comparison between different house configurations is desired, the user must save the input data and calculated energy consumption for each configuration using the Save Option and then invoke the Economics Option. The first configuration saved on any File is by default the Base Case. Subsequent configurations and their economic costs compared to the Base Case can be saved within the same File under other Run Names. In the Economics Option, PEAR uses the Base Case as the standard against which the cost-effectiveness of other configurations in the File are compared.

THE BAR CHART OPTION

The Bar Chart Option analyzes the energy efficiency of the configuration currently in the Input option by plotting the estimated contribution to heating and cooling energy use due to the ceiling, walls, floor, windows, and infiltration (Figure 8).

The heating and cooling bars are scaled by energy costs in dollars. This is a "display only" screen to show which parts of a house are energy inefficient and should be improved. The values given are approximate and *should not be used for loads calculations,* since for simplicity, interactive effects such as internal loads have been omitted.

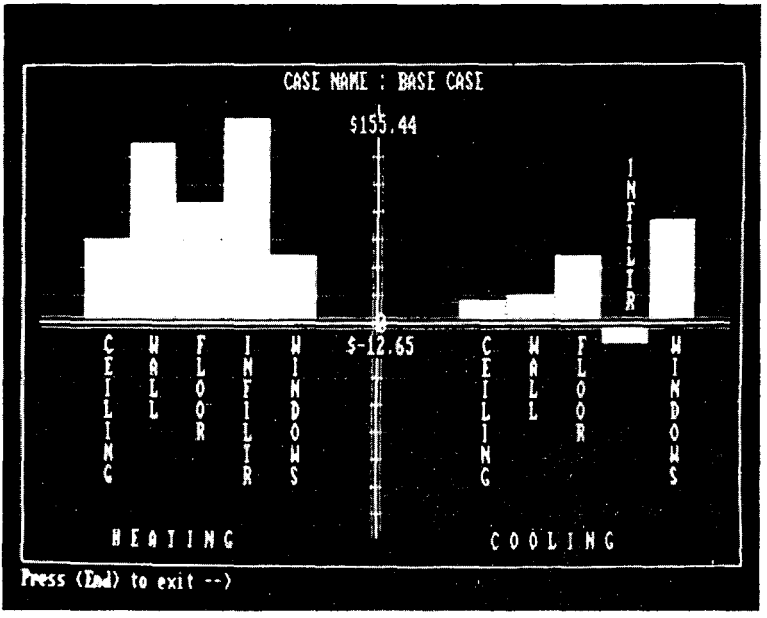

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Figure 8. Bar Chart

To Exit the Bar Graph Option, press the *End* key. The program returns to the Option Selection mode with the seven options displayed across the bottom of the screen.

THE SAVE OPTION

The Save Option permits the user to save the results from a Run in a designated File for later retrieval or economic analysis.

1. If a current File is attached to PEAR, the program responds directly with the Save screen (Figure 9). The operations of the Save screen are described in the next section.

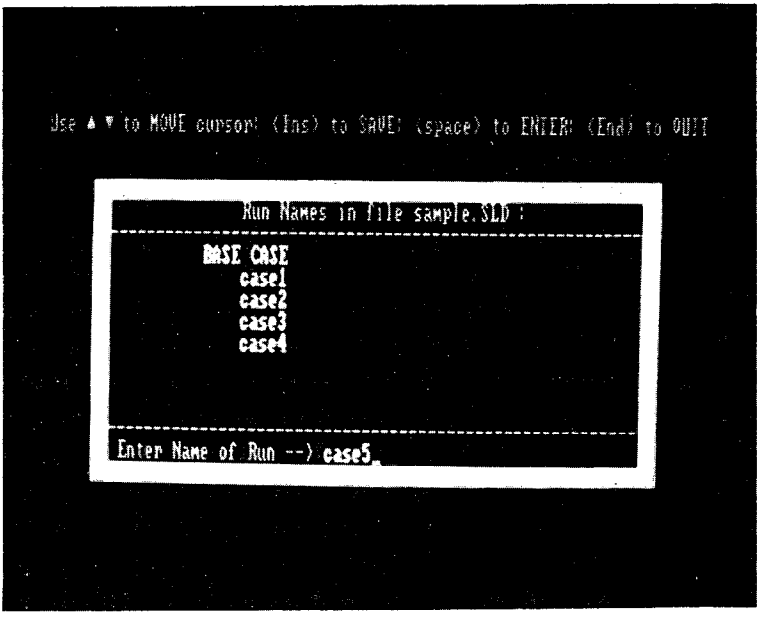

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Figure 9. Save Screen

2. If there is no current File attached to PEAR, the program prompts :

ENTER USER FILE NAME :

Type, next to the prompt, the name of the File

with the added extension (i.e., *.SLD) in which the Run data should be saved.

3. If there is no file with that name, the program asks :

USE NEW FILE (filename).SLD? <Y/N>

Type N (No) to abort the option or if the File name is incorrect. The program will return to the earlier prompt requesting "ENTER USE FILE NAME :". If you wish to exit the SAVE option at this point, hit the *Return* key.

Type Y (Yes) if the File name is correct. Since this a new file, there are no other Runs. Therefore, the current Run will be saved automatically as the Base Case and a message to that effect is displayed. Notice that PEAR then returns automatically to the Option Selection mode.

4. If there is an existing file with that name, the program prompts :

USE EXISTING FILE (filename).SLD? <Y/N>

Type N (No) to abort the option or if the File name is incorrect. The program will return to the earlier prompt requesting "ENTER USE FILE NAME :". If you wish to exit the Save option at

this point, press the *Return* key. If the File name is incorrect, type the correct name.

Type Y (Yes) if the File name is correct. The Save screen, which is explained in the following section, is now displayed.

The Save Screen :

The Save screen lists all Runs in the attached File. The File name is shown at the top of the screen, and the *Cursor* is positioned at the top of the Run Name list and indicated by highlight.

The Prompts :

1. USE ▲▼ TO MOVE CURSOR : The *Cursor* movement keys marked with up and down arrows are used to move the *Cursor*.

2. <Ins> TO SAVE : To overwrite the Run onto an existing Run, use the *Ins* key.

3. <Space> TO ENTER : To save the current Run under a new Run Name, press the *Space Bar*.

4. <End> TO QUIT

To Save a Run :

There are two ways to save a run. The Run information can be saved either under a new Run Name, or overwritten onto an existing Run. Once a Run has been saved, the program displays a message to that effect and then automatically exits to the Option Selection mode.

A. To save under a new Run Name :

1. Press the *Space Bar.*

   The program prompts : ENTER NAME OF RUN -->

2. Type the name of the new Run, and then press *Return.* If no name is entered, pressing *Return* will abort the Save Option and return the user to the Option Selection mode. This can be done on purpose if the user wishes to exit the Save Option at this point without saving a new Run.

B. To overwrite :

1. Move the *Cursor* until the highlight is over the desired Run Name.
2. Press <Ins>.

An alternate method to overwrite an existing Run is to follow the commands for *saving a Run* mentioned

earlier, but entering the name of the existing Run.

1. Press the *Space Bar.*

   The program prompts : ENTER NAME OF RUN -->

2. Type the name of the existing Run, and then press *Return.*

To Exit the Save Option Without Saving a Run :

Press the *End* key. PEAR displays a message and returns to the Option Selection mode with the seven options displayed across the bottom of the screen.

THE READ OPTION

The Read Option recalls data from previous Runs which already have been saved in an existing File. The functions of this option are very similar to those of the Save Option.

1. If a File is currently attached to PEAR, the program responds directly with the Read Screen (Figure 10) and enters the Read mode as described next.

2. If there is no current File in PEAR, the program asks :

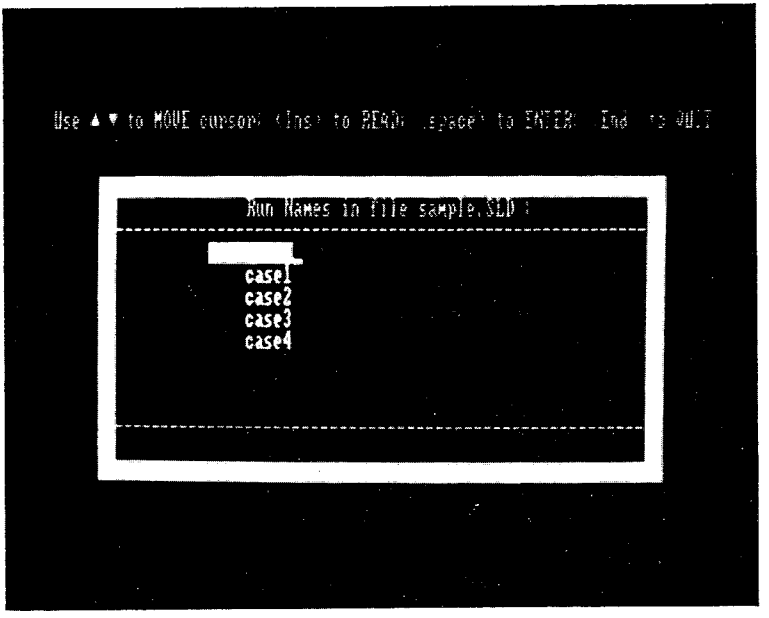

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Figure 10. Read Screen

ENTER USER FILE NAME :

Type the name of the File with the desired Run information. If you wish to exit the *Read* option without reading a file, press the *Return* key.

If there is no file by that name, the program states:

FILE (filename).SLD NOT FOUND

and returns to the earlier prompt "ENTER USER FILE NAME :"

If the file name of an existing File is entered, the program asks :

USE EXISTING FILE (filename).SLD? <Y/N>

3. Type N (No) to abort the option or if the File name is incorrect. The program will return to the earlier prompt "ENTER USE FILE NAME :". To abort the option, press the *Return* key.

4. Type Y (Yes) to display the Read screen, which is explained in the following section.

The Read Screen :

The Read screen (Figure 10) is similar in format to the Save screen. It lists all Runs attached to the File name entered. The name of the file is shown at the top of the screen, and the *Cursor* is indicated as a highlight over one of the Run Names. The *Cursor* may be moved using the two direction keys with arrows pointing up and down.

To Exit Without Reading :

Press the <End> key.

To Select a Run :

1. Move the *Cursor* down the list to the desired Run Name.
2. Press <Ins>.
3. Press the *Return* key.

or

1. Press the *Space Bar.*

The program asks : ENTER NAME OF RUN -->

2. Type the name of the run.
3. Press the *Return* key.

PEAR activates the requested Run and then automatically returns to the Option Selection mode with the seven options displayed across the bottom of the screen. The requested Run can now be used with the Input, Bar Chart, or Save options.

THE ECONOMICS OPTION

When the Base Case has been completed along with one or more additional Runs having various combinations of alternative conservation measures, there is enough information for the PEAR program to perform an economic analysis.

The Economics Option operates on the Runs in the current active file in the PEAR program. If there is no active file, PEAR will ask for the file name, to which the user must respond as in the READ Option. To change to a different file, the user must invoke first the Change File Option and then the Economics Option.

The Economics screen compares the economic merits of the Runs in the File to the Base Case based on the energy savings and incremental costs of the additional conservation measures (Figure 11). Two economic criteria are used : Simple payback in years, and the Savings-to-Investment Ratio.

The Economics Screen :

A brief statement of the Base Case characteristics is displayed across the bottom of the screen giving the insulation R-values of the ceiling, wall and foundation, infiltration rate, window area, number of window layers, and total annual energy cost for space conditioning only.

The different Run Names are displayed across the top of the screen and, below them, the following data extracted for each Run : abbreviated Run description, yearly energy savings for each fuel (electric, gas, and oil) in dollars as compared to the Base Case, total annual energy cost for space conditioning, cost of measure, lifetime of measure, and tax credit.

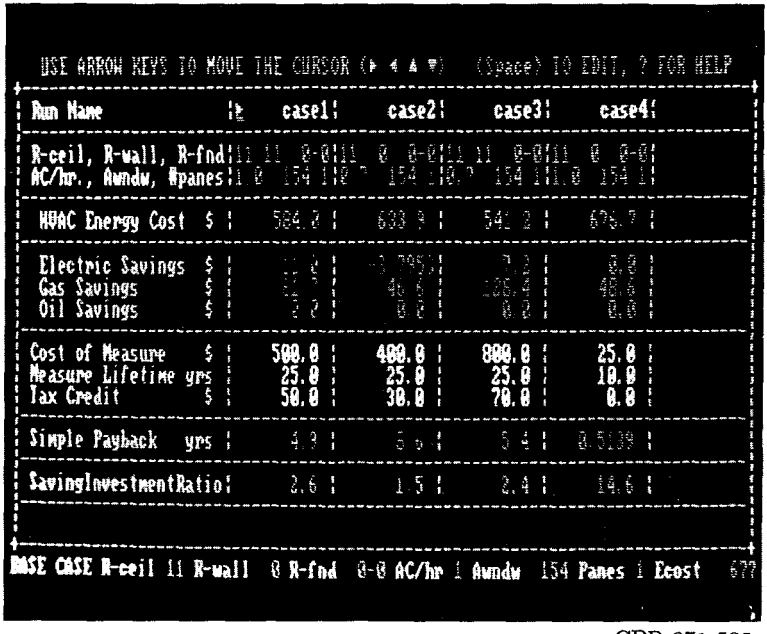

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Figure 11. Economics Screen

The last two rows show two economic indicators calculated by the Economics Option based on the above data : Simple Payback (in years) and the Savings-to-Investment Ratio.

The Prompts :

The prompts across the top of the screen are similar to those displayed for the Input screens. See page 9 for explanations of these prompts.

To Edit Data on the Economics Screen :

The editing procedure for the Economics screen is identical to that for the Input screens. For a description of the operations, refer to page 11.

In contrast to the Input screens, however, not all the data on the Economics screen can be changed. The following building data are extracted from the Run record and *cannot* be edited : house description, yearly energy savings, and yearly energy cost.

The following economic data are also extracted from the Run record but *can* be edited : *Cost, Lifetime of Measures,* and *Tax Credits.* This allows the user to explore the impact of different prices and costs on the economic viability of the same conservation measure. Once these values have been changed, PEAR recalculates the Simple Payback and Savings-to-Investment Ratio. Changes made on the Economics screen, however, *cannot* be saved onto the Run record. Permanent changes to the Run record must be done through the Input and Save options.

The user can also change the Run Name to that of any run existing in the current File. This is useful for Files containing more than five Runs, since the screen can show only five Runs at one time. The user can also scroll the cursor left or right to view other Runs in the current File. When the Run Name is changed, the screen will automatically insert the data for the new

Run and calculate the economic indicators.

Explanation of Economic Indicators :

Based on the calculated annual energy savings, user inputs for costs of conservation measures, fuel, lifetime of measure, loan period, and fuel escalation and interest rates, PEAR calculates two economic indicators: Simple Payback Period (SPP) and the Savings-to-Investment Ratio (SIR).

The Simple Payback Period (SPP) is a commonly used economic indicator for the length of time required to recover the capital cost of conservation, ignoring any effects due to inflation, changing fuel prices, or the time value of money.

$$SPP = \frac{I - \alpha}{\Delta E * P} \qquad (1)$$

where : I = cost of conservation measure ($)
α = tax credit ($)
ΔE = annual energy savings (therms or kWh)
P = initial fuel price

The Savings-to-Investment Ratio (SIR) is a more detailed economic indicator that takes the above into account, but also includes escalating fuel costs, the time value of money, lifetime of the conservation option, and loan terms. SIR is equal to the benefit (energy

savings) over the measure lifetime divided by the cost of the conservation measures (investment) over the measure lifetime.

$$SIR = \frac{\alpha + \sum_{j=1}^{2}\sum_{k=1}^{N} \Delta E(j) * P(j) * \frac{(1+EF(j))^k}{(1+d)^k}}{0.2 * I + \sum_{i=1}^{n} \frac{12 * m}{(1+d)^i}} \qquad (2)$$

where : α= tax credit ($)
ΔE= annual energy savings (MBtu)
P= initial fuel price ($)
EF= fuel escalation rate in real terms
d= real discount rate (yrs.)
I= cost of conservation measure ($)
i= interest rate for loan-annual (%)
j= heating or cooling
N= lifetime of measure (yrs.)
n= loan period (yrs.)
m= monthly mortgage payment

$$\left(0.8 * I * (i/100*12) * \frac{(1 + i/100*12)^{n*12}}{(1 + i/100)^{n*12} - 1} \right)$$

To Exit the Economics Option :

1. Press *End*.

The seven options are displayed across the bottom of the screen, indicating that the program is back in the Option Selection mode.

THE CHANGE FILE OPTION

The Change File Option allows the user to exit one file and enter another without exiting or restarting the PEAR program. The operation of this option is very similar to that for the Save and Read options.

1. Once the Change File Option is invoked, the program prompts :

   ENTER USER FILE NAME :

2. Type, next to the prompt, the name of the new File to be displayed. If there is an existing file by that name, the program asks :

   USE EXISTING FILE (filename).SLD? <Y/N>

   If there is no file by that name, the program asks :

   USE NEW FILE (filename).SLD? <Y/N>

   Type N (No) to abort the Option or if the File name is incorrect. The program will return to the earlier prompt "ENTER USE FILE NAME :". If you wish to exit the Change File option at this point, press the *Return* key. If you wish to correct the File name, respond by entering the correct File name.

Type Y (Yes) to change file.

PEAR has changed to the requested file and then has automatically returned to the Option Selection mode.

THE QUIT OPTION

This option ends the PEAR program and returns the user to MS-DOS. To invoke this option, move the cursor to *QUIT* and press *Return.*

REFERENCES

Reference 1 documents the methodology and assumptions used by LBL in creating the DOE-2.1 residential database. Reference 2 is a listing of the database in tabular format, and Reference 3 describes the additional regression analyses used in the PEAR program.

1. Y. J. Huang, R. Ritschard, J. C. Bull, S. Byrne, I. Turiel, D. Wilson, C. Hsui, and D. Foley 1987. "Methodology and Assumptions for Evaluating Heating and Cooling Energy Requirements in New Single-Family Residential Buildings (Technical Support Document for the PEAR Microcomputer

Program)", LBL Report No. 19128, Lawrence Berkeley Laboratory, University of California, Berkeley CA.

2. Y. J. Huang, R. Ritschard, I. Turiel, S. Byrne, J. Bull, D. Wilson, C. Hsui, and L. Chang 1986. "Affordable Housing Through Energy Conservation, Database for Simplified Energy Calculations", LBL Report No. 16343, Lawrence Berkeley Laboratory, University of California, Berkeley CA.

3. Y. J. Huang, R. Ritschard, and J. C. Bull, 1985. "Simplified Calculations of Energy Use of Residences Using a Large DOE-2 Database", LBL Report No. 20107, Lawrence Berkeley Laboratory, University of California, Berkeley CA.

TABLES

Table 1. General Building Input List (Left Screen)

Item	Input Format
State~	First nine letters of state name, including blank spaces.
City	First nine letters of city name, including blank spaces (e.g., **San Franc**, not **Sanfranci**).
Prototype	One of 5 keywords for house prototypes: **1S**, **2S**, **SL**, **MT**, or **ET**.
Foundation Type	One of 3 keywords for foundation type: **SLAB**, **BASMNT**, or **CRAWL**.
Floor Area	Square footage of conditioned space (do not include garages, attics, or basements).
Wall Perimeter	Perimeter length of conditioned floor area in ft. (do not include garage or interior foundation perimeters, but include perimeter between the house and garage).

	Acceptable input
	Any state or the **District of Columbia.**
	Any of the 880 cities listed in Appendix A.
	1S = one-story ranch house, **2S** = two-story house, **SL** = split-level house, **MT** = middle-unit townhouse, **ET** = end-unit townhouse.
	SLAB = slab-on grade, **BASMNT** = basements, **CRAWL** = ventilated crawl space. The PEAR database does not include very atypical foundation types in certain locations such as basements in Miami or slab-on-grade in Minneapolis. See Appendix B for available foundation types in representative cities.
	Restricted to the reliable range of the PEAR database: 1000 to 3000 ft^2 for one-story, 1800 to 4000 ft^2 for two-story, 1500 to 2800 ft^2 for split-level, 900 to 2500 ft^2 for townhouses.
	Restricted by prototype and floor area (A): $4\sqrt{A}$ to $4.62\sqrt{A}$ for one-story, $2.83\sqrt{A}$ to $3.27\sqrt{A}$ for two-story, $3.41\sqrt{A}$ to $3.94\sqrt{A}$ for split-level, $82\sqrt{A}$ to $2\sqrt{A}$ for middle-unit townhouse, $2\sqrt{A}$ to $2.5\sqrt{A}$ for end-unit townhouse.

Table 1. General Building Input List
(Left Screen, Continued)

Item	Input Format	
Gross Wall Area	Total area of vertical surfaces in ft^2, including walls, windows, and doors.	
Window Areas	Gross window areas in ft^2, including area of window sash.	

	Acceptable input
	Restricted by prototype and floor area (A): $30\sqrt{A}$ to $46.2\sqrt{A}$ for one-story, $42.4\sqrt{A}$ to $65.3\sqrt{A}$ for two-story, $36.2\sqrt{A}$ to $55.8\sqrt{A}$ for split-level, $12.2\sqrt{A}$ to $40\sqrt{A}$ for middle-unit townhouse, $30\sqrt{A}$ to $50\sqrt{A}$ for end-unit townhouse. Restricted to reliable range of the PEAR database. Window area on any side cannot be more than 15%, and total window area not more than 20% of house floor area.

Table 2. Conservation Measure Input List (First Right Screen)

Item	Input Format	
Ceiling Insulation	Nominal R-value of *insulation layer only* (do not include resistances of construction layers or attic air films).	
Roof Color	Choice of 2 keywords: **DARK** or **LIGHT**.	
Wall Insulation	Nominal R-value of *insulation layer only* (do not include resistances of construction layers or wall air films).	
Wall Mass Location	Choice of 3 keywords: **NONE**, **IN**, **OUT**, or **MIXED**.	
Wall Color (light-frame walls only)	Choice of 2 keywords: **DARK** or **LIGHT**.	
Wall Heat Capacity (mass walls only)	Total heat capacity of wall assembly	

	Acceptable input
	Insulation R-values from 0 to 60. Note: PEAR assumes 2X6 24" o.c. ceiling construction and an attic.
	DARK corresponds to medium-grey color with an absorptance of 0.7; **LIGHT** to off-white color with an absorptance of 0.3.
	Insulation R-values from 0 to 27. Note: PEAR assumes 2X4 16" o.c. construction below R-11; 2X6 24" o.c. for R-19 walls and above.
	Keywords refer to the location of thermal mass in exterior walls. For light-weight walls, enter **NONE**; for mass walls, enter **IN** for those with mass *inside* the insulation, **OUT** for those with mass *outside* the insulation, and **MIXED** for those with integral or core insulation. For log walls, enter **MIXED**. Note: Keyword choice determines which of the next two input items are required.
	DARK corresponds to medium-grey color with an absorptance of 0.7; **LIGHT** to off-white color with an absorptance of 0.3.
	Heat capacities from 3.0 to 14.0 (Btu/ft^2·F). The wall heat capacity can be calculated by multiplying the mass by the specific heat of the wall : Wall mass = weight of wall per ft^2 of area (lb/ft^2) Specific heat = specific heat of wall mass in (Btu/lb·F)

Table 2. Conservation Measure Input List
(First Right Screen, Continued)

Item	Input Format	
Foundation insulation (for slab and basements only)	Choice of keyword depends on foundation type: **NONE**, **R5-2**, **R5-4** for slab-on-grade, **NONE**, **R5-4**, **R5-8**, **R10-8** for basement.	
Floor insulation (for crawl and basements only)	Nominal R-value of insulation layer under floor joists (do not include resistance of construction layers or air films).	
Window Layers	Number of panes: 1, 2 or 3.	
Window Sash Type	Choice of 3 keywords for type of window sash: **WOOD**, **ALUM**, or **ALUMTB**.	
Window Glass Type	Choice of 3 keywords for type of window glass: **REG**, **HA**, or **REFL**.	

	Acceptable input
	Keywords refer to R-value and depth of perimeter edge insulation: **R5-2** = R-5 extending down 2 ft, **R5-4** = R-5 extending down 4 ft, **R5-8** = R-5 extending down 8 ft, **R10-8** = R-10 extending down 8 ft. Insulation R-values from 0 to 22. Note: PEAR assumes 2×10 24" o.c. floor construction. PEAR assumes standard 1/8" glass; ¼" air gap in double pane and ½" air gap for triple-pane windows. **WOOD** = wood sash; **ALUM** = aluminum; **ALUMTB** = aluminum with thermal breaks. **REG** = standard clear glass; **HA** = heat absorbing glass; **REFL** = reflective glass.

Glass Characteristics	Transmittance	Reflectance	Shading Coefficient
HA 1-pane	50%	6%	.70
HA 2-pane	43	9	.59
HA 3-pane	39	7	.52
REFL 1-pane	20	45	.36
REFL 2-pane	19	45	.28
REFL 3-pane	17	45	.25

Table 2. Conservation Measure Input List
(First Right Screen, Continued)

Item	Input Format	
Window Insulation	Choice of 4 keywords: **NONE**, **R-1**, **R-3**, **R-5**.	
Infiltration	Average number of air changes per hour during winter months.	

	Acceptable input
	R-values refer to movable insulation covering all windows between 10 p.m. and 8 a.m. during the winter months. Air changes rates from 0.4 to 1.0 ach.

Table 3. Optional Measures and Equipment Input List (Second Right Screen)

Item	Input Format
Sunspace Length	Length of attached sunspace in ft.
Sunspace Glazing	Number of panes: 1 or 2.
Sunspace Roof	Choice of 2 keywords: **GLAZED** or **OPAQUE**.
Heating Equipment	Choice of 4 keywords: **OFUR** for oil furnace, **GFUR** for gas furnace, **ER** for electric resistance, and **HP** for heat pump.
Efficiency	Net efficiency of heating system.
Night Setback	**YES** or **NO**.
Cooling Equipment	Choice of 2 keywords: **AC** for air conditioner, **HP** for heat pump.
Efficiency	Net efficiency of cooling system.

	Acceptable input
	10 to 24 ft. Note: Sunspace data available only for 1-story prototype. PEAR assumes standard clear glass; and 1/2" air gap in double glazing. Glazed roofs are assumed to have the same number of panes as the vertical glazing; opaque roofs are assumed to be R-19 for single-glazed, and R-38 for double-glazed sunspaces. All heating systems are assumed to be central.
	The range of efficiencies allowed by PEAR depends on the system type: Furnaces: 55% to 95% Electric Resistance: 100% to 130% Heat Pumps: 4.0–12.5 HSPF Note: Net efficiency should include duct losses. For electric resistance systems, efficiencies above 100% assume use of zonal control. PEAR assumes a 6 hour night setback to 60 F between 12 and 6 a.m.; setbacks are not allowed for heat pumps. All cooling systems are assumed to be central.
	SEER from 6.0 to 14.0 Note: net efficiency should include duct losses.

Table 4. Appliances Input List
(Third Right Screen)

Item	Input Format	
Domestic Hot Water		
Type	One of two keywords: **ELEC, GAS.**	
Rating	Dollars ($)	
Conservation Option	One of six keywords: **NONE, FLOW, 1P, 2P, 1P+F, 2P+F.**	
Refrigerator		
Rating	Dollars ($)	
Dishwasher		
Rating	Dollars ($)	
Loads/Week	Number	
Clothes Washer		
Rating	Dollars ($)	
Loads/Week	Number	
Reference Electric Price	Dollars ($)	
Reference Gas Price	Dollars ($)	

	Acceptable input
	ELEC = Electric Hot Water System, **GAS** = Gas Hot Water System.
	FTC Energy Guide Label in dollars ($0 to $600).
	NONE = no conservation, **FLOW** = flow restrictor, **1P** = 1-panel solar, **2P** = 2-panel solar, **1P+F** = 1-panel solar + restrictor, **2P+F** = 2-panel solar + restrictor.
	FTC Energy Guide Label in dollars ($0 to $200).
	FTC Energy Guide Label in dollars ($0 to $200).
	Average number of loads/week (1 to 8).
	FTC Energy Guide Label in dollars ($0 to $200).
	Average number of loads/week (1 to 8).
	$/kWh for electric appliances ($0 to $50).
	$/therms for gas appliances ($0 to $50).

Table 5. Economics Input List
(Fourth Right Screen)

Item	Input Format	
Capital Cost of Measure	Dollars ($)	
Lifetime of Measure	Years	
Tax Credit Amount	Dollars ($)	
Initial Fuel Price (Electric)	Dollars ($)	
Fuel Escalation Rate (Electric)	Percent (%)	
Initial Fuel Price (Gas)	Dollars ($)	
Fuel Escalation Rate (Gas)	Percent (%)	
Initial Fuel Price (Oil)	Percent (%)	
Fuel Escalation Rate (Oil)	Percent (%)	
Discount Rate	Percent (%)	
Interest Rate of Loan	Percent (%)	
Loan Period	Years	

	Acceptable input
	Incremental cost of conservation measure compared to the BASE CASE ($0 to $20,000).
	Expected lifetime of conservation measure (0 to 30 years).
	Expected tax credit for conservation measure in dollars ($0 to $20,000).
	$/kWh for heat pumps and electric resistance heaters ($0 to $50).
	Expected rate of increase in the cost of electricity (0 to 20%).
	$/therm for gas furnaces ($0 to $50).
	Expected rate of increase in the cost of natural gas (0 to 20%).
	$/gallon for oil furnaces ($0 to $50).
	Expected rate of increase in the cost of oil (0 to 20%).
	Anticipated implicit discount rate of money (0 to 20%).
	Anticipated interest rate for loan (0 to 20%).
	Anticipated length of loan period (0 to 40 years).

Appendix A. List of Cities Included in PEAR

Alabama
Andalusia
Anniston
Auburn
Birmingham
Dothan
Eufaula
Gadsden
Huntsville
Mobile
Montgomery
Ozark
Scottsboro
Selma
Talladega
Tuscaloosa

Alaska
Anchorage
Fairbanks
Juneau
Kenai

Arizona
Casa Grande
Douglas
Flagstaff
Mesa
Nogales
Phoenix
Prescott
Tempe
Tucson
Yuma

Arkansas
Arkadelphia
Benton
Blytheville
Camden
Conway
El Dorado
Fayetteville
Fort Smith
Hope
Hot Springs
Jonesboro
Little Rock
Magnolia
Malvern
No. Little Rock
Paragould
Pine Bluff
Russellville
Searcy
Stuttgart
Texarkana

California
Antioch
Bakersfield
Barstow
Berkeley
Burbank
Chico
Chula Vista
Claremont
Concord
Corona
Culver City
Davis
El Centro
Escondido
Eureka
Fairfield
Fontana
Fresno
Hanford
Indio
Laguna Beach
La Mesa
Lancaster
Livermore
Lodi
Lompoc
Long Beach
Los Angeles
Los Banos
Los Gatos
Madera
Merced
Modesto
Monterey
Napa
Newport Beach
Oakland
Oceanside
Oxnard
Palm Springs
Palo Alto
Pasadena
Petaluma
Pomona
Porterville
Redding
Redlands
Redwood City
Richmond
Riverside
Sacramento
Salinas
San Bernardino

Appendix A. City List (Continued)

California (cont.)	Sterling	Miami
San Diego	**Connecticut**	Naples
San Francisco	Bridgeport	Ocala
San Gabriel	Danbury	Orlando
San Jose	Enfield	Palatka
San Luis Obispo	Groton	Pensacola
San Rafael	Hartford	Plant City
Santa Ana	Meriden	Pompano Beach
Santa Barbara	Middletown	St. Petersburg
Santa Cruz	New Haven	Sanford
Santa Maria	Norwalk	Sarasota
Santa Monica	Storrs	Tallahassee
Santa Paula	Waterbury	Tampa
Santa Rosa	**Delaware**	Titusville
Stockton	Dover	Vero Beach
Torrance	Newark	West Palm Beach
Tracy	Wilmington	Winter Haven
Tustin	**District Of C**	**Georgia**
Upland	Washington	Albany
Vacaville	**Florida**	Americus
Visalia	Bartow	Athens
Watsonville	Belle Glade	Atlanta
Woodland	Bradenton	Augusta
Yorba Linda	Clearwater	Brunswick
Colorado	Daytona Beach	Carrollton
Boulder	Deland	Columbus
Canon City	Fort Lauderdale	Covington
Colorado Springs	Fort Myers	Dalton
Denver	Fort Pierce	Douglas
Durango	Gainesville	Dublin
Fort Collins	Hialeah	Fitzgerald
Grand Junction	Homestead	Gainesville
Greeley	Jacksonville	La Grange
Lakewood	Key West	Macon
Longmont	Lakeland	Milledgeville
Pueblo	Melbourne	Moultrie

Appendix A. City List (Continued)

Georgia (cont.)
Newnan
Rome
Savannah
Thomasville
Tifton
Waycross
Hawaii
Hilo
Honolulu
Kahului
Kaneohe Mauka
Lahaina
Idaho
Boise
Caldwell
Coeur D'Alene
Idaho Falls
Moscow
Pocatello
Illinois
Alton
Aurora
Belleville
Bloomington
Carbondale
Champaign
Charleston
Chicago
Danville
Decatur
De Kalb
Dixon
Effingham
Elgin
Galesburg
Jacksonville
Joliet
Kewanee
Lincoln
Mattoon
Monmouth
Mount Vernon
Ottawa
Park Forest
Peoria
Peru
Pontiac
Quincy
Rantoul
Rockford
Springfield
Urbana
Waukegan
Wheaton
Indiana
Anderson
Bloomington
Columbus
Crawfordsville
Elwood
Evansville
Fort Wayne
Frankfort
Gary
Goshen
Greenfield
Hobart
Huntington
Indianapolis
Kokomo
La Porte
Lafayette
Marion
Martinsville
Muncie
New Castle
Richmond
Seymour
Shelbyville
South Bend
Terre Haute
Valparaiso
Vincennes
Wabash
West Lafayette
Iowa
Ames
Ankeny
Boone
Cedar Rapids
Clinton
Davenport
Des Moines
Dubuque
Fort Dodge
Indianola
Iowa City
Keokuk
Marshalltown
Mason City
Muscatine
Newton
Oskaloosa
Ottumwa
Sioux City
Spencer
Waterloo

Appendix A. City List (Continued)

	Jennings	Lawrence
Kansas	Lafayette	Lowell
Hutchinson	Lake Charles	New Bedford
Manhattan	Minden	Pittsfield
McPherson	Monroe	Springfield
Newton	Morgan City	Taunton
Olathe	Natchitoches	Worcester
Ottawa	New Iberia	**Michigan**
Parsons	New Orleans	Adrian
Salina	Ruston	Alpena
Topeka	Shreveport	Ann Arbor
Wichita	Tallulah	Battle Creek
Winfield	**Maine**	Bay City
Kentucky	Augusta	Benton Harbor
Ashland	Bangor	Big Rapids
Bowling Green	Lewiston	Cadillac
Covington	Portland	Detroit
Frankfort	Presque Isle	Escanaba
Henderson	Waterville	Flint
Hopkinsville	**Maryland**	Grand Haven
Lexington	Baltimore	Grand Rapids
Louisville	Cambridge	Holland
Madisonville	College Park	Jackson
Mayfield	Cumberland	Kalamazoo
Middlesboro	Hagerstown	Lansing
Murray	Laurel	Marquette
Owensboro	Rockville	Midland
Paducah	Salisbury	Monroe
Somerset	**Massachusetts**	Mt Pleasant
Louisiana	Amherst	Muskegon
Alexandria	Boston	Owosso
Bastrop	Brockton	Pontiac
Baton Rouge	Clinton	Port Huron
Bogalusa	Fitchburg	Saginaw
Hammond	Framingham	Sault Ste Marie
Houma	Haverhill	Traverse City

Appendix A. City List (Continued)

Michigan (cont.)	Vicksburg	Kearney
Ypsilanti	Yazoo City	Lincoln
Minnesota	**Missouri**	Norfolk
Albert	Carthage	North Platte
Austin	Columbia	Omaha
Bemidji	Fulton	Scottsbluff
Cloquet	Hannibal	**Nevada**
Duluth	Jefferson City	Carson City
Fairmont	Joplin	Ely
Faribault	Kansas City	Las Vegas
Fergus Falls	Kirksville	Reno
Marshall	Mexico	Sunrise Manr
Minneapolis	Moberly	Winnemucca
Rochester	Poplar Bluff	**New Hampshire**
St. Cloud	St. Charles	Concord
St. Paul	St. Joseph	Keene
Virginia	St. Louis	Lebanon
Willmar	Sedalia	Manchester
Mississippi	Sikeston	Nashua
Biloxi	Springfield	**New Jersey**
Brookhaven	Warrensburg	Atlantic City
Canton	**Montana**	Freehold
Clarksdale	Billings	Glassboro
Cleveland	Bozeman	Hammonton
Columbus	Butte	Jersey City
Corinth	Great Falls	Little Falls
Greenville	Havre	Long Branch
Greenwood	Helena	Millville
Gulfport	Kalispell	Moorestown
Hattiesburg	Missoula	Newark
Jackson	**Nebraska**	New Brunswick
Laurel	Beatrice	Paterson
Meridian	Columbus	Plainfield
Natchez	Fremont	Somerville
Picayune	Grand Island	Trenton
Tupelo	Hastings	Vineland

Appendix A. City List (Continued)

New Mexico (cont.)
Alamogordo
Albuquerque
Artesia
Carlsbad
Clovis
Gallup
Hobbs
Las Cruces
Los Alamos
Roswell
Santa Fe

New York
Albany
Batavia
Binghamton
Buffalo
Canandaigua
Cortland
Dobbs Ferry
Elmira
Fredonia
Geneva
Gloversville
Ithaca
Lockport
Massena
Mineola
New York
Ogdensburg
Oswego
Patchogue
Poughkeepsie
Rochester
Rome
Scarsdale
Schenectady
Syracuse
Utica
Watertown

North Carolina
Albemarle
Asheboro
Asheville
Boone
Burlington
Chapel Hill
Charlotte
Concord
Durham
Elizabeth City
Fayetteville
Gastonia
Goldsboro
Greensboro
Hickory
High Point
Kinston
Laurinburg
Lenoir
Lexington
Lumberton
Monroe
Morganton
New Bern
Raleigh
Reidsville
Rocky Mount
Salisbury
Shelby
Statesville
Wilmington
Wilson
Winston-Salem

North Dakota
Bismarck
Dickinson
Grand Forks
Jamestown
Mandan
Minot
Williston

Ohio
Akron
Ashland
Ashtabula
Athens
Bellefontaine
Bowling Green
Bucyrus
Cambridge
Canton
Cincinnati
Circleville
Cleveland
Columbus
Coshocton
Dayton
Defiance
Delaware
Dover
Elyria
Findlay
Greenville
Hamilton
Ironton
Lancaster
Lima

Appendix A. City List (Continued)

Ohio (cont.)
Mansfield
Middletown
Newark
Norwalk
Painesville
Portsmouth
Sandusky
Steubenville
Tiffin
Toledo
Urbana
Van Wert
Warren
Washington
Wilmington
Wooster
Xenia
Youngstown
Zanesville

Oklahoma
Ada
Altus
Ardmore
Bartlesville
Chickasha
Claremore
Duncan
El Reno
Enid
Guthrie
Lawton
McAlester
Miami
Oklahoma City
Okmulgee
Ponca City
Stillwater
Tulsa
Woodward

Oregon
Ashland
Bend
Corvallis
Eugene
Forest Grove
Grants Pass
Klamath Falls
La Grande
McMinnville
Medford
Oregon City
Pendleton
Portland
Roseburg
Salem

Pennsylvania
Allentown
Bradford
Carlisle
Chambersburg
Coatesville
Erie
Hanover
Harrisburg
Indiana
Johnstown
Lancaster
Meadville
New Castle
Philadelphia
Phoenixville
Pittsburgh
Reading
Scranton
Uniontown
Warren
West Chester
Wilkes-Barre
Williamsport
York

Rhode Island
Providence
Woonsocket

South Carolina
Aiken
Anderson
Charleston
Columbia
Conway
Florence
Georgetown
Greenville
Greenwood
Laurens
Orangeburg
Sumter
Union

South Dakota
Aberdeen
Brookings
Huron
Mitchell
Pierre
Rapid City
Sioux Falls
Watertown
Yankton

Appendix A. City List (Continued)

	Bryan	San Angelo
Tennessee	Canyon	San Antonio
Bristol	Cleburne	San Marcos
Chattanooga	College Station	Snyder
Clarksville	Corpus Christi	Sulphur Springs
Columbia	Corsicana	Taylor
Dyersburg	Dallas	Temple
Franklin	Del Rio	Tyler
Greeneville	Denison	Uvalde
Jackson	Denton	Vernon
Kingsport	El Paso	Victoria
Knoxville	Fort Worth	Waco
McMinnville	Gainesville	Waxahachie
Memphis	Galveston	Weatherford
Murfreesboro	Greenville	Weslaco
Nashville	Harlingen	Wichita Falls
Oak Ridge	Henderson	**Utah**
Paris	Hereford	Cedar City
Shelbyville	Houston	Logan
Springfield	Huntsville	Ogden
Tullahoma	Killeen	Provo
Union City	Kingsville	Saint George
Texas	Lamesa	Salt Lake City
Abilene	Laredo	Tooele
Alice	Lufkin	**Vermont**
Amarillo	Marshall	Burlington
Angleton	McAllen	Rutland
Austin	Midland	**Virginia**
Bay City	Mineral Wells	Blacksburg
Beaumont	Mount Pleasant	Charlottesville
Beeville	Odessa	Danville
Big Spring	Palestine	Fredericksburg
Borger	Paris	Hopewell
Brenham	Plainview	Lynchburg
Brownsville	Port Arthur	Martinsville
Brownwood	Port Lavaca	Newport

Appendix A. City List (Continued)

Virginia (cont.)
Norfolk
Richmond
Roanoke
Staunton
Suffolk
Winchester

Washington
Aberdeen
Bellingham
Bremerton
Centralia
Everett
Kennewick
Kent
Longview
Moses Lake
Olympia
Port Angeles
Pullman
Puyallup
Richland
Seattle
Spokane
Tacoma
Vancouver
Walla Walla
Wenatchee
Yakima

West Virginia
Beckley
Bluefield
Charleston
Clarksburg
Fairmont
Huntington
Martinsburg
Morgantown
Parkersburg
Wheeling

Wisconsin
Appleton
Beloit
Eau Claire
Fond Du Lac
Germantown
Green Bay
Janesville
Kenosha
La Crosse
Madison
Manitowoc
Marinette
Marshfield
Milwaukee
Oshkosh
Racine
Sheboygan
Stevens Point
Superior
Two Rivers
Watertown
Waukesha
Wausau
West Allis
Whitewater
Wisconsin Rapids

Wyoming
Casper
Cheyenne
Gillette
Green River
Laramie
Rock Springs
Sheridan

Appendix B. Foundation Types in PEAR Data Base for Representative Cities

City	Slab	Basement	Ventilated Crawl space
Albuquerque NM	X		
Atlanta GA	X	X	X
Birmingham AL	X	X	
Bismarck ND		X	
Boise ID		X	X
Boston MA		X	
Brownsville TX	X		
Buffalo NY		X	
Burlington VT		X	
Charleston SC	X		X
Cheyenne WY		X	
Chicago IL	X	X	
Cincinnati OH	X	X	X
Cleveland OH		X	
Denver CO		X	
Detroit MI		X	
El Paso TX	X		
Fort Worth TX	X		
Fresno CA	X		X
Great Falls MT		X	
Honolulu HA	X		
Houston TX	X		
Jacksonville FL	X		
Juneau AK		X	
Kansas City MO		X	
Las Vegas NV	X		X
Los Angeles CA	X		X
Medford OR		X	X

Appendix B. Foundation Types in PEAR Data Base for Representative Cities (continued)

City	Slab	Basement	Ventilated Crawl space
Memphis TN	X	X	X
Miami FL	X		
Minneapolis MN		X	
Nashville TN	X	X	X
New Orleans LA	X		
New York NY	X	X	
Oklahoma City OK	X		
Omaha NB		X	
Philadelphia PA		X	
Phoenix AZ	X		
Pittsburgh PA		X	
Portland ME		X	
Portland OR		X	X
Reno NV	X	X	
St. Louis MO		X	
Salt Lake City UT		X	
San Antonio TX	X		X
San Diego CA	X		X
San Francisco CA	X		X
Seattle WA		X	X
Washington DC		X	

Appendix C. Assumed U-Values for Conservation Insulation Measures in PEAR

Nominal R-value	Actual R-value	Steady-state Conductance (Btu/hr·ft^2·F)
Ceiling Insulation:		
R-0	4.17	0.2396
R-11	14.36	0.0696
R-19	20.59	0.0486
R-30	31.88	0.0314
R-38	40.02	0.0250
R-49	51.13	0.0196
R-60	62.19	0.0161
Wall Insulation for Standard Walls:		
R-0	4.56	0.2191
R-11	11.57	0.0864
R-19	17.28	0.0579
R-27	24.64	0.0406
Wall Insulation for Stucco Walls: (Southern California locations only)		
R-0	2.78	0.3594
R-11	9.70	0.1031
R-19	15.36	0.0651
R-27	24.10	0.0415
Floor Insulation for Basement Foundations:		
R-0	4.81	0.2080
R-11	14.99	0.0667
R-19	21.22	0.0471

Appendix C. Assumed U-Values for Conservation Insulation Measures in PEAR (continued)

Nominal R-value	Actual R-value	Steady-state Conductance (Btu/hr·ft^2·F)
Floor Insulation for Crawl Space Foundations: (Crawl spaces assumed to be ventilated)		
R-0	4.81	0.2080
R-11	14.99	0.0667
R-19	21.22	0.0471
Perimeter Insulation for Slab Foundations: (Slab edge assumed to be 8" above grade)		Perimeter U-value (Btu/hr·ft·F)
R-0		1.180
R-5 2 ft		0.395
R-5 4 ft		0.280
R-10 2 ft		0.320
R-10 4 ft		0.180
Perimeter Insulation for Basement Foundations: (Basement wall assumed to extend 12" above grade)		Perimeter U-value (Btu/hr·ft·F)
R-0		1.860
R-5 4 ft		1.050
R-5 8 ft		0.766
R-10 4 ft		0.810
R-10 8 ft		0.485

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INDEX (continued)

User's Manual Comments *

In order to improve the quality and usefulness of the PEAR user's manual, we need your active co-operation and participation. Your comments as a user and reader are greatly appreciated and will be carefully reviewed for incorporation into future revisions of this manual.

Please comment on the manual's completeness, accuracy, organization, usability, and readability:

Did you find errors in this manual? If so, please specify by page.

How can this manual be improved?

* Please return to R. Ritschard, Energy Analysis Program, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley CA 94720 USA.

Other comments:

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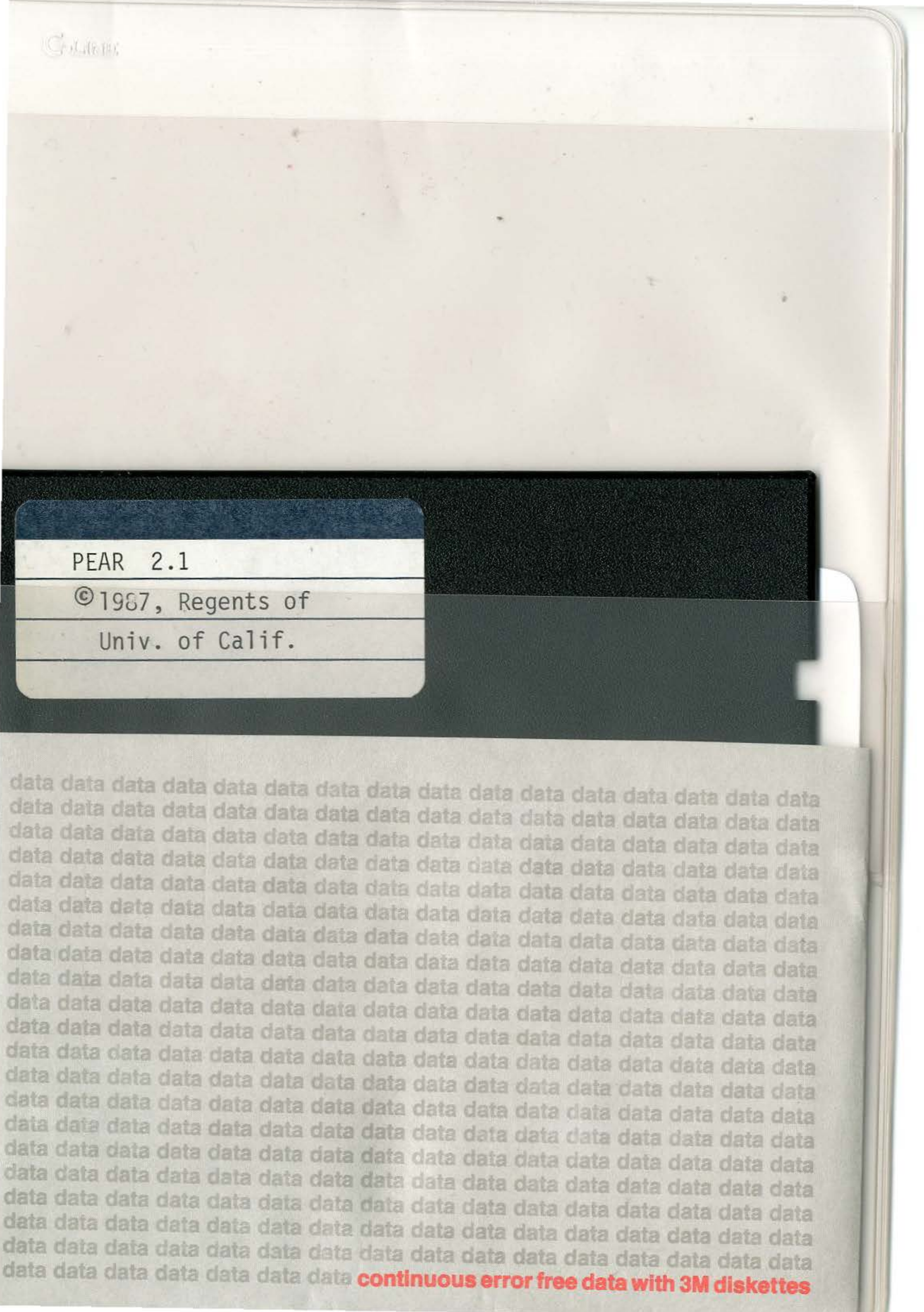
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