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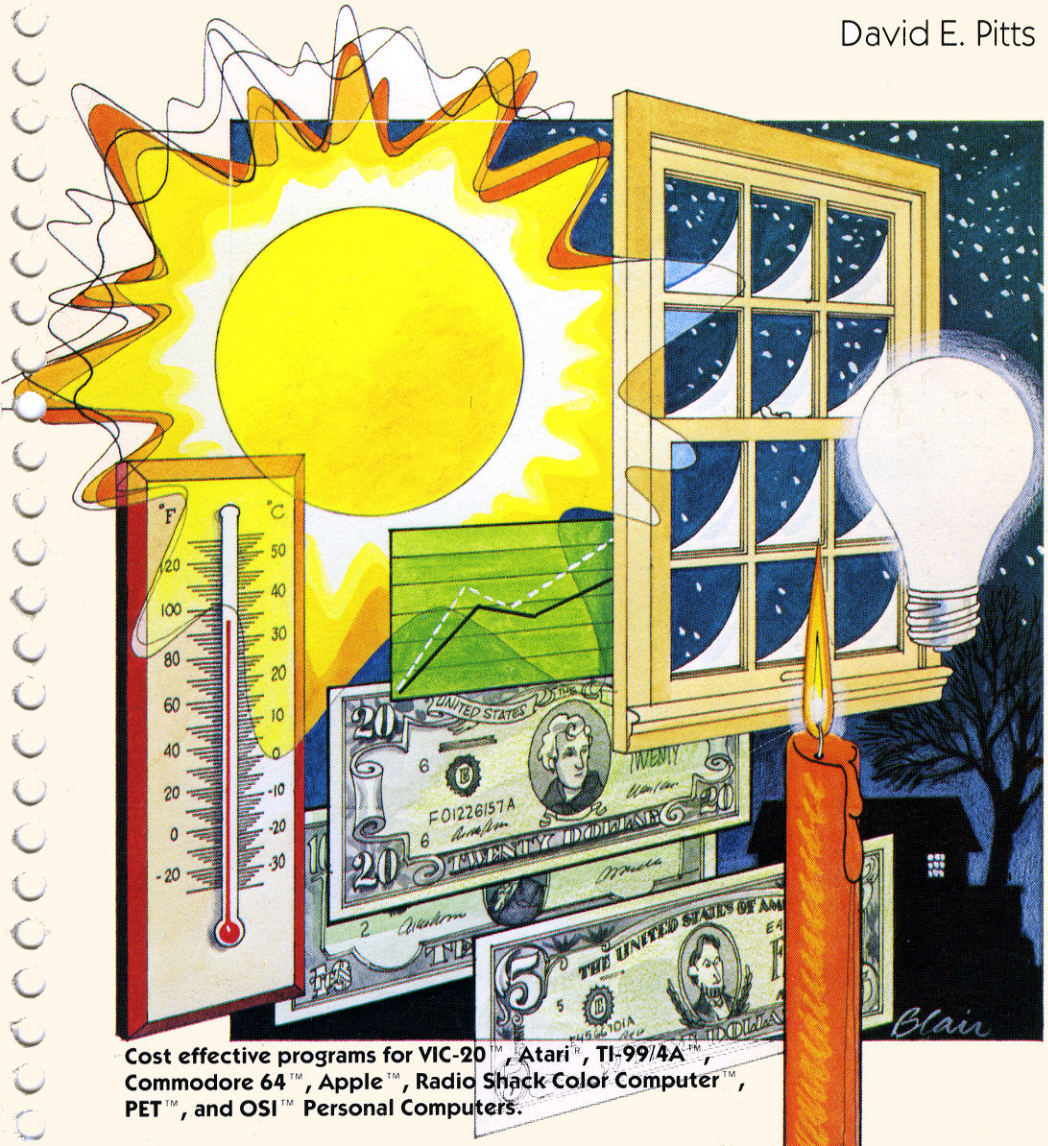
Home Energy Applications

On Your Personal Computer

Complete personal computer programs for analysis and planning of home heating and cooling costs, control, and much, much more.

David E. Pitts



Cost effective programs for VIC-20™, Atari®, TI-99/4A™, Commodore 64™, Apple™, Radio Shack Color Computer™, PET™, and OSI™ Personal Computers.

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On Your Personal Computer

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Introduction

Each chapter in this book is designed to explore a significant aspect of home energy consumption. Chapters begin with a discussion of the methods and merits of a particular kind of energy analysis. Following that is a computer program translated into versions for each of these popular home computers: VIC, Atari, Apple, TI-99/4A, Commodore 64, Radio Shack Color Computer, PET/CBM, and OSI.

The programs will analyze and report suggested alterations or improvements to windows, insulation, and other areas of your home where a small investment of time or money now may yield a significant future savings in your energy dollars.

Once the computer has information on your geographical area, your current expenses, and details about your house itself, it can provide specific, objective projections. Have your heating costs been increasing by 30% or more each year? Are you considering storm windows, a clock thermostat, more insulation, caulking, weather-stripping, or other defensive measures against the upward spiral of utility costs?

Since everyone's home is different and there are great variations in climatic conditions in the United States, it is often difficult to determine which of many alternatives is the best way to go about reducing energy consumption. These programs, utilizing the particular characteristics of your house together with the climate in your area, report projected savings for the homeowner. The effects of a great variety of different energy-saving improvements at locations anywhere within the contiguous 48 states are analyzed and forecast in complete, understandable reports.

You can use these graphs and reports to look at projected savings, together with costs and the current economic outlook to decide if each approach meets your criteria for a worthwhile investment.

Here's a major personal financial problem which can directly benefit from the speed and power of your personal computer. It's one of the fastest ways to make the computer pay for itself. When friends and neighbors find out what you're up to, don't be surprised if they ask you for a home energy analysis too. In most cases, these programs can result in very impressive savings.

The Apple and PET/CBM versions are the same as the Commodore 64 versions except in those cases ("Energy Plot" for example) where graphics variations required individualized programs. In some cases ("Home Heating And Cooling" for example), a lengthy series of DATA statements is identical in each computer's version. When this is the case, simply add the separate DATA list to your computer's program. If you are using an 80-column screen such as the CBM 8032, some programs contain information in REM statements to make adjustments for a more pleasing screen format. All programs are clear and well-commented. With the exception of "Energy Plot," the screen formats are essentially interchangeable and do not rely on graphics or computer-specific video techniques. There are notes in each chapter about any special handling required for particular computer models.

Before typing in any of the programs in this book, check the Appendix for an explanation of the conventions used in listing special keyboard characters.

1

Energy Data Base

1

Energy Data Base

Note: This program creates files of energy usage data for future reference and for use by other programs in this book. The OSI, Atari, Apple, and Color Computer versions store the files to disk. The VIC, PET/CBM/64, and TI versions create data files on tape.

Keeping track of energy use and cost is an integral part of any serious attempt at conserving energy cost. I have been doing this for several years by simply graphing my energy use on a chart, using my electric and natural gas bills. This is quite adequate to determine when I am reducing my energy use.

However, unless I also keep track of the cost, I am seeing only part of the picture. If I were to start keeping track of the cost on a chart, there would undoubtedly be other factors (such as cost per unit of energy or energy used per degree day) that I would also want to plot, and if I were not careful, I would end up plotting so many different factors that this would become a burden and I would likely forget the whole idea.

This data base program allows both energy use and cost to be saved on disk or tape and recalled by other programs, so that I don't have to constantly enter the same data in various programs. The data are saved by month and year, and additional data can be added as the need occurs. The dimensions for the energy (E) and cost (D) are made to be variable so that the program can be run on systems of varying size. The program has provisions to create and edit files called "NATGAS," "ELECT," "COAL," "OIL," and "WOOD." Should you desire to add other utilities, such as water, then simply remove one of the unused utilities from lines 380-420.

The program has five commands: L = list data, I = input data, G = get data from disk or tape, S = save data to disk or tape, and E = edit data (includes adding an additional year).

Adding Additional Years

When you enter "edit", a year of data will be displayed. If you desire to edit a different year, simply answer "N" to the prompt "Is line to be edited shown". Once the year desired is shown, answer with "Y", and the program will prompt you for the month desired. The program requires an exact match with the string for the

month, so be sure to enter the month as abbreviated in the program.

If you want to enter an additional year of data, answer "N" to each existing year as it is displayed. The program will add one to the number of years of data (N) and will go into input mode when you answer that you want to add to the number of years. If you plan on adding an additional year of data to the data base, you must allow for this addition when answering the prompt at the beginning of the program for the number of years.

Reference:

Retelle, Bob. *PEEK (65),* vol. 2 (October 1981), p. 14 (P.O. Box 347, Owings Mills, MD 21117).

Table. Sample Run — Electric Usage Data.

```
                ENERGY DATA BASE

# YEARS FOR DATA BASE (DEFAULT=5)?  3

(L,I,G,S,E)? I

   1) NATURAL GAS
   2) ELECTRICITY
   3) COAL
   4) OIL
   5)WOOD

CHOOSE ONE ? 2

BEGINNING YEAR 1979
ENDING YEAR 1981

YEAR          ELECT          ELECT
 1979         USAGE          COST
JAN           75Ø           3Ø.19
FEB           827           33.16
MAR           718           31.86
APR           728           31.64
MAY           875           35.95
JUNE          1192          5Ø.92
```

JULY	1768	76.92
AUG	2Ø43	86.1
SEPT	2166	88.1
OCT	664	3Ø.99
NOV	775	33.58
DEC	777	34.39

YEAR 198Ø	ELECT USAGE	ELECT COST
JAN	714	37.54
FEB	679	34.Ø2
MAR	673	31.34
APR	716	31.53
MAY	861	4Ø.75
JUNE	1576	81.Ø7
JULY	198Ø	1Ø2.36
AUG	2Ø43	1Ø5.62
SEPT	1761	92.2
OCT	1261	67.49
NOV	775	41.48
DEC	955	46.43

YEAR 1981	ELECT USAGE	ELECT COST
JAN	777	38.26
FEB	846	43.21
MAR	8Ø4	45.14
APR	933	52.96
MAY	1Ø98	62.33
JUNE	157Ø	1Ø7.8
JULY	198Ø	141.Ø3
AUG	2Ø46	137.Ø8
SEPT	1638	1Ø9.91
OCT	137Ø	91.47
NOV	6Ø5	37.84
DEC	833	53.83

Program 1. OSI Version.

```
10 REM ENERGY DATABASE
25 R$=CHR$(13)
30 GOSUB530:PRINTTAB(25);"ENERGY DATA BASE":PRINT:PRINT:PRINT
35 REMPOKE2888,0:POKE8722,0:REM ACCEPT NULL INPUT
40 INPUT"# YRS FOR DATA BASE";N:IFN=0THENN=5
50 DIMM$(12),E(N,12),D(N,12)
60 FORI=1TO12:READM$(I):NEXT:PRINT
70 DATAJAN,FEB,MAR,APR,MAY,JUNE,JULY,AUG,SEPT,OCT,NOV,DEC
80 PRINT"(L,I,G,S,E)"
90 GOSUB540
100 Y=(C>68)+(C>70)+(C>72)+(C>75)+(C>82)
110 ONABS(Y)GOSUB130,320,350,270,510:GOTO80
115 END
120 REM EDIT
130 PRINTTAB(10);"EDIT":FORI=1TON:GOSUB480:FORM=1TO12:PRINTM$(M);TAB(15);
140 PRINTE(I,M);TAB(29);D(I,M):NEXT
150 PRINT:PRINT"IS LINE TO BE EDITED SHOWN?":PRINT"<Y> OR <N>"
160 GOSUB540:IFC=78THENNEXT:GOTO220
170 IFC<>89THEN160
180 INPUT"MONTH TO EDIT";A$:FORJ=1TO12:IFM$(J)<>A$THENNEXT
190 PRINT"EDIT MONTH OF";M$(J);E(I,J);D(I,J):INPUT"ENERGY USAGE";E(I,J)
200 INPUT"ENERGY COST";D(I,J)
210 RETURN
220 PRINT"ADD 1 YEAR TO DATA BASE, <Y> OR <N>"
230 GOSUB540:IFC=78THENRETURN
240 IFC<>89THEN230
250 EY=EY+1:N=N+1:K=N:GOSUB460:RETURN
260 REM LIST DATA
```

```
270 FORI=1TON:GOSUB480:FORM=1TO12:PRINTM$(M);TAB(15);E(I,M);TAB(29);
280 PRINTD(I,M):NEXT:PRINT:PRINT:PRINT"ANY KEY TO CONTINUE"
290 GOSUB540
300 NEXT:RETURN
310 REM GET DISK FILE
320 INPUT"DISK FILE NAME";C$:DISK OPEN,6,C$:INPUT#6,N,BY,EY
330 FORI=1TON:FORM=1TO12:INPUT#6,E(I,M),D(I,M):NEXT:NEXT:RETURN
340 REM INPUT DATA
350 K=1:PRINT:PRINT:PRINT"1)NATGAS":PRINT"2)ELECT":PRINT"3)COAL"
360 PRINT"4)OIL":PRINT"5)WOOD":PRINT:PRINT:PRINT"CHOOSE ONE"
370 GOSUB540:IFC<49ORC>53THEN370
380 IFC=49THENC$="NATGAS":GOTO440
390 IFC=50THENC$="ELECT":GOTO440
400 IFC=51THENC$="COAL":GOTO440
410 IFC=52THENC$="OIL":GOTO440
420 IFC=53THENC$="WOOD":GOTO440
430 GOTO370
440 GOSUB530:INPUT"BEGINNING YEAR";BY
450 INPUT"ENDING YEAR";EY:N=EY-BY+1
460 FORI=KTON:GOSUB480:FORM=1TO12:PRINTM$(M);TAB(15);
470 INPUTE(I,M):PRINTTAB(29);:INPUTD(I,M):NEXT:GOSUB530:NEXT:RETURN
480 GOSUB530:PRINT"YEAR";TAB(15);C$;TAB(29);C$
490 PRINTI+BY-1;TAB(15);"USAGE";TAB(29);"COST":RETURN
500 REM SAVE DATA TO DISK
510 PRINT"SAVING ";C$;" TO DISK":DISK OPEN,6,C$:PRINT#6,N;R$;BY;R$;EY
520 FORI=1TON:FORM=1TO12:PRINT#6,E(I,M);R$;D(I,M)
525 NEXT:NEXT:DISK CLOSE,6:RETURN
530 FORL=1TO20:PRINT:NEXT:RETURN
540 DISK!"GO 252B":C=PEEK(9815):RETURN:REM PEEK KEYBOARD
```

1

Program 2. VIC Version.

```
10 REM ENERGY DATABASE  VIC VERSION
30 R$=CHR$(13):PRINT"{CLEAR}   ENERGY DATA BA
   SE{03 DOWN}"
40 N=5:PRINT"# YEARS FOR DATA BASE":PRINT"DES
   IRED,";:INPUT"DEFAULT=5";N
50 DIMM$(12),E(N,12),D(N,12)
60 FORI=1TO12:READM$(I):NEXT:PRINT
70 DATAJAN,FEB,MAR,APR,MAY,JUNE,JULY,AUG,SEPT
   ,OCT,NOV,DEC
80 PRINT"(L,I,G,S,E){DOWN}"
90 GETY$:IFY$=""THEN90
100 C=ASC(Y$):Y=(C>68)+(C>70)+(C>72)+(C>75)+(C
   >82):ONABS(Y)GOSUB130,320,350,270,510
110 GOTO80
120 REM EDIT
130 PRINT"{CLEAR}EDIT":FORI=1TON:GOSUB480:FORM
   =1TO12:PRINTM$(M);TAB(6);E(I,M);TAB(1
   3);D(I,M)
140 NEXT
150 PRINT"{DOWN}IS LINE TO BE EDITED  SHOWN?":
   PRINT"<Y> OR <N>"
160 GETY$:IFY$=CHR$(78)THENNEXT:GOTO220
170 IF Y$<>CHR$(89)THEN160
180 INPUT"MONTH TO EDIT";A$:FORJ=1TO12:IFM$(J)
   <>A$THENNEXT
190 PRINT"{UP}EDIT MONTH OF ";:PRINTM$(J);E(I,
   J);D(I,J):INPUT"ENERGY USAGE";E(I,J)
200 INPUT"ENERGY COST";D(I,J)
210 RETURN
220 PRINT"ADD 1 YR TO DATA BASE ";
230 GETY$:IFY$=CHR$(78)THENRETURN
240 IF Y$<>CHR$(89)THEN230
250 EY=EY+1:N=N+1:K=N:GOSUB460:RETURN
260 REM LIST DATA
270 FORI=1TON:GOSUB480:FORM=1TO12:PRINTM$(M);T
   AB(6);E(I,M);TAB(13);D(I,M):NEXT
280 PRINT"{DOWN}ANY KEY TO CONTINUE"
290 GETY$:IFY$=""THEN290
300 NEXT:RETURN
310 REM GET TAPE FILE
320 INPUT"TAPE FILE NAME";C$:OPEN1,1,0,C$:INPU
   T#1,N,BY,EY
330 FORI=1TON:FORM=1TO12:INPUT#1,E(I,M),D(I,M)
```

```
    :NEXT:NEXT:CLOSE1:RETURN
340 REM INPUT DATA
350 K=1:PRINT"1) NATURAL GAS":PRINT"2) ELECTRI
    CITY":PRINT"3) COAL":PRINT"4) OIL"
360 PRINT"5) WOOD":PRINT"{DOWN}CHOOSE ONE"
370 GETY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"ANDY$<>
    "4"ANDY$<>"5"THEN370
380 IFY$="1"THENC$="NATGAS":GOTO440
390 IFY$="2"THENC$="ELECT":GOTO440
400 IFY$="3"THENC$="COAL":GOTO440
410 IFY$="4"THENC$="OIL":GOTO440
420 IFY$="5"THENC$="WOOD":GOTO440
430 GOTO370
440 INPUT"{CLEAR}BEGINNING YEAR";BY
450 INPUT"{DOWN}ENDING YEAR";EY:N=EY-BY+1
460 FORI=KTON:GOSUB480:FORM=1TO12:PRINTM$(M);T
    AB(6);
470 INPUTE(I,M):PRINTTAB(13);"{UP}";:INPUTD(I,
    M):NEXT:PRINT:NEXT:RETURN
480 PRINT"{CLEAR}YEAR";TAB(6);C$;TAB(13);C$
490 PRINTI+BY-1;TAB(6);"USAGE";TAB(13);"COST":
    RETURN
500 REM SAVE DATA TO  TAPE
510 PRINT"SAVING ";C$;" TO TAPE":OPEN1,1,1,C$:
    PRINT#1,N;R$;BY;R$;EY:FORI=1TON:FORM=
    1TO12
520 PRINT#1,E(I,M);R$;D(I,M):NEXT:NEXT:CLOSE1:
    RETURN
```

Program 3. PET/CBM/64 Version.

```
10 REM ENERGY DATABASE
30 R$=CHR$(13):PRINT"{CLEAR}                ENERGY
     DATA BASE{03 DOWN}"
40 N=5:PRINT"# YEARS FOR DATA BASE DESIRED,":
    INPUT"DEFAULT=5";N
50 DIMM$(12),E(N,12),D(N,12)
60 FORI=1TO12:READM$(I):NEXT:PRINT
70 DATAJAN,FEB,MAR,APR,MAY,JUNE,JULY,AUG,SEPT
    ,OCT,NOV,DEC
80 PRINT"(L,I,G,S,E){DOWN}"
90 GETY$:IFY$=""THEN90
100 C=ASC(Y$):Y=(C>68)+(C>70)+(C>72)+(C>75)+(C
```

1

```
    >82):ONABS(Y)GOSUB130,320,350,270,510
110 GOTO80
120 REM EDIT
130 PRINT"{CLEAR}                    EDIT":FORI
    =1TON:GOSUB480:FORM=1TO12
140 PRINTM$(M);TAB(14);E(I,M);TAB(27);D(I,M):N
    EXT
150 PRINT"{DOWN}IS LINE TO BE EDITED SHOWN?":P
    RINT"<Y> OR <N>"
160 GETY$:IFY$=CHR$(78)THENNEXT:GOTO220
170 IF Y$<>CHR$(89)THEN160
180 INPUT"MONTH TO EDIT";A$:FORJ=1TO12:IFM$(J)
    <>A$THENNEXT
190 PRINT"{UP}EDIT MONTH OF ";:PRINTM$(J);E(I,
    J);D(I,J):INPUT"ENERGY USAGE";E(I,J)
200 INPUT"ENERGY COST";D(I,J)
210 RETURN
220 PRINT"ADD 1 YR TO DATA BASE ";
230 GETY$:IFY$=CHR$(78)THENRETURN
240 IF Y$<>CHR$(89)THEN230
250 EY=EY+1:N=N+1:K=N:GOSUB460:RETURN
260 REM LIST DATA
270 FORI=1TON:GOSUB480:FORM=1TO12:PRINTM$(M);T
    AB(14);E(I,M);TAB(27);D(I,M):NEXT
280 PRINT"{DOWN}ANY KEY TO CONTINUE"
290 GETY$:IFY$=""THEN290
300 NEXT:RETURN
310 REM GET TAPE FILE
320 INPUT"TAPE FILE NAME";C$:OPEN1,1,0,C$:INPU
    T#1,N,BY,EY
330 FORI=1TON:FORM=1TO12:INPUT#1,E(I,M),D(I,M)
    :NEXT:NEXT:CLOSE1:RETURN
340 REM INPUT DATA
350 K=1:PRINT"1) NATURAL GAS":PRINT"2) ELECTRI
    CITY":PRINT"3) COAL":PRINT"4) OIL"
360 PRINT"5) WOOD":PRINT"{DOWN}CHOOSE ONE"
370 GETY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"ANDY$<>
    "4"ANDY$<>"5"THEN370
380 IFY$="1"THENC$="NATGAS":GOTO440
390 IFY$="2"THENC$="ELECT":GOTO440
400 IFY$="3"THENC$="COAL":GOTO440
410 IFY$="4"THENC$="OIL":GOTO440
420 IFY$="5"THENC$="WOOD":GOTO440
430 GOTO370
```

```
440 INPUT"{CLEAR}BEGINNING YEAR";BY
450 INPUT"{DOWN}ENDING YEAR";EY:N=EY-BY+1
460 FORI=KTON:GOSUB480:FORM=1TO12:PRINTM$(M);T
    AB(14);
470 INPUTE(I,M):PRINTTAB(27);"{UP}";:INPUTD(I,
    M):NEXT:PRINT:NEXT:RETURN
480 PRINT"{CLEAR}YEAR";TAB(14);C$;TAB(27);C$
490 PRINTI+BY-1;TAB(14);"USAGE";TAB(27);"COST"
    :RETURN
500 REM SAVE DATA TO  TAPE
510 PRINT"SAVING ";C$;" TO TAPE":OPEN1,1,1,C$:
    PRINT#1,N;R$;BY;R$;EY:FORI=1TON:FORM=
    1TO12
520 PRINT#1,E(I,M);R$;D(I,M):NEXT:NEXT:CLOSE1:
    RETURN
```

Program 4. Atari Version.

```
10 REM *** ENERGY DATA BASE ***
20 REM *** ATARI VERSION ***
30 POKE 752,1:POKE 82,2:? CHR$(125):O
   PEN #1,4,0,"K:":POKE 85,11:? "ENER
   GY DATA BASE":? :? :?
50 DIM M$(4),MONTH$(48),FILENAME$(12)
   ,A$(4),E(10,12),D(10,12),TT$(14)
60 FOR I=1 TO 12:READ M$:MONTH$(LEN(M
   ONTH$)+1)=M$:FOR J=0 TO N:D(J,I)=0
   :E(J,I)=0:NEXT J:NEXT I
70 DATA JAN ,FEB ,MAR ,APR ,MAY ,JUNE
   ,JULY,AUG ,SEPT,OCT ,NOV ,DEC
80 ? :? "TYPE FIRST LETTER OF OPTION:
   "
90 ? :? "LIST DATA":? :? "INPUT DATA"
   :? :? "GET DATA":? :? "SAVE DATA":
   ? :? "EDIT DATA":?
100 GET #1,A
110 IF A=76 THEN GOSUB 310
120 IF A=73 THEN GOSUB 390
130 IF A=71 THEN GOSUB 360
140 IF A=83 THEN GOSUB 550
150 IF A=69 THEN GOSUB 170
160 GOTO 90
```

1

```
170 ? CHR$(125):POKE 85,10:? "EDIT":F
    OR I=1 TO N:GOSUB 530
180 A=1:FOR M=1 TO 12:POKE 85,1:? MON
    TH$(A,A+3);:A=A+4:POKE 85,8:? E(I
    ,M);:POKE 85,17:? D(I,M):NEXT M
190 ? :? "IS LINE TO BE EDITED SHOWN
    (Y OR N)?"
200 GET #1,A:IF A=78 THEN NEXT I:GOTO
     270
210 IF A<>89 THEN 200
220 ? "MONTH YOU WANT TO EDIT";:INPUT
     A$:A=1:FOR J=1 TO 12
230 IF MONTH$(A,A+2)<>A$ THEN A=A+4:N
    EXT J:? A$;"(BELL) IS NOT A MONTH
    .":GOTO 220
240 ? :? "EDIT MONTH OF ";MONTH$(A,A+
    3);E(I,J);"/";D(I,J)
250 ? "ENERGY USAGE";:INPUT E:E(I,J)=
    E:? "ENERGY COST";:INPUT D:D(I,J)
    =D
260 RETURN
270 ? "ADD 1 YEAR TO DATA BASE (Y OR
    N)?";
280 GET #1,A:IF A=78 THEN RETURN
290 IF A<>89 THEN 280
300 EY=EY+1:N=N+1:K=N:GOSUB 510:RETUR
    N
310 REM LIST DATA
320 FOR I=1 TO N:A=1:GOSUB 530:FOR M=
    1 TO 12:? MONTH$(A,A+3);:POKE 85,
    8:? E(I,M);:POKE 85,22:? D(I,M)
325 A=A+4:NEXT M
330 ? :? :? "HIT ANY KEY TO CONTINUE"
340 GET #1,A
350 NEXT I:RETURN
360 REM GET DISK FILE
362 GOSUB 400
365 TT$="D:":TT$(3)=FILENAME$
370 OPEN #2,4,0,TT$:INPUT #2,N,BY,EY:
    FOR I=1 TO N
380 FOR M=1 TO 12:INPUT #2,E,D:E(I,M)
```

```
    =E:D(I,M)=D:NEXT M:NEXT I:CLOSE #
    2:RETURN
390 REM INPUT DATA
391 GOSUB 400:GOTO 499
400 K=1:? :? :? " 1...NATURAL GAS":?
    " 2...ELECTRICITY":? " 3...COAL"
410 ? " 4...OIL":? " 5...WOOD":? :? :
    ? "CHOOSE ONE"
420 GET #1,A:IF A<>49 AND A<>50 AND A
    <>51 AND A<>52 AND A<>53 THEN 420
430 IF A=49 THEN FILENAME$="NATGAS":G
    OTO 490
440 IF A=50 THEN FILENAME$="ELECTRIC"
    :GOTO 490
450 IF A=51 THEN FILENAME$="COAL":GOT
    O 490
460 IF A=52 THEN FILENAME$="OIL":GOTO
     490
470 IF A=53 THEN FILENAME$="WOOD":GOT
    O 490
480 GOTO 420
490 RETURN
499 ? CHR$(125):? "BEGINNING YEAR";:I
    NPUT BY
500 ? "ENDING YEAR";:INPUT EY:N=EY-BY
    +1
510 A=1:FOR I=K TO N:GOSUB 530:FOR M=
    1 TO 12:? MONTH$(A,A+3);:A=A+4:?
    "   ";:INPUT E:E(I,M)=E:? "{UP}";
520 POKE 85,22:INPUT D:D(I,M)=D:NEXT
    M:A=1:NEXT I:RETURN
530 ? CHR$(125):? "YEAR";:POKE 85,8:?
     FILENAME$;:POKE 85,22:? FILENAME
    $
540 ? I+BY-1;:POKE 85,8:? "USAGE";:PO
    KE 85,22:? "COST":POKE 85,0:FOR J
    =1 TO 40:? "-";:NEXT J:RETURN
550 REM SAVE DATA TO DISK
551 GOSUB 400
555 TT$="D:":TT$(3)=FILENAME$
560 OPEN #2,8,0,TT$:? #2;N:? #2;BY:?
```

```
    #2;EY:FOR I=1 TO N:FOR M=1 TO 12:
    ? #2;E(I,M):? #2;D(I,M)
570 NEXT M:NEXT I:CLOSE #2:RETURN
```

Program 5. Color Computer Version.

```
10 REM DATABASE
20 CLS:PRINTTAB(8);"ENERGY DATA BASE":PRINT
30 PRINT"# OF YEARS FOR DATA BASE":INPUT"DESI
    RED, DEFAULT=5";N:IFN=0THENN=5
40 DIMM$(12),E(N,12),D(N,12)
50 FORI=1TO12:READM$(I):NEXT
60 DATAJAN,FEB,MAR,APR,MAY,JUNE,JULY,AUG,SEPT
    ,OCT,NOV,DEC
70 PRINT"(L,I,G,S,E)":PRINT
80 Y$=INKEY$:IFY$=""THEN80
90 C=ASC(Y$):Y=(C>68)+(C>70)+(C>72)+(C>75)+(C
    >82)
95 ONABS(Y) GOSUB 110,220,230,190,300
100 GOTO70
110 CLS:PRINTTAB(10);"EDIT":FORI=1TON:GOSUB290

115 FORM=1TO12:PRINTTAB(1);M$(M);TAB(8);E(I,M)
    ;TAB(17);D(I,M):NEXT
120 PRINT"IS LINE TO BE EDITED SHOWN?":PRINT"<
    Y> OR <N>"
130 Y$=INKEY$:IFY$=CHR$(78)THENNEXT:GOTO160ELS
    EIFY$<>CHR$(89)THEN130
140 INPUT"MONTH DESIRED TO EDIT";A$:FORJ=1TO12

141 IFM$(J)<>A$THENNEXTELSEPRINT"EDIT MONTH OF
     ";M$(J);E(I,J);D(I,J)
142 IFM$(J)<>A$THEN INPUT"ENERGY USAGE";E(I,J)
    :INPUT"ENERGY COST";D(I,J)
150 RETURN
160 PRINT"ADD 1 YEAR TO DATA BASE?";
170 Y$=INKEY$:IFY$=CHR$(78)THENRETURNELSEIFY$<
    >CHR$(89)THEN170
180 EY=EY+1:N=N+1:K=N:GOSUB280:RETURN
190 FORI=1TON:GOSUB290:FORM=1TO12:PRINTM$(M);T
    AB(8);E(I,M);TAB(17);D(I,M)
195 NEXT:PRINT"HIT ANY KEY TO CONTINUE"
200 IFINKEY$=""THEN200
```

```
210 NEXT:RETURN
220 INPUT"DISK FILE NAME";C$:OPEN "I",#1,C$:IN
    PUT#1,N,BY,EY:FORI=1TON
225 FORM=1TO12:INPUT#1,E(I,M),D(I,M):NEXT:NEXT
    :CLOSE#1:RETURN
230 K=1:PRINT" 1) NATURAL GAS":PRINT" 2) ELECT
    RICITY":PRINT" 3) COAL"
235 PRINT" 4) OIL":PRINT" 5) WOOD":PRINT:PRINT
    "CHOOSE ONE"
240 Y$=INKEY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"AND
    Y$<>"4"ANDY$<>"5"THEN240
250 IFY$="1"THENC$="NATGAS"ELSEIFY$="2"THENC$=
    "ELECT"ELSEIFY$="3"THENC$="COAL"
255 IFY$="4"THENC$="OIL"ELSEIFY$="5"THENC$="WO
    OD"ELSE230
260 INPUT"BEGINNING YEAR";BY
270 INPUT"ENDING YEAR";EY:N=EY-BY+1
280 FORI=K TON:GOSUB290:FORM=1TO12:PRINTTAB(1)
    ;M$(M);TAB(8);:INPUTE(I,M)
285 PRINT @81+32*(M-1),"";:INPUTD(I,M):NEXT:PR
    INT:NEXT:RETURN
290 CLS:PRINT" YEAR";TAB(8);"ENERGY";TAB(17);"
    ENERGY";TAB(25);C$
295 PRINTI+BY-1;TAB(8);"USAGE";TAB(18);"COST":
    RETURN
300 OPEN "O",#1,C$:WRITE#1,N,BY,EY:FORI=1TON:F
    ORM=1TO12:WRITE#1,E(I,M),D(I,M)
310 NEXT:NEXT:CLOSE#1:RETURN
```

Program 6. TI-99 Version.

```
10 REM energy database, TI version
22 CALL CLEAR
23 CALL SCREEN(7)
30 GOSUB 530
32 PRINT TAB(7);"energy data base": :
    : : :
50 DIM M$(12),E(10,12),D(10,12)
55 REM dimension currently set up for
    10 years
60 FOR I=1 TO 12
62 READ M$(I)
64 NEXT I
```

1

```
66 PRINT
70 DATA JAN,FEB,MAR,APR,MAY,JUNE,JULY
   ,AUG,SEPT,OCT,NOV,DEC
80 PRINT "(l,i,g,s,e)"
90 GOSUB 540
95 IF (C<65)+(C>84)THEN 80
100 Y=(C>68)+(C>70)+(C>72)+(C>75)+(C>
    82)
105 CALL CLEAR
110 ON ABS(Y)GOSUB 130,320,350,262,51
    0
112 GOTO 80
115 END
120 REM edit
130 PRINT "edit"
132 FOR I=1 TO N
134 GOSUB 480
136 FOR M=1 TO 12
138 PRINT M$(M);TAB(10);E(I,M);TAB(21
    );D(I,M)
140 NEXT M
142 PRINT "is line to be edited shown
    ? <y> or <n>"
160 GOSUB 540
162 IF C<>78 THEN 170
164 NEXT I
166 GOTO 220
170 IF C<>89 THEN 160
180 INPUT "month to edit? ":A$
182 FOR J=1 TO 12
184 IF SEG$(M$(J),1,3)=SEG$(A$,1,3)TH
    EN 190
186 NEXT J
190 PRINT "edit month of ";M$(J);E(I,
    J);D(I,J)
192 INPUT "energy usage? ":E(I,J)
200 INPUT "energy cost? ":D(I,J)
210 RETURN
220 PRINT "add 1 year to data base, <
    y> or <n>"
230 GOSUB 540
232 IF C<>78 THEN 240
```

```
234 RETURN
240 IF C<>89 THEN 230
250 EY=EY+1
252 N=N+1
254 K=N
256 GOSUB 460
258 RETURN
260 REM list data
262 FOR I=1 TO N
264 GOSUB 480
266 FOR M=1 TO 12
268 PRINT M$(M);TAB(10);E(I,M);TAB(21
    );D(I,M)
270 NEXT M
272 PRINT : :
280 PRINT "any key to continue"
290 GOSUB 540
300 NEXT I
302 RETURN
310 REM get tape file
320 OPEN #2:"CS1",INTERNAL,INPUT ,FIX
    ED 128
322 INPUT #2:C$,N,BY,EY
330 FOR I=1 TO N
334 INPUT #2:E(I,1),D(I,1),E(I,2),D(I
    ,2),E(I,3),D(I,3),E(I,4),D(I,4),E
    (I,5),D(I,5),E(I,6),D(I,6),E(I,7),
    D(I,7)
335 INPUT #2:E(I,8),D(I,8),E(I,9),D(I
    ,9),E(I,10),D(I,10),E(I,11),D(I,1
    1),E(I,12),D(I,12)
336 NEXT I
337 CLOSE #2
339 RETURN
340 REM input data
350 K=1
352 PRINT : :
354 PRINT TAB(10);"1)natgas"
355 PRINT TAB(10);"2)elect"
356 PRINT TAB(10);"3)coal"
357 PRINT TAB(10);"4)oil"
```

1

```
358 PRINT TAB(10);"5)wood": : : :
360 PRINT "choose one"
370 GOSUB 540
372 IF (C<49)+(C>53)THEN 370
380 IF C<>49 THEN 390
382 C$="natgas"
384 GOTO 440
390 IF C<>50 THEN 400
392 C$="elect"
394 GOTO 440
400 IF C<>51 THEN 410
402 C$="coal"
404 GOTO 440
410 IF C<>52 THEN 420
412 C$="oil"
414 GOTO 440
420 IF C<>53 THEN 430
422 C$="wood"
424 GOTO 440
430 GOTO 370
440 GOSUB 530
442 INPUT "beginning year? ":BY
444 INPUT "ending year? ":EY
450 N=EY-BY+1
460 FOR I=K TO N
462 GOSUB 480
464 FOR M=1 TO 12
466 PRINT M$(M);TAB(9);
470 INPUT E(I,M)
472 PRINT TAB(21);
474 INPUT D(I,M)
475 NEXT M
476 GOSUB 530
477 NEXT I
478 RETURN
479 REM ************
480 GOSUB 530
482 PRINT "year";TAB(10);C$;TAB(21);C
    $
490 PRINT I+BY-1;TAB(10);"usage";TAB(
    21);"cost"
492 RETURN
```

```
500 REM save data to tape***
510 PRINT "saving ";C$;" to tape"
512 OPEN #2:"CS1",SEQUENTIAL,INTERNAL
    ,OUTPUT,FIXED 128
514 PRINT #2:C$,N,BY,EY
520 FOR I=1 TO N
524 PRINT #2:E(I,1),D(I,1),E(I,2),D(I
    ,2),E(I,3),D(I,3),E(I,4),D(I,4),E
    (I,5),D(I,5),E(I,6),D(I,6),E(I,7),
    D(I,7)
525 PRINT #2:E(I,8),D(I,8),E(I,9),D(I
    ,9),E(I,10),D(I,10),E(I,11),D(I,1
    1),E(I,12),D(I,12)
526 NEXT I
527 CLOSE #2
528 RETURN
530 CALL CLEAR
532 RETURN
540 CALL KEY(3,C,STATUS)
550 IF STATUS=0 THEN 540
560 RETURN
```

Program 7. Apple Version.

```
10  REM  ENERGY DATABASE APPLE VERSION
30  HOME : INVERSE : PRINT "  ENERGY DATA BA
    SE  ":D$ =  CHR$ (4): NORMAL : PRINT : PRINT

40 N = 5: PRINT "# OF YEARS FOR DATA BASE DE
    SIRED,": INPUT "  DEFAULT=5: ";N$:N =  VAL
    (N$): IF N$ = "" THEN N = 5
50  DIM M$(12),E(N,12),D(N,12)
60  FOR I = 1 TO 12: READ M$(I): NEXT : PRINT

70  DATA  JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SE
    P,OCT,NOV,DEC
80  HOME : PRINT : INVERSE : PRINT "L";: NORMAL
    : PRINT "IST DATA"
81  PRINT : INVERSE : PRINT "I";: NORMAL : PRINT
    "NPUT DATA"
82  PRINT : INVERSE : PRINT "G";: NORMAL : PRINT
    "ET DATA"
83  PRINT : INVERSE : PRINT "S";: NORMAL : PRINT
    "AVE DATA"
```

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```
85  PRINT : INVERSE : PRINT "E";: NORMAL : PRINT
     "DIT DATA"
90  PRINT : PRINT "WHICH? ";: GET Y$: IF Y$ =
     CHR$ (27) THEN  HOME : END
95  PRINT Y$
100 C =  ASC (Y$):Y = (C > 68) + (C > 70) +
    (C > 72) + (C > 75) + (C > 82): ON  ABS
    (Y) GOSUB 130,310,350,270,500
110  PRINT  CHR$ (7): GOTO 80
120  REM  EDIT
130  HOME : PRINT "** EDIT **": PRINT : FOR
    I = 1 TO N: GOSUB 480: FOR M = 1 TO 12:
     IF M / 2 =  INT (M / 2) THEN  INVERSE

135  PRINT M$(M);: NORMAL : PRINT  TAB( 6);E
    (I,M); TAB( 13);D(I,M)
140  NEXT
150  PRINT : PRINT "IS LINE TO BE EDITED SHO
    WN? (Y/N):";
160  GET Y$: IF Y$ =  CHR$ (78) THEN  HOME :
     NEXT : GOTO 220
170  IF Y$ <  > CHR$ (89) THEN  PRINT  CHR$
    (7);: GOTO 160
180  PRINT : INPUT "MONTH TO EDIT? ";A$:A$ =
     LEFT$ (A$,3): FOR J = 1 TO 12: IF M$(J
    ) <  > A$ THEN  NEXT : PRINT  CHR$ (7):
     GOTO 130
190  HOME : PRINT "EDIT MONTH OF";M$(J);": U
    SAGE ";E(I,J);"  COST $";D(I,J): PRINT

195  INPUT "ENERGY USAGE? ";T$: IF T$ > "" THEN
    E(I,J) =  VAL (T$)
200  INPUT "ENERGY COST? $";T$: IF T$ > "" THEN
    D(I,J) =  VAL (T$)
210  RETURN
220  PRINT : PRINT "DO YOU WANT TO ADD ONE Y
    EAR": PRINT "TO THE DATA BASE? (Y/N):";

230  GET Y$: IF Y$ =  CHR$ (78) THEN  RETURN

240  IF Y$ <  > CHR$ (89) THEN  PRINT  CHR$
    (7);: GOTO 230
250 EY = EY + 1:N = N + 1:K = N: GOSUB 460: RETURN
260  REM  LIST DATA
270  FOR I = 1 TO N: HOME : GOSUB 480: FOR M
     = 1 TO 12: IF M / 2 =  INT (M / 2) THEN
     INVERSE
275  PRINT M$(M);: NORMAL : PRINT  TAB( 6);E
```

```
     (I,M); TAB( 13);D(I,M): NEXT
280  PRINT : PRINT "PRESS ANY KEY TO CONTINU
     E:";
290  GET Y$
300  NEXT : RETURN
310  REM  GET DISK FILE
311  HOME : PRINT "GET DISK FILE: WHICH?": PRINT
     : GOSUB 600
320  PRINT : FLASH : PRINT "READING ";C$: NORMAL
     : PRINT
321  ONERR  GOTO 335
322  PRINT D$;"OPEN ";C$: PRINT D$;"READ ";C
     $
325  INPUT N: INPUT BY: INPUT EY
330  FOR I = 1 TO N: FOR M = 1 TO 12: INPUT
     E(I,M): INPUT D(I,M): NEXT : NEXT : PRINT
     D$;"CLOSE";C$: POKE 216,0: RETURN
335  PRINT D$;"CLOSE";C$;: HOME : PRINT  CHR$
     (7): PRINT : INVERSE : PRINT "ERROR REA
     DING ";C$;: FOR I = 1 TO 3000: NEXT : NORMAL
     : GOTO 80
340  REM  INPUT DATA
350  HOME : PRINT "*** INPUT DATA ***": PRINT
     : PRINT : GOSUB 600
445  INPUT "BEGINNING YEAR? ";BY
450  INPUT "ENDING YEAR? ";EY:N = EY - BY +
     1
460  FOR I = K TO N: HOME : GOSUB 480: PRINT
     : FOR M = 1 TO 12: PRINT M$(M); TAB( 6)
     ;
470  INPUT E(I,M): VTAB 3 + M: POKE 36,13: INPUT
     D(I,M): NEXT : PRINT : NEXT : RETURN
480  INVERSE : PRINT "YEAR"; TAB( 6);C$; TAB(
     13);C$
490  PRINT I + BY - 1; TAB( 6);"USAGE"; TAB(
     13);"COST": NORMAL : RETURN
500  REM  SAVE DATA TO DISK
501  FLASH : PRINT : PRINT "WRITING ";C$: NORMAL
     : PRINT
503  ONERR  GOTO 40
505  PRINT D$;"OPEN";C$: PRINT D$;"WRITE";C$

510  PRINT N: PRINT BY: PRINT EY: FOR I = 1 TO
     N: FOR M = 1 TO 12
520  PRINT E(I,M): PRINT D(I,M): NEXT : NEXT

530  PRINT D$;"CLOSE";C$: POKE 216,0
535  RETURN
```

1

```
540  HOME : INVERSE : PRINT "ERROR "; PEEK (
     222);" TRYING TO WRITE ";C$: PRINT : PRINT
     : NORMAL : FOR W = 1 TO 3000: NEXT : PRINT
     D$;"CLOSE";C$: GOTO 80
600 K = 1: PRINT "1) NATURAL GAS": PRINT : PRINT
     "2) ELECTRICITY": PRINT : PRINT "3) COA
     L": PRINT : PRINT "4) OIL": PRINT : PRINT
     "5) WOOD": PRINT : PRINT "CHOOSE ONE:";

610  GET Y$: IF Y$ =  CHR$ (27) THEN  HOME :
      END
620  IF Y$ = "1" THEN C$ = "NATGAS"
630  IF Y$ = "2" THEN C$ = "ELECT"
640  IF Y$ = "3" THEN C$ = "COAL"
650  IF Y$ = "4" THEN C$ = "OIL"
660  IF Y$ = "5" THEN C$ = "WOOD"
670  IF Y$ < "1" OR Y$ > "5" THEN  PRINT  CHR$
     (7);: GOTO 610
680  PRINT Y$: RETURN
```

2

Energy Workbook

2

Energy Workbook

Note: The DATA statements in lines 1000-2000 (Program 7) should be added to whichever version of the program you use.

The energy workbook program allows for a wide variety of fuels for both heating and cooling: oil, natural gas,electricity, wood, liquid petroleum, gas, and coal. The savings due to installing storm windows, changing thermostat settings, caulking and weather-stripping, or adding ceiling or floor insulation are calculated for the homeowner. The required inputs are shown in Table 1. Repetitive calculations involving future energy cost can easily be made using the program, thus improving the homeowner's estimate of the accrued energy savings.

The program is based on an algorithm from the Federal Energy Administration which divides the 48 contiguous states into climatic regions for cooling and heating for average housing, fuel, and climatic conditions. If the user's situation is unusual in terms of home construction, altitude, etc., additional advice from government offices or utility companies may be needed.

String variables are used to read the table of states, cities, and heating (H) and cooling (C) factors. Commas are used for delimiters separating the states from the cities and their factors. Because of this, names of cities comprised of two or more words have had the interior blanks removed. Both the heating zone and the cooling zone range from zero to five, with five being the most severe winter climate and zero being the most severe summer climate. The heating and cooling zones are used to calculate a heating factor and a cooling factor. The fuel factors FH (I) and FC(I) are read from the DATA statements for the fuel chosen by the user, and a heating index (HI) or cooling index (CI) is calculated by the product of the heating (or cooling) factor times the fuel factor times the price per fuel unit.

The fuel index (FI) is calculated by the sum of the heating index and cooling index. The annual heating fuel cost is taken from the total energy cost for the heating season times .85 to account for other uses of fuel (e.g., hot water heating). To account for other use such as lighting, the annual cooling cost is calculated from total cooling season fuel cost times .6. These ratios can be

checked by determining average off season to average in season usage. The appropriate ratios should be used in statements 175 and 200 (lines 177 and 206 in the TI version). The ratios in my home were .56 and .88 for cooling and heating respectively, quite close to the Energy Administration's estimate.

Annual heating savings due to changing the thermostat setting are calculated from the product of the number of degrees turned down times the annual heating cost (HS) times a savings factor (Y). Additional savings due to setting back the nighttime temperature are calculated using a similar procedure, but with an added factor .3 (due to the reduced time the set back temperature is in effect). Cooling seasons savings are calculated from the annual cooling cost times .02 times the number of degrees the thermostat is turned up. The annual savings from caulking and weather-stripping are calculated from a draft factor times the total floor area times the fuel index. The draft factor is the sum of the factors for windows, doors, and general house condition, each of which ranges from 0 to .02 in steps of .01, ranging from a tight fit (0) to drafty.

Annual savings from storm windows are calculated from the product of the single glass area, the factor 0.65, and the fuel index. The annual savings from adding ceiling insulation are computed from the product of the ceiling savings index (X-I), the first floor area, and the fuel index (line 470). The ceiling savings index is calculated as the difference between the conduction factor between the recommended ceiling insulation and the existing ceiling insulation. The recommended ceiling insulation is calculated in lines 450-460 and is only a function of the heating zone, thereby underestimating the savings accrued due to reducing air conditioning cost. The annual savings from floor insulation are calculated by the product of the floor factor (J), the floor savings index, the floor area, and the fuel index.

Reference

Home Energy Saver's Workbook. FEA/D-77/117. Washington, D.C.: Government Printing Office, 1977.

Table 1.

The items needed for Energy Workbook are the following:

1) State
2) City
3) Heating fuel cost (e.g., .37 cents/cu. ft.)
4) Cooling fuel cost (e.g., 5.14 cents/KWH)
5) Square ft. of single glass windows in house
6) Annual heating fuel cost
7) Annual cooling fuel cost
8) Check leakage around windows and doors with candle or cigarette
9) Floor area of house — sq. ft.
10) Ceiling R value, use following table:

R Values for Various Thicknesses of Insulation

	BATTS OR BLANKETS		LOOSE FILL (POURED-IN)			
	glass fiber	rock wool	glass fiber	rock wool	cellulosic fiber	
R-11	3½"-4"	3"	5"	4"	3"	R-11
R-13	4"	4½"	6"	4½"	3½"	R-13
R-19	6"-6½"	5¼"	8"-9"	6"-7"	5"	R-19
R-22	6½"	6"	10"	7"-8"	6"	R-22
R-26	8"	8½"	12"	9"	7"-7½"	R-26
R-30	9½"-10½"	9"	13"-14"	10"-11"	8"	R-30
R-33	11"	10"	15"	11"-12"	9"	R-33
R-38	12"-13"	10½"	17"-18"	13"-14"	10"-11"	R-38

11) First floor area — sq. ft.
12) Floor R value if basement is unheated or if house is on pillars.

Table 2. Sample Run.

```
                    ENERGY WORKBOOK

ITEMS NEEDED FOR WORKBOOK:

1) STATE & CITY
2) HEATING FUEL COST (E.G. .37 CENTS/CU FT)
3) COOLING FUEL COST (E.G. 5.14 CENTS/KWH)
4) SQ FT OF SINGLE GLASS WINDOWS
5) ANNUAL HEATING AND COOLING FUEL COST
6) CHECK FOR LEAKAGE AROUND WINDOWS AND DOORS WITH CANDLE
7) FLOOR AREA OF HOUSE - SQ FT
8) CEILING R VALUE - USE TABLE PROVIDED
9) FIRST FLOOR AREA - SQ FT
10) FLOOR R VALUE IF BASEMENT IS UNHEATED OR HOUSE IS ON PILLARS
```

```
STATE(DON'T ABBREVIATE)?  TEXAS

      1       DALLAS
      2       HOUSTON
      3       BROWNSVILLE
      4       AMARILLO

CHOOSE # FOR NEAREST  CITY?  2

      1       OIL/GALLON
      2       NATGAS/CUFT
      3       ELECTRICITY/KWH
      4       WOOD/CORD
      5       LPG/CUFT
      6       LPG/LBS
      7       LPG/GALLON
      8       COAL/TON

CHOOSE # FOR HEATING  FUEL?  2
COST PER UNIT FOR HEATING FUEL (CENTS)?  .45

CHOOSE # FOR COOLING  FUEL?  3
COST PER UNIT FOR COOLING  FUEL(CENTS)?  6
============================================================

INPUT # OF SQ FT OF SINGLE GLASS WINDOWS
DO NOT COUNT STORM WINDOWS OR SLIDING GLASS DOORS?  190

ANNUAL SAVINGS DUE TO STORM WINDOWS=  116.7
============================================================

IS HEATING FUEL USED  FOR OTHER PURPOSES, E.G. COOKING? Y
ANNUAL HEATING FUEL COST (DOLLARS)?  175

IS COOLING FUEL USED FOR OTHER PURPOSES, E.G. LIGHTING? Y
ANNUAL COOLING FUEL COST (DOLLARS)?  800
============================================================

THE FOLLOWING SECTION EVALUATES THE SAVINGS OBTAINED BY TURNING
THE THERMOSTAT DOWN IN WINTER OR UP IN SUMMER FROM THE SETTING
YOU HAVE BEEN USING.

HEATING

DEGREES TURNED DOWN DURING DAY?  5
SAVINGS =$ 37.18
ADDITIONAL DEGREES TURNED DOWN DURING NIGHT?  5
SAVINGS=$ 11.15
ANNUAL TOTAL HEATING  SAVINGS =$ 48.33

COOLING

DEGREES THERMOSTAT TURNED UP DURING COOLING?  5
SAVINGS =$ 48

TOTAL ANNUAL SAVINGS =$ 96.33
============================================================

ANNUAL SAVINGS FROM CAULKING AND WEATHERSTRIPPING

CHECK DRAFTS HOLDING CANDLE NEAR CRACK ON WINDY DAY
```

```
CHOOSE ONE OF FOLLOWING:
1) WINDOWS WITH GOOD FIT
2) SOME LEAKAGE
3) RATHER DRAFTY

? 2

CHOOSE ONE OF FOLLOWING:
1) DOORS FIT WELL
2) SOME LEAKAGE
3) DRAFTY

? 2

CHOOSE ONE OF FOLLOWING:
1) CAULKING AND WEATHERSTRIPPING GOOD
2) NEED REPAIR
3) NO CAULKING OR WEATHERSTRIPPING

? 2

FLOOR AREA OF HOUSE - SQ FT? 2000

ANNUAL SAVINGS FOR CAULKING AND WEATHERSTRIPPING = $ 56.7
============================================================

ANNUAL SAVINGS FROM CEILING INSULATION

CEILING R VALUE 19
FIRST FLOOR AREA OF HOUSE (SQ FT)? 2000

ANNUAL SAVINGS BY BRINGING CEILING R UPTO 26 = $ 22.68
============================================================

IS HOUSE ON PILLARS OR AN UNHEATED BASEMENT? Y
CHOOSE FOUNDATION FACTOR FROM LIST BELOW:

FACTOR          FOUNDATION CHARACTERISTICS
 Ø.5          BUILDING WITH TIGHT CRAWL SPACE
 Ø.5       BUILDING WITH TIGHT BASEMENT (UNHEATED)
 Ø.8           STONE WALL BASEMENT (UNHEATED)
 Ø.8   2 FT OR MORE OF BASEMENT WALL EXPOSED (UNHEATED)
 Ø.8              CRAWL SPACE SKIRTED
 1.Ø          BUILDING ON PILLARS WITH NO SKIRTS

FLOOR FACTOR FROM ABOVE TABLE? 1
CURRENT R FACTOR FOR FLOOR? .Ø77

ANNUAL SAVINGS BY INCREASING FLOOR R VALUE TO 11 = $ 793.86
============================================================

============================================================
```

Program 1. OSI Version.

```
1 REM ENERGY WORKBOOK IS BASED ON FEA/D-77/117, APRIL 1977
2 L=96
3 FORI=1TO25:PRINT:NEXT:::PRINTTAB(25);"ENERGY WORKBOOK":PRINT:PRINT:PRINT:PRINT
4 PRINT"ITEMS NEEDED FOR ENERGY WORKBOOK":PRINT:PRINT"1) STATE":PRINT"2) CITY"
5 PRINT"3) HEATING FUEL COST (E.G. .37 CENTS/CU FT)"
6 PRINT"4) COOLING FUEL COST (E.G. 5.14 CENTS/KWH)"
7 PRINT"5) SQUARE FT OF SINGLE GLASS WINDOWS IN HOUSE"
8 PRINT"7) ANNUAL HEATING AND COOLING FUEL COST"
9 PRINT"8) CHECK FOR LEAKAGE AROUND WINDOWS AND DOORS WITH CANDLE"
10 PRINT"9) FLOOR AREA OF HOUSE - SQ FT"
11 PRINT"10) CEILING R VALUE - USE TABLE PROVIDED WITH INSTRUCTIONS"
12 PRINT"11) FIRST FLOOR AREA - SQ FT"
13 PRINT"12) FLOOR R VALUE IF BASEMENT IS UNHEATED OR HOUSE IS ON PILLARS"
14 PRINT:PRINT:PRINT:INPUT"STATE(DON'T ABBREVIATE)";B$:FORI=1TOL:READC$
15 IFLEFT$(B$,7)=LEFT$(C$,7)THENB$=C$:READD$
20 NEXT:FORI=1TO4:B$(I)="":NEXT:I=1:Y=LEN(D$):J=1
25 X=ASC(MID$(D$,I,1)):IFX=32THEN45
30 B$(J)=B$(J)+CHR$(X):GOTO55
45 I=I+1:X(J)=VAL(MID$(D$,I,1)):I=I+2:Y(J)=VAL(MID$(D$,I,1))
47 I=I+1:J=J+1
55 IFI<YTHENI=I+1:GOTO25
58 J=J-1:PRINT:PRINT:PRINT:FORI=1TOJ
60 PRINTTAB(15);I;TAB(20);B$(I);TAB(35);B$:NEXT
65 PRINT:PRINT:INPUT"CHOOSE # FOR NEAREST CITY";I:H=X(I):C=Y(I):REM ZONES
80 X=1:FORI=1TO5:IFC=ITHEN90
85 X=X-.25:NEXT
90 HC=X:X=0:FORI=0TO5:IFH=ITHEN100:HF & CF ARE HEAT & COOL FACTORS
95 X=X+.5:NEXT
100 HF=X:PRINT:PRINT
```

```
110 FORI=1TO8:READB$,FH(I),FC(I):PRINTSPC(15);I;B$:NEXT
115 PRINT:PRINT:INPUT"CHOOSE # FOR HEATING FUEL";J
120 INPUT"COST PER UNIT FOR HEATING FUEL(CENTS)";S:S=S/100
125 HI=S*FH(J)*HF:REM HEAT INDEX
126 PRINT:PRINT:INPUT"CHOOSE # FOR COOLING FUEL";J
127 INPUT"COST PER UNIT FOR COOLING FUEL(CENTS)";S:S=S/100
130 CI=S*FC(J)*HC:FI=HI+CI:REM COOL AND FUEL INDEX
135 PRINT:PRINT:PRINT:PRINT
145 PRINT"INPUT # OF SQUARE FT OF SINGLE GLASS WINDOWS, DO NOT"
150 INPUT"COUNT STORM WINDOWS OR SLIDING GLASS DOORS";X
170 X=INT(X*100*FI*.65)/100
175 PRINT"ANNUAL SAVINGS DUE TO STORM WINDOWS= $";X:X=.85:GOSUB800
180 PRINT:PRINT"IS HEATING FUEL USED FOR OTHER PURPOSES, E.G. COOKING ";
190 INPUTB$:IFASC(B$)=78THENX=1
200 INPUT"ANNUAL HEATING FUEL COST (DOLLARS)";HS:HS=HS*X:PRINT:PRINT:X=.6
210 PRINT"IS COOLING FUEL USED FOR OTHER PURPOSES, E.G. LIGHTING";
220 INPUTB$:IFASC(B$)=78THENX=1
230 INPUT"ANNUAL COOLING FUEL COST (DOLLARS)";CS:CS=CS*X
240 PRINT:PRINT:Y=.05:FORI=1TO3:IFI=HTHEN247
245 Y=Y-.01:NEXT:IFH=4THENY=.025
246 IFH=5THENY=.02
247 GOSUB800
250 PRINT"THE FOLLOWING SECTION EVALUATES THE SAVINGS OBTAINED BY TURNING"
255 PRINT"THE THERMOSTAT DOWN IN WINTER OR UP IN SUMMER FROM THE SETTING"
256 PRINT"YOU HAVE BEEN USING.":PRINT:PRINT:PRINT"HEATING":PRINT
260 INPUT"DEGREES TURNED DOWN DURING DAY";X:S=INT(100*Y*HS*X)/100
265 PRINT"SAVINGS =$";S:PRINT"ADDITIONAL DEGREES TURNED DOWN DURING NIGHT";
270 INPUTX:I=INT(100*Y*HS*X*.3)/100:PRINT"SAVINGS=$";I
280 S=S+I:PRINT"ANNUAL TOTAL HEATING SAVINGS =$";S:PRINT:PRINT"COOLING":PRINT
285 INPUT"DEGREES THERMOSTAT TURNED UP DURING COOLING";X
```

```
290 I=INT(100*CS*X*.02)/100:PRINT"SAVINGS =$";I
300 PRINT:PRINT"TOTAL ANNUAL SAVINGS =$";S+I:GOSUB800
310 PRINT:PRINT:PRINT"ANNUAL SAVINGS FROM CAULKING AND WEATHERSTRIPPING"
315 PRINT"CHECK DRAFTS HOLDING CANDLE NEAR CRACK ON WINDY DAY"
320 PRINT"CHOOSE ONE OF FOLLOWING":PRINT"     1) WINDOWS WITH GOOD FIT"
340 PRINT"     2) SOME LEAKAGE":PRINT"     3) RATHER DRAFTY"
350 INPUTY:PRINT:PRINT"CHOOSE ONE OF FOLLOWING":PRINT"     1) DOORS FIT GOOD"
360 PRINT"     2) SOME LEAKAGE":PRINT"     3) DRAFTY":INPUTI
370 PRINT:PRINT:PRINT"CHOOSE ONE OF FOLLOWING":PRINT
380 PRINT"     1) CAULKING AND WEATHERSTRIPPING GOOD":PRINT"     2) NEEDREPAIR"
390 PRINT"     3) NO CAULKING OR WEATHERSTRIPPING":INPUTS
400 INPUT"FLOOR AREA OF HOUSE - SQ FT";X
410 X=X*(Y+I+S-3)/100*FI:X=INT(X*100)/100:PRINT
420 PRINT"ANNUAL SAVINGS FOR CAULKING AND WEATHERSTRIPPING= $";X:GOSUB800
440 PRINT:PRINT:PRINT"ANNUAL SAVINGS FROM CEILING INSULATION":PRINT:PRINT
450 Y=38:INPUT"CEILING R VALUE";X:IFH<3THENY=26
455 IFH=3THENY=30
460 IFH=4THENY=33
465 INPUT"FIRST FLOOR AREA OF HOUSE (SQ FT)";F
470 R=Y:GOSUB900:I=R:R=X:GOSUB900:X=R:X=INT(100*(X-I)*F*FI)/100
475 IFX<0THENX=0
480 PRINT"ANNUAL SAVINGS BY BRINGING CEILING R UP TO";Y;" = $";X:GOSUB800
550 INPUT"IS THE HOUSE ON PILLARS OR HAVE AN UNHEATED BASEMENT";B$
555 IFASC(B$)=78THEN799
560 PRINT"CHOOSE FOUNDATION FACTOR FROM LIST BELOW":PRINT
565 PRINT"   FACTOR      FOUNDATION CHARACTERISTICS":PRINT
```

```
570 PRINT"      0.5 BUILDING WITH TIGHT CRAWL SPACE"
580 PRINT"      0.5 BUILDING WITH TIGHT BASEMENT (UNHEATED)"
590 PRINT"      0.8 STONE WALL BASEMENT (UNHEATED)"
600 PRINT"      0.8 2 FT OR MORE OF BASEMENT WALL EXPOSED (UNHEATED)"
610 PRINT"      0.8 CRAWL SPACE SKIRTED"
620 PRINT"      1.0 BUILDING ON PILLARS WITH NO SKIRTS"
625 PRINT:INPUT"FLOOR FACTOR FROM ABOVE TABLE";J
627 Y=11:IFH>1THENY=13:IFH>2THENY=19:IFH>3THENY=22
628 R=Y:GOSUB900:Q=R:INPUT"CURRENT R FACTOR FOR FLOOR";R
630 GOSUB900:X=J*(R-Q)*F*FI:PRINT:PRINT:X=INT(X*100)/100:IFX<0THENX=0
640 PRINT"ANNUAL SAVINGS BY INCREASING FLOOR R VALUE TO ";Y;" =$";X
645 GOSUB800
799 RESTORE:PRINT:PRINT:GOSUB800:PRINT:PRINT:L=96:GOTO14
800 PRINT"================================================================="
801 RETURN
828 R=Y:GOSUB900:I=R
899 REM CONDUCTION FACTOR SUBROUTINE
900 IFR<11THEN920
901 IFR<12THENR=.077:RETURN
902 IFR<15THENR=.066:RETURN
903 IFR<20THENR=.048:RETURN
904 IFR<24THENR=.042:RETURN
905 IFR<28THENR=.036:RETURN
906 IFR<34THENR=.031:RETURN
910 R=.025:RETURN
920 R=.5-.0385*R:RETURN
```

2

Program 2. VIC Version.

```
1 REM ENERGY WORKBOOK IS BASED ON FEA/D-77/1
    17, APRIL 1977  VIC VERSION
2 L=96
3 PRINT"{CLEAR}{09 DOWN}     ENERGY WORKBOOK"
    :FORI=1TO1500:NEXT
4 PRINT"ITEMS NEEDED{DOWN}":PRINT"1) STATE &
     CITY"
5 PRINT"2) HEATING FUEL COST":REM E.G. .37 C
    ENTS/CU FT
6 PRINT"3) COOLING COST":REM E.G. 5.14 CENTS
    /KWH
7 PRINT"4) SQ FT OF SINGLE        GLASS WINDO
    WS"
8 PRINT"5) ANNUAL HEATING AND     COOLING FUE
    L COST"
9 PRINT"6) CHECK FOR LEAKAGE      AROUND WIND
    OWS AND     DOORS WITH CANDLE"
10 PRINT"7) FLOOR AREA - SQ FT"
11 PRINT"8) CEILING R VALUE":REM USE TABLE PR
    OVIDED
12 PRINT"9) FIRST FLOOR AREA"
13 PRINT"10) FLOOR R VALUE IF       BASEMENT I
    S USED":PRINT"     OR HOUSE IS ON"
14 PRINT"     PILLARS":PRINT"{DOWN}STATE(DON'T
     ABBREVIATE":INPUTB$:FORI=1TOL:READC$
15 IFLEFT$(B$,7)=LEFT$(C$,7)THENB$=C$:READD$
20 NEXT:FORI=1TO4:B$(I)="":NEXT:I=1:Y=LEN(D$)
    :J=1
25 X=ASC(MID$(D$,I,1)):IFX=32THEN45
30 B$(J)=B$(J)+CHR$(X):GOTO55
45 I=I+1:X(J)=VAL(MID$(D$,I,1)):I=I+2:Y(J)=VA
    L(MID$(D$,I,1))
47 I=I+1:J=J+1
55 IFI<YTHENI=I+1:GOTO25
58 J=J-1:PRINT"{CLEAR}       ";B$;"{03 DOWN}":
    FORI=1TOJ
60 PRINTI;B$(I):NEXT
65 PRINT:PRINT:PRINT"CHOOSE # FOR NEAREST  CI
    TY":INPUTI:H=X(I):C=Y(I):REM ZONES
80 X=1:FORI=1TO5:IFC=ITHEN90
85 X=X-.25:NEXT
90 HC=X:X=0:FORI=0TO5:IFH=I THEN100:REM H
    F & CF ARE HEAT AND COOL FACTORS
```

```
95 X=X+.5:NEXT
100 HF=X:PRINT:PRINT
110 FORI=1TO8:READB$,FH(I),FC(I):PRINTI;B$:NEX
    T
115 PRINT"{Ø2 DOWN}CHOOSE # FOR HEATING  FUEL"
    :INPUTJ
120 PRINT"{DOWN}COST PER UNIT FOR HEATING FUEL
     (CENTS)":INPUTS:S=S/1ØØ
125 HI=S*FH(J)*HF:REM HEAT INDEX
126 PRINT"{Ø2 DOWN}CHOOSE # FOR COOLING  FUEL"
    :INPUTJ
127 PRINT"{DOWN}COST PER UNIT FOR COOLING  FUE
    L(CENTS":INPUTS:S=S/1ØØ
130 CI=S*FC(J)*HC:FI=HI+CI:REM COOL AND FUEL I
    NDEX
145 PRINT"{DOWN}INPUT # OF SQ FT OF   SINGLE G
    LASS WINDOWS, DO NOT"
150 PRINT"COUNT STORM WINDOWS OR SLIDING GLASS
     DOORS":INPUTX
170 X=INT(X*1ØØ*FI*.65)/1ØØ
175 PRINT"{CLEAR}ANNUAL SAVINGS DUE TO STORM W
    INDOWS= ";X:X=.85:GOSUB8ØØ
180 PRINT:PRINT"IS HEATING FUEL USED  FOR OTHE
    R PURPOSES, E.G. COOKING"
190 INPUTB$:IFASC(B$)=78THENX=1
200 PRINT"ANNUAL HEATING FUEL   COST (DOLLARS)
    ":INPUTHS:HS=HS*X:PRINT:PRINT:X=.6
210 PRINT"IS COOLING FUEL USED  FOR OTHER PURP
    OSES, E.G. LIGHTING"
220 INPUTB$:IFASC(B$)=78THENX=1
230 PRINT"ANNUAL COOLING FUEL   COST (DOLLARS)
    ":INPUTCS:CS=CS*X
240 PRINT:PRINT:Y=.Ø5:FORI=1TO3:IFI=HTHEN247
245 Y=Y-.Ø1:NEXT:IFH=4THENY=.Ø25
246 IFH=5THENY=.Ø2
247 GOSUB8ØØ
250 PRINT"{CLEAR}THE FOLLOWING SECTION EVALUAT
    ES THE SAVINGS OBTAINED BY TURNING"
255 PRINT"THE THERMOSTAT DOWN INWINTER OR UP I
    N SUMMER FROM THE SETTING"
256 PRINT"YOU HAVE BEEN USING.":PRINT:PRINT"HE
    ATING":PRINT
260 PRINT"DEGREES TURNED DOWN   DURING DAY":IN
    PUTX:S=INT(1ØØ*Y*HS*X)/1ØØ
265 PRINT"SAVINGS =$";S:PRINT"{DOWN}ADDITIONAL
```

```
     DEGREES TURNED DOWN DURING NIGHT"
270 INPUTX:I=INT(100*Y*HS*X*.3)/100:PRINT"{DOW
    DOWN}SAVINGS=$";I
280 S=S+I:PRINT"{DOWN}ANNUAL TOTAL HEATING  SA
    VINGS =$";S:PRINT:PRINT"COOLING{DOWN}
    "
285 PRINT"DEGREES THERMOSTAT TURNED UP DURING ~
    COOLING":INPUTX
290 I=INT(100*CS*X*.02)/100:PRINT"SAVINGS =$";
    I
300 PRINT:PRINT"TOTAL ANNUAL SAVINGS =$";S+I:G
    OSUB800
310 PRINT"{DOWN}ANNUAL SAVINGS FROM CAULKING A
    ND WEATHERSTRIPPING"
315 PRINT"CHECK DRAFTS HOLDING CANDLE NEAR CRA
    CK ON WINDY DAY"
320 PRINT"{DOWN}CHOOSE ONE OF FOLLOWING":PRINT
    " 1) WINDOWS WITH GOOD FIT"
340 PRINT"2) SOME LEAKAGE":PRINT"3) RATHER DRA
    FTY"
350 INPUTY:PRINT:PRINT"{DOWN}CHOOSE ONE OF FOL
    LOWING":PRINT"1) DOORS FIT GOOD"
360 PRINT"2) SOME LEAKAGE":PRINT"3) DRAFTY":IN
    PUTI
370 PRINT"{DOWN}CHOOSE ONE OF FOLLOWING":PRINT

380 PRINT"1) CAULKING AND          WEATHERSTRI
    PPING      GOOD"
390 PRINT"2) NEED REPAIR":PRINT"3) NO CAULKING
     OR        WEATHERSTRIPPING":INPUTS
400 PRINT"FLOOR AREA OF HOUSE -":INPUT"SQ FT";
    X
410 X=X*(Y+I+S-3)/100*FI:X=INT(X*100)/100:PRIN
    T
420 PRINT"{CLEAR}ANNUAL SAVINGS FOR CAULKING A
    NDWEATHERSTRIPPING= $";X:GOSUB800
440 PRINT:PRINT:PRINT"ANNUAL SAVINGS FROM CEIL
    ING INSULATION":PRINT:PRINT
450 Y=38:INPUT"CEILING R VALUE";X:IFH<3THENY=2
    6
455 IFH=3THENY=30
460 IFH=4THENY=33
465 PRINT"FIRST FLOOR AREA OF HOUSE (SQ FT)":I
    NPUTF
470 R=Y:GOSUB900:I=R:R=X:GOSUB900:X=R:X=INT(10
```

```
    Ø*(X-I)*F*FI)/1ØØ
475 IFX<ØTHENX=Ø
48Ø PRINT"ANNUAL SAVINGS BY BRINGING CEILING R
     UPTO";Y;" = $";X:GOSUB8ØØ
55Ø INPUT"IS HOUSE ON PILLARS OR HAVE AN UNHEA
    TED BASEMENT";B$
555 IFASC(B$)=78THEN799
56Ø PRINT"CHOOSE FOUNDATION FACTOR FROM LIST B
    ELOW{DOWN}"
565 PRINT"{DOWN}FACTOR FOUNDATION CHARACTERIST
    ICS"
57Ø PRINT" Ø.5 BUILDING WITH TIGHT CRAWL SPACE
    "
58Ø PRINT"Ø.5 BUILDING WITH TIGHT BASEMENT (UN
    HEATED)"
59Ø PRINT"Ø.8 STONE WALL BASEMENT (UNHEATED)"
6ØØ PRINT"Ø.8 2 FT OR MORE OF BASEMENT WALL EX
    POSED (UNHEATED)"
61Ø PRINT"Ø.8 CRAWL SPACE SKIRTED"
62Ø PRINT"1.Ø BUILDING ON PILLARS WITH NO SKIR
    TS"
625 PRINT"{DOWN}FLOOR FACTOR FROM ABOVE TABLE"
    :INPUTJ
627 Y=11:IFH>1THENY=13:IFH>2THENY=19:IFH>3THEN
    Y=22
628 R=Y:GOSUB9ØØ:Q=R:PRINT"CURRENT R FACTOR FO
    R FLOOR":INPUTR
63Ø GOSUB9ØØ:X=J*(R-Q)*F*FI:PRINT:PRINT:X=INT(
    X*1ØØ)/1ØØ:IFX<ØTHENX=Ø
64Ø PRINT"ANNUAL SAVINGS BY INCREASING FLOOR R
     VALUE TO ";Y;" =$";X
645 GOSUB8ØØ
799 RESTORE:PRINT:PRINT:GOSUB8ØØ:PRINT:PRINT:L
    =96:GOTO14
8ØØ PRINT"----------------------":RETURN
828 R=Y:GOSUB9ØØ:I=R
899 REM CONDUCTION FACTOR SUBROUTINE
9ØØ IFR<11THEN92Ø
9Ø1 IFR<12THENR=.Ø77:RETURN
9Ø2 IFR<15THENR=.Ø66:RETURN
9Ø3 IFR<2ØTHENR=.Ø48:RETURN
9Ø4 IFR<24THENR=.Ø42:RETURN
9Ø5 IFR<28THENR=.Ø36:RETURN
9Ø6 IFR<34THENR=.Ø31:RETURN
91Ø R=.Ø25:RETURN
92Ø R=.5-.Ø385*R:RETURN
```

2

Program 3. Microsoft Version.

```
1 REM ENERGY WORKBOOK IS BASED ON FEA/D-77/1
    17, APRIL 1977/
2 L=96
3 PRINT"{CLEAR}{09 DOWN}              ENERGY WO
    RKBOOK{03 DOWN}":FORI=1TO1000:NEXT
4 PRINT"{CLEAR}{03 DOWN}               ITEMS NE
    EDED{DOWN}":PRINT"1) STATE & CITY"
5 PRINT"2) HEATING FUEL COST":REM E.G. .37 C
    ENTS/CU FT
6 PRINT"3) COOLING COST":REM E.G. 5.14 CENTS
    /KWH
7 PRINT"4) SQ FT OF SINGLE GLASS WINDOWS"
8 PRINT"5) ANNUAL HEATING AND COOLING FUEL C
    OST"
9 PRINT"6) CHECK FOR LEAKAGE AROUND WINDOWS ~
    AND    DOORS WITH CANDLE"
10 PRINT"7) FLOOR AREA - SQ FT"
11 PRINT"8) CEILING R VALUE":REM USE TABLE PR
    OVIDED
12 PRINT"9) FIRST FLOOR AREA"
13 PRINT"10) FLOOR R VALUE IF BASEMENT IS USE
    D"
14 PRINT"    OR HOUSE IS ON PILLARS{02 DOWN}"

15 INPUT"STATE(DON'T ABBREVIATE)";B$:PRINT"{
    CLEAR}":FORI=1TOL:READC$
16 IFLEFT$(B$,7)=LEFT$(C$,7)THENB$=C$:READD$
20 NEXT:FORI=1TO4:B$(I)="":NEXT:I=1:Y=LEN(D$)
    :J=1
25 X=ASC(MID$(D$,I,1)):IFX=32THEN45
30 B$(J)=B$(J)+CHR$(X):GOTO55
45 I=I+1:X(J)=VAL(MID$(D$,I,1)):I=I+2:Y(J)=VA
    L(MID$(D$,I,1))
47 I=I+1:J=J+1
55 IFI<YTHENI=I+1:GOTO25
58 J=J-1:PRINT"{CLEAR}                ";B$;"{0
    3 DOWN}":FORI=1TOJ
60 PRINTTAB(12);I;B$(I):NEXT
65 PRINT:PRINT:INPUT"CHOOSE # FOR NEAREST CIT
    Y";I:H=X(I):C=Y(I):REM ZONES
80 X=1:FORI=1TO5:IFC=ITHEN90
85 X=X-.25:NEXT
9Ø HC=X:X=Ø:FORI=ØTO5:IFH=I THEN1ØØ:REM H
```

```
    F & CF ARE HEAT AND COOL FACTORS
95 X=X+.5:NEXT
100 HF=X:PRINT:PRINT
110 FORI=1TO8:READB$,FH(I),FC(I):PRINTTAB(12);
    I;B$:NEXT
115 INPUT"{02 DOWN}CHOOSE # FOR HEATING FUEL";
    J
120 PRINT"{DOWN}COST PER UNIT FOR HEATING FUEL
     (CENTS)":INPUTS:S=S/100
125 HI=S*FH(J)*HF:REM HEAT INDEX
126 INPUT"{02 DOWN}CHOOSE # FOR COOLING FUEL";
    J
127 PRINT"{DOWN}COST PER UNIT FOR COOLING FUEL
    (CENTS)":INPUTS:S=S/100
130 CI=S*FC(J)*HC:FI=HI+CI:REM COOL AND FUEL I
    NDEX
145 PRINT"{CLEAR}INPUT # OF SQ FT OF SINGLE GL
    ASS WINDOWS"
150 PRINT"DO NOT COUNT STORM WINDOWS OR SLIDIN
    G ":INPUT"GLASS DOORS";X
170 X=INT(X*100*FI*.65)/100
175 PRINT"{CLEAR}ANNUAL SAVINGS DUE TO STORM W
    INDOWS= $":PRINTTAB(12);X:X=.85:GOSUB
    800
180 PRINT:PRINT"IS HEATING FUEL USED FOR OTHER
     PURPOSES"
190 INPUT"E.G.COOKING-Y,N";B$:IFASC(B$)=78THEN
    X=1
200 PRINT"ANNUAL HEATING FUEL COST (DOLLARS)":
    INPUTHS:HS=HS*X:PRINT:PRINT:X=.6
210 PRINT"IS COOLING FUEL USED FOR OTHER PURPO
    SES"
220 INPUT"E.G. LIGHTING-Y,N";B$:IFASC(B$)=78TH
    ENX=1
230 PRINT"ANNUAL COOLING FUEL COST (DOLLARS)":
    INPUTCS:CS=CS*X
240 PRINT:PRINT:Y=.05:FORI=1TO3:IFI=HTHEN247
245 Y=Y-.01:NEXT:IFH=4THENY=.025
246 IFH=5THENY=.02
247 GOSUB800
250 PRINT"{CLEAR}THE FOLLOWING SECTION EVALUAT
    ES THE      SAVINGS OBTAINED BY TURNIN
    G"
255 PRINT"THE THERMOSTAT DOWN IN WINTER OR UP ~
    IN  SUMMER FROM THE SETTING YOU"
```

2

```
256 PRINT"HAVE BEEN USING.":PRINT:PRINT"HEATIN
    G":PRINT
260 PRINT"DEGREES TURNED DOWN DURING":INPUT"DA
    Y";X:S=INT(100*Y*HS*X)/100
265 PRINT"SAVINGS =$";S:PRINT"{DOWN}ADDITIONAL
     DEGREES TURNED DOWN DURING"
270 INPUT"NIGHT";X:I=INT(100*Y*HS*X*.3)/100:PR
    INT"{DOWN}SAVINGS=$";I
280 S=S+I:PRINT"{DOWN}ANNUAL TOTAL HEATING SAV
    INGS =$";S:PRINT:PRINT"COOLING{DOWN}"

285 PRINT"DEGREES THERMOSTAT TURNED UP DURING ~
        COOLING":INPUTX
290 I=INT(100*CS*X*.02)/100:PRINT"SAVINGS =$";
    I
300 PRINT:PRINT"TOTAL ANNUAL SAVINGS =$";S+I:G
    OSUB800
310 PRINT"{DOWN}ANNUAL SAVINGS FROM CAULKING A
    ND WEATHERSTRIPPING"
315 PRINT"CHECK DRAFTS HOLDING CANDLE NEAR CRA
    CK  ON WINDY DAY"
320 PRINT"{DOWN}CHOOSE ONE OF FOLLOWING":PRINT
    "1) WINDOWS WITH GOOD FIT"
340 PRINT"2) SOME LEAKAGE":PRINT"3) RATHER DRA
    FTY"
350 INPUTY:PRINT:PRINT"{DOWN}CHOOSE ONE OF FOL
    LOWING":PRINT"1) DOORS FIT GOOD"
360 PRINT"2) SOME LEAKAGE":PRINT"3) DRAFTY":IN
    PUTI
370 PRINT"{DOWN}CHOOSE ONE OF FOLLOWING":PRINT

380 PRINT"1) CAULKING AND WEATHERSTRIPPING GOO
    D"
390 PRINT"2) NEED REPAIR":PRINT"3) NO CAULKING
     OR WEATHERSTRIPPING":INPUTS
400 PRINT"FLOOR AREA OF HOUSE -":INPUT"SQ FT";
    X
410 X=X*(Y+I+S-3)/100*FI:X=INT(X*100)/100:PRIN
    T
420 PRINT"{CLEAR}ANNUAL SAVINGS FOR CAULKING A
    ND       WEATHERSTRIPPING= $";X:GOSUB
    800
440 PRINT:PRINT:PRINT"ANNUAL SAVINGS FROM CEIL
    ING INSULATION":PRINT:PRINT
450 Y=38:INPUT"CEILING R VALUE";X:IFH<3THENY=26
```

```
455 IFH=3THENY=30
460 IFH=4THENY=33
465 PRINT"FIRST FLOOR AREA OF HOUSE (SQ FT)":I
    NPUTF
470 R=Y:GOSUB900:I=R:R=X:GOSUB900:X=R:X=INT(10
    0*(X-I)*F*FI)/100
475 IFX<0THENX=0
480 PRINT"ANNUAL SAVINGS BY BRINGING CEILING R
        UPTO";Y;" = $";X:GOSUB800
550 INPUT"IS HOUSE ON PILLARS OR HAVE AN UNHEA
    TED BASEMENT";B$
555 IFASC(B$)=78THEN799
560 PRINT"CHOOSE FOUNDATION FACTOR FROM LIST B
    ELOW{DOWN}"
565 PRINT"{DOWN}FACTOR FOUNDATION CHARACTERIST
    ICS"
570 PRINT"0.5 BUILDING WITH TIGHT CRAWL SPACE"
580 PRINT"0.5 BUILDING WITH TIGHT BASEMENT    ~
            (UNHEATED)"
590 PRINT"0.8 STONE WALL BASEMENT (UNHEATED)"
600 PRINT"0.8 2 FT OR MORE OF BASEMENT WALL   ~
            EXPOSED (UNHEATED)"
610 PRINT"0.8 CRAWL SPACE SKIRTED"
620 PRINT"1.0 BUILDING ON PILLARS WITH NO SKIR
    TS"
625 PRINT"{DOWN}FLOOR FACTOR FROM ABOVE TABLE"
    :INPUTJ
627 Y=11:IFH>1THENY=13:IFH>2THENY=19:IFH>3THEN
    Y=22
628 R=Y:GOSUB900:Q=R:PRINT"CURRENT R FACTOR FO
    R FLOOR":INPUTR
630 GOSUB900:X=J*(R-Q)*F*FI:PRINT:PRINT:X=INT(
    X*100)/100:IFX<0THENX=0
640 PRINT"ANNUAL SAVINGS BY INCREASING FLOOR R
        VALUE TO ";Y;" =$";X
645 GOSUB800
799 END
800 PRINT"-----------------------------------
    ---":RETURN
828 R=Y:GOSUB900:I=R
899 REM CONDUCTION FACTOR SUBROUTINE
900 IFR<11THEN920
901 IFR<12THENR=.077:RETURN
902 IFR<15THENR=.066:RETURN
```

2

```
903 IFR<20THENR=.048:RETURN
904 IFR<24THENR=.042:RETURN
905 IFR<28THENR=.036:RETURN
906 IFR<34THENR=.031:RETURN
910 R=.025:RETURN
920 R=.5-.0385*R:RETURN
```

Program 4. Atari Version.

```
1 REM ENERGY WORKBOOK IS BASED ON FEA
  /D-77/117, APRIL 1977  ATARI VERSIO
  N
2 L=96
3 PRINT "{CLEAR}ENERGY WORKBOOK":DIM
  A$(40),B$(40),C$(40),D$(40),BB$(20*
  5),BL(4),X(10),Y(10),FH(8),FC(8)
4 PRINT "{DOWN}ITEMS NEEDED:{DOWN}":P
  RINT "1) STATE & CITY"
5 PRINT "2) HEATING FUEL COST":REM E.
  G. .37 CENTS/CU FT
6 PRINT "3) COOLING COST":REM E.G. 5.
  14 CENTS/KWH
7 PRINT "4) SQ FT OF SINGLE GLASS WIN
  DOWS"
8 PRINT "5) ANNUAL HEATING AND":? "
  {3 SPACES}COOLING FUEL COST"
9 PRINT "6) CHECK FOR LEAKAGE AROUND
  WINDOWS":? "{3 SPACES}AND DOORS WIT
  H CANDLE"
10 PRINT "7) FLOOR AREA - SQ FT"
11 PRINT "8) CEILING R VALUE":REM USE
    TABLE PROVIDED
12 PRINT "9) FIRST FLOOR AREA"
13 PRINT "10) FLOOR R VALUE IF BASEME
   NT IS USED":PRINT "{4 SPACES}OR HO
   USE IS ON":? "{4 SPACES}PILLARS"
14 ? :? "STATE(DON'T ABBREVIATE)":INP
   UT B$:FOR I=1 TO L:READ C$
15 TRAP 20:IF B$=C$(1,LEN(B$)) THEN B
```

```
   $=C$:TRAP 40000:READ D$
20 NEXT I:FOR I=1 TO 4:BL(I)=0:NEXT I
   :I=1:Y=LEN(D$):J=1
25 X=ASC(D$(I)):IF X=32 THEN 45
30 BB$(J*20+BL(J)+1)=CHR$(X):BL(J)=BL
   (J)+1:GOTO 55
45 I=I+1:X(J)=VAL(D$(I)):I=I+2:Y(J)=V
   AL(D$(I))
47 I=I+1:J=J+1
55 IF I<Y THEN I=I+1:GOTO 25
58 J=J-1:PRINT "{CLEAR}{6 SPACES}";B$
   ;"{3 DOWN}":FOR I=1 TO J
60 PRINT I;". ";BB$(I*20+1,I*20+BL(I)
   ):NEXT I
65 PRINT :PRINT :PRINT "CHOOSE # FOR
   NEAREST CITY":INPUT I:H=X(I):C=Y(I
   ):REM ZONES
80 X=1:FOR I=1 TO 5:IF C=I THEN 90
85 X=X-0.25:NEXT I
90 HC=X:X=0:FOR I=0 TO 5:IF H=I THEN
   100:REM HF & CF ARE HEAT AND COOL
   FACTORS
95 X=X+0.5:NEXT I
100 HF=X:PRINT :PRINT
110 FOR I=1 TO 8:READ B$,T1,T2:FH(I)=
    T1:FC(I)=T2:PRINT I;". ";B$:NEXT
    I
115 PRINT "{2 DOWN}CHOOSE # FOR HEATI
    NG FUEL":INPUT J
120 PRINT "{CLEAR}COST PER UNIT FOR H
    EATING FUEL (CENTS)":INPUT S:S=S/
    100
125 HI=S*FH(J)*HF:REM HEAT INDEX
126 PRINT "{2 DOWN}CHOOSE # FOR COOLI
    NG FUEL":INPUT J
127 PRINT "{DOWN}COST PER UNIT FOR CO
    OLING FUEL(CENTS)":INPUT S:S=S/10
    0
130 CI=S*FC(J)*HC:FI=HI+CI:REM COOL A
    ND FUEL INDEX
145 PRINT "{DOWN}INPUT # OF SQ FT OF
```

2

```
    SINGLE GLASS":? "WINDOWS, DO NOT"
150 PRINT "COUNT STORM WINDOWS OR SLI
    DING GLASS  DOORS";:INPUT X
170 X=INT(X*100*FI*0.65)/100
175 PRINT "{CLEAR}ANNUAL SAVINGS DUE
    TO":? "STORM WINDOWS= ";X:X=0.85:
    GOSUB 800
180 PRINT :PRINT "IS HEATING FUEL USE
    D FOR OTHER":? "PURPOSES, E.G. CO
    OKING"
190 INPUT B$:IF ASC(B$)=78 THEN X=1
200 PRINT "ANNUAL HEATING FUEL COST (
    DOLLARS)":INPUT HS:HS=HS*X:PRINT
    :PRINT :X=0.6
210 PRINT "IS COOLING FUEL USED FOR O
    THER":? "PURPOSES, E.G. LIGHTING"
220 INPUT B$:IF ASC(B$)=78 THEN X=1
230 PRINT "ANNUAL COOLING FUEL COST (
    DOLLARS)":INPUT CS:CS=CS*X
240 PRINT :PRINT :Y=0.05:FOR I=1 TO 3
    :IF I=H THEN 247
245 Y=Y-0.01:NEXT I:IF H=4 THEN Y=0.0
    25
246 IF H=5 THEN Y=0.02
247 GOSUB 800
250 PRINT "{CLEAR}THE FOLLOWING SECTI
    ON EVALUATES THE{3 SPACES}SAVINGS
     OBTAINED BY TURNING"
255 PRINT "THE THERMOSTAT DOWN IN WIN
    TER OR UP{3 SPACES}IN SUMMER FROM
     THE SETTING"
256 PRINT "YOU HAVE BEEN USING.":PRIN
    T :PRINT "HEATING"
260 PRINT "DEGREES TURNED DOWN DURING
     DAY":INPUT X:S=INT(100*Y*HS*X)/1
    00
265 PRINT "SAVINGS =$";S:PRINT "
    {DOWN}ADDITIONAL DEGREES TURNED D
    OWN DURING NIGHT";
270 INPUT X:I=INT(100*Y*HS*X*0.3)/100
    :PRINT "{DOWN}SAVINGS=$";I
```

```
280 S=S+I:PRINT "{DOWN}ANNUAL TOTAL H
    EATING  SAVINGS =$";S:PRINT :PRIN
    T "COOLING{DOWN}"
285 PRINT "DEGREES THERMOSTAT TURNED
    UP DURING  COOLING";:INPUT X
290 I=INT(100*CS*X*0.02)/100:PRINT "S
    AVINGS =$";I
300 PRINT :PRINT "TOTAL ANNUAL SAVING
    S =$";S+I:GOSUB 800
310 PRINT :? "ANNUAL SAVINGS FROM CAU
    LKING AND":? "WEATHER STRIPPING"
315 PRINT "CHECK DRAFTS HOLDING CANDL
    E NEAR":? "CRACK ON WINDY DAY"
320 PRINT :? "CHOOSE ONE OF FOLLOWING
    ":PRINT "1) WINDOWS WITH GOOD FIT
    "
340 PRINT "2) SOME LEAKAGE":PRINT "3)
     RATHER DRAFTY"
350 INPUT Y:PRINT :PRINT "{CLEAR}CHOO
    SE ONE OF FOLLOWING":PRINT "1) DO
    ORS FIT WELL"
360 PRINT "2) SOME LEAKAGE":PRINT "3)
     DRAFTY":INPUT I
370 PRINT "{CLEAR}CHOOSE ONE OF FOLLO
    WING":PRINT
380 PRINT "1) CAULKING AND":? "
    {3 SPACES}WEATHER STRIPPING GOOD"
390 PRINT "2) NEED REPAIR":PRINT "3)
    NO CAULKING":? "{3 SPACES}WEATHER
    STRIPPING":INPUT S
400 PRINT "FLOOR AREA OF HOUSE -":? "
    SQ FT";:INPUT X
410 X=X*(Y+I+S-3)/100*FI:X=INT(X*100)
    /100:PRINT
420 PRINT "{CLEAR}ANNUAL SAVINGS FOR
    CAULKING AND":? "WEATHER STRIPPIN
    G= $";X:GOSUB 800
440 PRINT :PRINT :PRINT "ANNUAL SAVIN
    GS FROM CEILING INSULATION":PRINT
     :PRINT
450 Y=38:? "CEILING R VALUE";:INPUT X
```

```
    :IF H<3 THEN Y=26
455 IF H=3 THEN Y=30
460 IF H=4 THEN Y=33
465 PRINT "FIRST FLOOR AREA OF HOUSE
    (SQ FT)":INPUT F
470 R=Y:GOSUB 900:I=R:R=X:GOSUB 900:X
    =R:X=INT(100*(X-I)*F*FI)/100
475 IF X<0 THEN X=0
480 PRINT "ANNUAL SAVINGS BY BRINGING
     CEILING R":? "UP TO ";Y;" = $";X
    :GOSUB 800
550 ? "IS HOUSE ON PILLARS OR HAVE":?
     "AN UNHEATED BASEMENT";:INPUT B$
555 IF ASC(B$)=78 THEN 799
560 PRINT "CHOOSE FOUNDATION FACTOR F
    ROM LIST BELOW{DOWN}"
565 PRINT "{DOWN}FACTOR FOUNDATION CH
    ARACTERISTICS"
570 PRINT "0.5 BUILDING WITH TIGHT CR
    AWL SPACE"
580 PRINT "0.5 BUILDING WITH TIGHT BA
    SEMENT (UNHEATED)"
590 PRINT "0.8 STONE WALL BASEMENT (U
    NHEATED)"
600 PRINT "0.8 2 FT OR MORE OF BASEME
    NT WALL EXPOSED (UNHEATED)"
610 PRINT "0.8 CRAWL SPACE SKIRTED"
620 PRINT "1.0 BUILDING ON PILLARS WI
    TH NO SKIRTS"
625 ? :PRINT "FLOOR FACTOR FROM ABOVE
     TABLE":INPUT J
627 Y=11:IF H>1 THEN Y=13:IF H>2 THEN
     Y=19:IF H>3 THEN Y=22
628 R=Y:GOSUB 900:Q=R:PRINT "CURRENT
    R FACTOR FOR FLOOR":INPUT R
630 GOSUB 900:X=J*(R-Q)*F*FI:PRINT :P
    RINT :X=INT(X*100)/100:IF X<0 THE
    N X=0
640 PRINT "ANNUAL SAVINGS BY INCREASI
    NG FLOOR R  VALUE TO ";Y;" =$";X
645 GOSUB 800
```

```
799 RESTORE :PRINT :PRINT :GOSUB 800:
    PRINT :PRINT :L=96:GOTO 14
800 PRINT "-------------------------
    -----------":RETURN
828 R=Y:GOSUB 900:I=R
899 REM CONDUCTION FACTOR SUBROUTINE
900 IF R<11 THEN 920
901 IF R<12 THEN R=0.077:RETURN
902 IF R<15 THEN R=0.066:RETURN
903 IF R<20 THEN R=0.048:RETURN
904 IF R<24 THEN R=0.042:RETURN
905 IF R<28 THEN R=0.036:RETURN
906 IF R<34 THEN R=0.031:RETURN
910 R=0.025:RETURN
920 R=0.5-0.0385*R:RETURN
```

Program 5. Color Computer Version.

```
1 REM ENERGY WORKBOOK IS BASED ON FEA/D-77/1
    17, APRIL 1977
2 L=96
3 CLS:PRINTTAB(9)"ENERGY WORKBOOK"
4 PRINT"ITEMS NEEDED FOR ENERGY WORKBOOK":PR
    INT"1) STATE":PRINT"2) CITY"
5 PRINT"3) HEATING FUEL COST":PRINT"       (E
    .G. .37 CENTS/CU FT)"
6 PRINT"4) COOLING FUEL COST":PRINT"       (E
    .G. 5.14 CENTS/KWH)"
7 PRINT"5) SQUARE FT OF SINGLE GLASS        I
    N HOUSE":INPUT"CONTINUE";ZZ$:CLS
8 PRINT"6) ANNUAL HEATING AND COOLING       F
    UEL COST"
9 PRINT "7) CHECK FOR LEAKAGE AROUND         ~
    WINDOWS AND DOORS WITH          CANDL
    E"
10 PRINT"8) FLOOR AREA OF HOUSE - SQ FT"
11 PRINT"9) CEILING R VALUE - USE TABLE      P
    ROVIDED WITH INSTRUCTIONS"
12 PRINT"10) FIRST FLOOR AREA - SQ FT"
13 PRINT"11)FLOOR R VALUE IF BASEMENT IS     U
    NHEATED OR HOUSE IS ON          PILLAR
    S"
```

2

```
14 PRINT:INPUT"STATE(DON'T ABBREVIATE)";B$:FO
    RI=1TOL:READC$
15 IFLEFT$(B$,7)=LEFT$(C$,7)THENB$=C$:READD$
20 NEXT:FORI=1TO4:B$(I)="":NEXT:I=1:Y=LEN(D$)
    :J=1
22 CLS
25 X=ASC(MID$(D$,I,1)):IFX=32THEN45
30 B$(J)=B$(J)+CHR$(X):GOTO55
45 I=I+1:X(J)=VAL(MID$(D$,I,1)):I=I+2:Y(J)=VA
    L(MID$(D$,I,1))
47 I=I+1:J=J+1
55 IFI<Y THENI=I+1:GOTO25
58 J=J-1:PRINT:FORI=1TOJ:PRINTI;TAB(5);B$(I);
    TAB(20);B$:NEXT
65 PRINT:INPUT"CHOOSE # FOR NEAREST CITY";I:H
    =X(I):C=Y(I):REM ZONES
70 CLS
80 X=1:FORI=1TO5:IFC=I THEN90
85 X=X-.25:NEXT
90 HC=X:X=0:FORI=0TO5:IFH=I THEN100:HF & CF A
    RE HEAT AND COOL FACTORS
95 X=X+.5:NEXT
100 HF=X:PRINT
110 FORI=1TO8:READB$,FH(I),FC(I):PRINTTAB(5);I
    ;B$:NEXT
115 PRINT:INPUT"CHOOSE # FOR HEATING FUEL";J
120 INPUT"COST PER UNIT FOR HEATING FUEL    (C
    ENTS)";S:S=S/100
125 HI=S*FH(J)*HF:REM HEAT INDEX
126 PRINT:INPUT"CHOOSE # FOR COOLING INDEX";J
127 INPUT"COST PER UNIT FOR COOLING FUEL(CENTS
    )";S:S=S/100
130 CI=S*FC(J)*HC:FI=HI+CI:REM COOL AND FUEL I
    NDEX
135 PRINT
145 PRINT"INPUT # OF SQUARE FT OF SINGLE  GLAS
    S WINDOWS"
150 PRINT"DO NOT COUNT    STORM WINDOWS OR SLI
    DING GLASS  DOORS";:INPUTX
170 X=INT(X*100*FI*.65)/100
175 PRINT"ANNUAL SAVINGS DUE TO STORM     WIND
    OWS = $";X:X=.85:GOSUB800
180 PRINT:PRINT"IS HEATING FUEL USED FOR OTHER
     PURPOSES, E.G. COOKING";
190 INPUTB$:IFASC(B$)=78THENX=1
```

```
200 INPUT"ANNUAL HEATING FUEL COST          (DOL
    LARS)";HS:HS=HS*X:PRINT:X=.6
210 PRINT"IS COOLING FUEL USED FOR OTHER PURPO
    SES, E.G. LIGHTING";
220 INPUTB$:IFASC(B$)=78THENX=1
230 INPUT"ANNUAL COOLING FUEL COST          (DOL
    LARS)";CS:CS=CS*X
240 PRINT:Y=.05:FORI=1TO3:IFI=H THEN247
245 Y=Y-.01:NEXT:IFH=4THENY=.025
246 IFH=5THENY=.02
247 CLS
250 PRINT"THE FOLLOWING SECTION EVALUATES THE ~
    SAVINGS OBTAINED BY"
251 PRINT"TURNING THE THERMOSTAT DOWN IN THE  ~
        WINTER OR UP IN SUMMER"
252 PRINT"FROM THE SETTING YOU HAVE BEEN USING
    .":PRINT:PRINT:PRINT"HEATING":PRINT
260 INPUT"DEGREES TURNED DOWN DURING THE  DAY"
    ;X:S=INT(100*Y*HS*X)/100
265 PRINT"SAVINGS =$";S:PRINT"ADDITIONAL DEGRE
    ES TURNED DOWN DURING THE NIGHT";
270 INPUTX:I=INT(100*Y*HS*X*.3)/100:PRINT"SAVI
    NGS=$";I
280 S=S+I:PRINT"ANNUAL TOTAL HEATING SAVINGS =
    $";S:PRINT:PRINT"COOLING":PRINT
285 INPUT"DEGREES THERMOSTAT TURNED UP    DURI
    NG COOLING";X
290 I=INT(100*CS*X*.02)/100:PRINT"SAVINGS =$";
    I
300 PRINT:PRINT"TOTAL ANNUAL SAVINGS =$";S+I:G
    OSUB800
310 PRINT:PRINT"ANNUAL SAVINGS FROM CAULKING A
    NDWEATHERSTRIPPING"
315 PRINT"CHECK DRAFTS HOLDING CANDLE NEARCRAC
    K ON WINDY DAY"
320 PRINT"CHOOSE ONE OF FOLLOWING":PRINT"   1)
     WINDOWS WITH GOOD FIT"
340 PRINT"   2) SOME LEAKAGE":PRINT"   3) RATH
    ER DRAFTY"
350 INPUTY:CLS:PRINT:PRINT"CHOOSE ONE OF THE F
    OLLOWING"
355 PRINT"   1) DOORS FIT GOOD"
360 PRINT"   2) SOME LEAKAGE":PRINT"   3) DRAF
    TY":INPUTI
365 CLS
```

2

```
370 PRINT:PRINT:PRINT"CHOOSE ONE OF THE FOLLOW
    ING"
380 PRINT"   1) CAULKING AND WEATHER-          ~
      STRIPPING GOOD"
381 PRINT"   2) NEED REPAIR":PRINT"   3) NO CA
    ULKING OR WEATHER-        STRIPPING"
382 INPUTS
395 CLS
400 INPUT"FLOOR AREA OF HOUSE-SQ FT";X
410 X=X*(Y+I+S-3)/100*FI:X=INT(X*100)/100:PRIN
    T
420 PRINT"ANNUAL SAVINGS FOR CAULKING AND WEAT
    HERSTRIPPING= $";X:GOSUB800
440 PRINT:PRINT:PRINT"ANNUAL SAVINGS FROM CEIL
    ING     INSULATION":PRINT:PRINT
450 Y=38:INPUT"CEILING R VALUE";X:IFH<3THENY=2
    6
455 IFH=3THENY=30
460 IFH=4THENY=33
465 INPUT"FIRST FLOOR AREA OF HOUSE       (SQ ~
    FT)";F
470 R=Y:GOSUB900:I=R:R=X:GOSUB900:X=R:X=INT(10
    0*(X-I)*F*FI)/100
475 IFX<0THENX=0
480 PRINT"ANNUAL SAVINGS BY BRINGING CEILING R
     UP TO";Y;" = $";X:GOSUB800
550 INPUT"IS THE HOUSE ON PILLARS OR HAVE AN U
    NHEATED BASEMENT";B$
555 IFASC(B$)=78THEN799
560 PRINT"CHOOSE FOUNDATION FACTOR FROM   LIST
     BELOW"
565 PRINT"FACTOR  FOUNDATION CHARACTERISTICS"
570 PRINT"0.5 BUILDING WITH TIGHT CRAWL        ~
    SPACE"
580 PRINT"0.5 BUILDING WITH TIGHT BASEMENT     ~
    (UNHEATED)"
590 PRINT"0.8 STONE WALL BASEMENT              ~
    (UNHEATED)"
600 PRINT"0.8 2 FT OR MORE OF BASEMENT         ~
    WALL EXPOSED (UNHEATED)"
610 PRINT"0.8 CRAWL SPACE SKIRTED"
620 PRINT"1.0 BUILDING ON PILLARS WITH NO      ~
    SKIRTS"
625 INPUT"FLOOR FACTOR FROM ABOVE TABLE";J
627 Y=11:IFH>1THENY=13:IFH>2THENY=19:IFH>3THEN
    Y=22
```

```
628 R=Y:GOSUB900:Q=R:INPUT"CURRENT R FACTOR FO
    R FLOOR";R
630 GOSUB900:X=J*(R-Q)*F*FI:PRINT:PRINT:X=INT(
    X*100)/100:IFX<OTHENX=0
640 PRINT"ANNUAL SAVINGS BY INCREASING    FLOO
    R R VALUE TO ";Y;" =$";X
645 GOSUB800
799 RESTORE:GOSUB800:PRINT:L=96:GOTO14
800 PRINT"================================":RE
    TURN
828 R=Y:GOSUB900:I=R
899 REM CONDUCTION FACTOR SUBROUTINE
900 IFR<11THEN920
901 IFR<12THENR=.077:RETURN
902 IFR<15THENR=.066:RETURN
903 IFR<20THENR=.048:RETURN
904 IFR<24THENR=.042:RETURN
905 IFR<28THENR=.036:RETURN
906 IFR<34THENR=.031:RETURN
910 R=.025:RETURN
920 R=.5-.0385*R:RETURN
```

Program 6. TI-99 Version.

```
1 REM energy workbook,TI version, is
  based on fea/d-77/117,april 1977
2 L=96
4 CALL CLEAR
5 PRINT TAB(8);"energy workbook"
6 PRINT TAB(9);"items needed": :
7 PRINT "1) state"
8 PRINT "2) city"
9 PRINT "3) heating fuel cost
  {11 SPACES}(e.g. .37 cents/cu ft)"
10 PRINT "4) cooling fuel cost
   {11 SPACES}(e.g. 5.14 cents/kwh)"
11 PRINT "5) square ft of single
   {9 SPACES}glass windows in house"
12 PRINT "6) annual heating and
   {10 SPACES}cooling fuel cost"
13 PRINT "7) check for leakage around
```

```
   {4 SPACES}windows and doors"
14 PRINT "8) floor area of house-sqft
   "
15 PRINT "9) ceiling r value-use
   {9 SPACES}table provided"
16 PRINT "10)first floor area-sq ft"
17 PRINT "11)floor r value if basemen
   t{3 SPACES}is unheated or house is
   {5 SPACES}on pillars"
18 INPUT "state (don't abbreviate)? "
   ;BB$
19 FOR I=1 TO L
20 READ C$
21 IF SEG$(BB$,1,7)<>SEG$(C$,1,7)THEN
    24
22 BB$=C$
23 READ D$
24 NEXT I
25 FOR I=1 TO 4
26 B$(I)=""
27 NEXT I
28 I=1
29 Y=LEN(D$)
30 J=1
31 X=ASC(SEG$(D$,I,1))
32 IF X=32 THEN 45
33 B$(J)=B$(J)&CHR$(X)
35 GOTO 55
45 I=I+1
46 XX(J)=VAL(SEG$(D$,I,1))
47 I=I+2
48 YY(J)=VAL(SEG$(D$,I,1))
49 I=I+1
50 J=J+1
55 IF I>=Y THEN 58
56 I=I+1
57 GOTO 31
58 J=J-1
59 PRINT : : :
60 FOR I=1 TO J
61 PRINT I;TAB(5);B$(I);TAB(19);BB$
```

```
62 NEXT I
63 PRINT : : :
64 INPUT "choose # for nearest city "
   :I
65 H=XX(I)
66 C=YY(I)
80 X=1
82 FOR I=1 TO 5
84 IF C=I THEN 90
85 X=X-.25
87 NEXT I
90 HC=X
91 X=0
92 FOR I=0 TO 5
93 IF H=I THEN 100
95 X=X+.5
96 NEXT I
100 HF=X
102 PRINT : : :
110 FOR I=1 TO 8
112 READ BB$,FH(I),FC(I)
114 PRINT TAB(5);I;BB$
115 NEXT I
116 PRINT : : :
117 INPUT "choose # for heating fuel
    ":J
120 INPUT "cost per unit for heating
    {3 SPACES}fuel (cents)? ":S
121 S=S/100
125 HI=S*FH(J)*HF
126 PRINT : : :
127 INPUT "choose # for cooling fuel
    ":J
128 INPUT "cost per unit for cooling
    fuel (cents)? ":S
129 S=S/100
130 CI=S*FC(J)*HC
131 FI=HI+CI
133 PRINT : : : :
140 PRINT "input # of sq ft of single
      glass windows, do not count sto
      rm windows or sliding{4 SPACES}
```

```
    glass doors";
150 INPUT X
170 X=INT(X*100*FI*.65)/100
175 PRINT "annual savings due to stor
    m windows = $";X
177 X=.85
178 GOSUB 800
180 PRINT : :
181 INPUT "is heating fuel used for
    {4 SPACES}other purposes (e.g.coo
    king ?":BB$
190 IF (ASC(BB$)<>78)*(ASC(BB$)<>110)
    THEN 200
191 X=1
200 INPUT "annual heating fuel cost
    {4 SPACES}(dollars)? ":HS
202 HS=HS*X
204 PRINT : : :
206 X=.6
210 INPUT "is cooling fuel used for
    {4 SPACES}other purposes, e.g.
    {8 SPACES}lighting?":BB$
220 IF (ASC(BB$)<>78)*(ASC(BB$)<>110)
    THEN 230
225 X=1
230 INPUT "annual cooling fuel cost
    {4 SPACES}(dollars)? ":CS
235 CS=CS*X
237 PRINT : : :
240 Y=.05
241 FOR I=1 TO 3
242 IF I=H THEN 247
243 Y=Y-.01
244 NEXT I
245 IF H<>4 THEN 247
246 Y=.025
247 IF H<>5 THEN 249
248 Y=.02
249 GOSUB 800
250 PRINT "the following section
```

```
    {7 SPACES}evaluates the savings
    {7 SPACES}obtained by turning the"
252 PRINT "thermostat down in winter
    {3 SPACES}or up in summer from th
    e{4 SPACES}setting you have been
    using": : : : :
256 PRINT "heating": :
260 INPUT "degrees turned down during
      day? ":X
262 S=INT(100*Y*HS*X)/100
265 PRINT "savings =$ ";S
267 INPUT "additional degrees turned
    {3 SPACES}down during night? ":X
270 I=INT(100*Y*HS*X*.3)/100
272 PRINT "savings =$";I
279 S=S+I
280 PRINT "annual total heating savin
    gs=$ ";S: : :
282 PRINT "cooling": :
285 INPUT "degrees thermostat turned
    updduring cooling? ":X
290 I=INT(100*CS*X*.02)/100
295 PRINT "savings =$ ";I: : :
300 PRINT "total annual savings =
    {6 SPACES}$";S+I
305 GOSUB 800
310 PRINT : : :
312 PRINT "annual savings from caulki
    ng and weatherstripping": :
315 PRINT "check drafts holding candl
    e near crack on windy day": : :
320 PRINT "choose one of following"
325 PRINT "{3 SPACES}1) windows with
    good fit"
330 PRINT "{3 SPACES}2) some leakage"
340 PRINT "{3 SPACES}3) rather drafty
    "
350 INPUT Y
353 PRINT : :
355 PRINT "choose one of following"
357 PRINT "{3 SPACES}1) doors fit goo
```

```
    d{11 SPACES}2) some leakage
    {13 SPACES}3) drafty"
360 INPUT I
368 PRINT : :
369 PRINT "choose one of following"
370 PRINT "{3 SPACES}1) caulking and
    weather-{7 SPACES}stripping good
    {11 SPACES}2) need repairs{13
    SPACES}3) none exists"
390 INPUT S
400 INPUT "floor area of house -
    {7 SPACES}sq ft? ":X
405 X=X*(Y+I+S-3)/100*FI
410 X=INT(X*100)/100
415 PRINT
420 PRINT "annual savings for caulkin
    g and weatherstripping =$";X
430 GOSUB 800
440 PRINT : : :
442 PRINT "annual savings from ceilin
    g insulation": : :
450 Y=38
452 INPUT "ceiling r value?  ":X
453 IF H>=3 THEN 455
454 Y=26
455 IF H<>3 THEN 457
456 Y=30
457 IF H<>4 THEN 459
458 Y=33
459 INPUT "first floor area of house
    {3 SPACES}(sq ft)? ":F
465 R=Y
467 GOSUB 900
468 I=R
469 R=X
470 GOSUB 900
472 X=R
474 X=INT(100*(X-I)*F*FI)/100
475 IF X>=0 THEN 477
476 X=0
477 PRINT "annual savings by bringing
```

```
      ceiling r up to ";Y;" = $";X
480 GOSUB 800
550 INPUT "is the house on pillars or
      have an unheated basement? ":BB
    $
555 IF (ASC(BB$)<>89)*(ASC(BB$)<>121)
    THEN 700
560 PRINT "choose foundation factor
    {4 SPACES}from list below": : :
565 PRINT "  factor{4 SPACES}foundati
    on"
566 PRINT "{12 SPACES}characteristics"
    : : :
570 PRINT "{3 SPACES}0.5  building wi
    th tight crawl space"
580 PRINT "{3 SPACES}0.8  building wi
    th tight basement (unheated)"
590 PRINT "{3 SPACES}0.8 stone wall b
    asement (unheated)"
600 PRINT "{3 SPACES}0.8 2 ft or more
     of basement wall exposed (unheat
    ed)"
610 PRINT "{3 SPACES}0.8 crawl space
    skirted"
620 PRINT "{3 SPACES}1.0 building on
    pillars with no skirts": :
625 INPUT "floor factor from above tb
    l?":J
627 Y=11
628 IF H<=1 THEN 634
629 Y=13
630 IF H<=2 THEN 634
631 Y=19
632 IF H<=3 THEN 634
633 Y=22
634 R=Y
635 GOSUB 900
637 Q=R
638 INPUT "current r factor for floor
    ? ":R
640 GOSUB 900
642 X=J*(R-Q)*F*FI
```

```
644 PRINT : :
646 X=INT(X*100)/100
648 IF X>=0 THEN 650
649 X=0
650 PRINT "annual savings by increasi
    ng floor r value to";Y;" =
    {4 SPACES}$";X
655 GOSUB 800
700 RESTORE
705 PRINT : : :
710 GOSUB 800
715 PRINT : :
720 L=96
725 GOTO 18
800 PRINT "-------------------------
    --"
805 RETURN
828 R=Y
829 GOSUB900
830 I=R
899 REM conductin factor subroutine
900 IF R<11 THEN 922
901 IF R>=12 THEN 904
902 R=.077
903 RETURN
904 IF R>=15 THEN 907
905 R=.066
906 RETURN
907 IF R>=20 THEN 910
908 R=.048
909 RETURN
910 IF R>=24 THEN 913
911 R=.042
912 RETURN
913 IF R>=28 THEN 916
914 R=.036
915 RETURN
916 IF R>=34 THEN 919
917 R=.031
918 RETURN
919 R=.025
920 RETURN
```

```
922 R=.5-.0385*R
923 RETURN
```

Program 7. DATA Statements.

```
1000 DATACALIFORNIA,LOSANGELES 1 4 SANFRANCISCO
     3 4 SACRAMENTO 1 3
1010 DATACOLORADO,DENVER 3 4 DURANGO 4 4 ASPEN ~
    4 5
1020 DATAALABAMA, MONTGOMERY 1 2 BIRMINGHAM 1 3
     HUNTSVILLE 2 3
1030 DATAARIZONA,PHOENIX 1 3 FLAGSTAFF 3 3,CONN
    ECTICUTT,HARTFORD 3 5
1040 DATANEW MEXICO,ROSWELL 2 3 ALBUQUERQUE 3 3
     SANTAFE 3 4
1050 DATAUTAH,SALTLAKECITY 3 4 MOAB 4 4,IDAHO,B
    OISE 3 5 POCATELLO 4 4
1070 DATAMONTANA,BILLINGS 4 5,OREGON,PORTLAND 2
     5 BAKER 3 5
1090 DATAWASHINGTON,SEATTLE 3 5,NEVADA,RENO 3 3
     LASVEGAS 1 3
1110 DATANORTH DAKOTA,GRANDFORKS 5 5,OKLAHOMA,O
    KLAHOMACITY 2 3
1120 DATASOUTH DAKOTA,SIOUXFALLS 4 4 PIERRE 4 5

1130 DATANEBRASKA,OMAHA 3 4,KANSAS,WICHITA 2 4 ~
    TOPEKA 3 4
1160 DATATEXAS,DALLAS 1 3 HOUSTON 1 2 BROWNSVIL
    LE 0 1 AMARILLO 2 3
1170 DATALOUISIANA,NEWORLEANS 1 2 SHREVEPORT 1 ~
    3
1180 DATAARKANSAS,LITTLEROCK 1 3 FAYETTEVILLE 2
     3
1190 DATAMISSOURI,SPRINGFIELD 2 3 STLOUIS 2 4 K
    ANSASCITY 3 4
1200 DATAIOWA,DESMOINES 3 4 SIOUXCITY 4 4,VERMO
    NT,MONTPELIER 4 5
1210 DATAMINNESOTA,MINNEAPOLIS 4 5 DULUTH 5 5,N
    EW HAMPSHIRE,CONCORD 4 5
1220 DATAWISCONSIN,MADISON 4 4 EAUCLAIRE 4 5,RH
    ODE ISLAND,PROVIDENCE 3 5
1230 DATAILLINOIS,CHICAGO 3 4 SPRINGFIELD 2 4,V
    IRGINIA,RICHMOND 2 4
1240 DATAMICHIGAN,DETROIT 3 4 GRANDRAPIDS 4 5 S
    AULTST.MARIE 5 5
```

2

```
1270 DATAINDIANA,INDIANAPOLIS 3 4 EVANSVILLE 2 ~
    4,WYOMING,CASPER 4 5
1290 DATATENNESSEE,MEMPHIS 2 3 KNOXVILLE 2 4 CH
    ATTANOOGA 2 3
1300 DATAMISSISSIPPI,JACKSON 1 2 TUPELO 1 3,KEN
    TUCKY,LOUISVILLE 2 4
1320 DATAWEST VIRGINIA,CHARLESTON 3 4,MASSACHUS
    ETTS,BOSTON 3 5
1330 DATAFLORIDA,MIAMI 0 1 JACKSONVILLE 1 2,OHI
    O,COLUMBUS 3 4
1340 DATAGEORGIA,SAVANNAH 1 3 ATLANTA 2 3,MAINE
    ,PORTLAND 4 5
1350 DATASOUTH CAROLINA,CHARLESTON 1 3,NEW JERS
    EY,NEWARK 2 4
1360 DATANORTH CAROLINA,RALEIGH 2 3 ASHEVILLE 2
     4 WILMINGTON 1 3
1390 DATAPENNSYLVANIA,PITTSBURGH 3 4,MARYLAND,B
    ALTIMORE 2 4
1410 DATANEW YORK,NEWYORK 3 4 ALBANY 4 5,DELAWA
    RE,WILMINGTOON 2 4
1480 DATAERROR
1500 DATAOIL/GALLON,1,0,NATGAS/CUFT,120,150,ELE
    CTRICITY/KWH,30,15
1510 DATAWOOD/CORD,.01,0,LPG/CUFT,50,60,LPG/LBS
    ,6,7,LPG/GALLON,1.3,1.5
1520 DATACOAL/TON,.006,0
2000 END
```

3

Energy Plot

3

Energy Plot

Note: The data plotted by this program must be stored in files created by the "Energy Data Base" program in this book. For the OSI, Atari, Apple, and Color Computer versions, the program expects the data files to be stored on disk. The VIC, PET/CBM, 64, and TI versions expect the data to be stored on tape.

This program produces bar charts of energy use, energy cost, and cost/energy for the data created in the data base program. It is set up to handle files for: "NATGAS," "ELECT," "COAL," "OIL" and "WOOD," overlaying the bars for each successive year in different colors. To overcome the problem of one year overwriting another, an algorithm was developed which PEEKs the screen at the top of the new bar and POKEs the new color only as long as the color remains the same. This will cause the second year's data to sometimes exactly overwrite the first year's, but more often it will cause a short bar to be placed above the first bar or a bar to start in the interior of the first and extend to the abscissa of the graph. This routine will thus allow multiple years' data to be displayed simultaneously for each month of the year.

This program was originally written on the OSI 4P and on the 5K version of the VIC-20. The routines are very similar except for the location of the screens, width of the screens, and positions of the origins of the graphs (upper left corner = V, width of screen = D, upper left corner of the color screen = E+V, and the origin of the graph = T). Having these variables defined at the beginning of the program will help make the conversion to other memory mapped video systems a little easier.

When the OSI version is run, it must first clear the color screen (line 35). This is not necessary on the VIC, as the lower three bits of the color screen are set by the CLR command. Line 40 sets the screen positions, and widths of the screens, and turns on the color in the OSI version. Lines 50-70 clear the screen, print the heading, accept an input for the number of years of data (N), and read in the symbols for the months (M$).

The DIMension statement is variable for the Energy (E), the Cost (D), and the variable to be plotted (Z). Lines 80-170 input the data files from disk or tape. Lines 180 to 210 plot the energy, cost,

and rate, and turn the color off (in the OSI version). The subroutine to get the data from tape or disk is located in lines 220-240. The main plotting subroutine is located in lines 250-300. Line 290 detects the SHIFT key on the OSI and any key on the VIC-20 for plotting the next year or the next graph. The bargraph generation routine is located in lines 310-350.

Different symbols and different colors are used on the OSI for each year of data. The VIC-20 version uses the same symbol and different colors for each year of data. This was done because a convenient group of symbols were in a contiguous area of the character table (and because I have a black and white monitor on the OSI). VIC-20 users may also use different characters if they desire by changing the variable CH to vary with I. Similarly, users may let the color (CO) vary or set it to a single color in line 270.

Lines 330 and 340 provide the bar overlaying logic. This can be removed and the routine can be modified to plot one year of data at a time by calling the bar blanking routine in line 460 after each year of data is plotted. Lines 360 to 390 determine the maximum (MX) and the minimum (MI), and set up the scaling factor PR. Lines 400-440 print the labels and draw the ordinant and abscissa. Line 420 POKEs the abscissa and line 430 POKEs the abscissa labels (the months of the year).

Line 440 places the tic marks on the ordinant, and line 460 blanks out the bars on the OSI version. The VIC-20 version doesn't need this subroutine since it has a clear screen command. OSI users who have the 3.3 DOS can also replace this line with a clear screen command. Users interested in plotting a single year at a time may want to increase the resolution of the bar graphs by using the techniques discussed by David Swaim ("High Resolution Bar Graphs for the PET," **COMPUTE!**, October 1981, #10, pp. 143-144).

Atari Notes For "Energy Plot"

Instead of merely converting the VIC-20 or OSI version of "Energy Plot" to the Atari, a custom program was written in order to exploit some of the Atari's special features, such as high-resolution graphics.

The program will display three line (versus bar) graphs for each year of energy data (see the figure). The data, fuel and fuel cost, should have been previously entered with the Atari version of "Energy Data Base" and saved on disk. The program will ask you

to type the first letter of the appropriate file (E for Electric, C for Coal, etc.).

You will then see the one-color, high-resolution screen (GRAPHICS 8) transformed into a four-color, high-resolution screen with the horizontal resolution of GRAPHICS 7, and the vertical resolution of GRAPHICS 8. This special mode, known only as Antic Mode 14, cannot be accessed directly from BASIC, but can be created with display-list modification. (Briefly, all Instruction Register modes 15 and 79 must be changed to 14 and 78, respectively.) In order to PLOT on this screen, we must use "POKE 87,7" to trick the OS (operating system) into thinking we are in graphics mode seven. If we don't do this, the colors will be garbled and unaddressable. Unfortunately, although this allows us to draw in four colors, it limits the vertical height to 96 lines, only half the screen. The other half can only be drawn upon with tricky techniques.

One tricky technique used is a machine language routine known as "TextPlot" (**COMPUTE!**, November 1981, #18). This routine allows you to place any ATASCII character anywhere on the screen. TextPlot is used to draw the axes, display the title, key, and give other messages. This fills the screen nicely. The graph is plotted in an imaginary window (see the figure). The other routine used in this program is a relatively short one that "plots" numerals. It is used to display the minimum and maximum values of the graph. It was used instead of TextPlot because it has a greater density. (Each character is 3v by 5h, rather than 8x8, so you can fit more numbers into less space.)

You can use it in your own programs by calling line 3000 (GOSUB 3000) with the variable "A" containing the numeral (0-9). If A = –2, then a decimal point will be plotted. The numeral will be plotted at screen coordinates NX and NY. Alternatively, you can enter the subroutine at 3500 with GX, GY, and GC (the X-Y coordinates and the color, 0-3) to print the number in the variable N. GD is used to limit the length of the number plotted to fit it into a limited display width (from the left margin to the side of the graph, in Energy Plot). Set it to eight or more, or just leave the statement out of the subroutine. Also, the subroutine at 1000 prints a string (MSG$) using TextPlot, at coordinates GX and GY in color GC. If ALT is set to one, the color will alternate through the string (set it to zero for normal use). You can also try to use the subroutine at 2000, which scales and plots a line from the array Z (1-12). One final note: you may want to delete line 397 to improve color

contrast. Since line 397 generates random colors, some lines may look similar due to similar color shades selected.

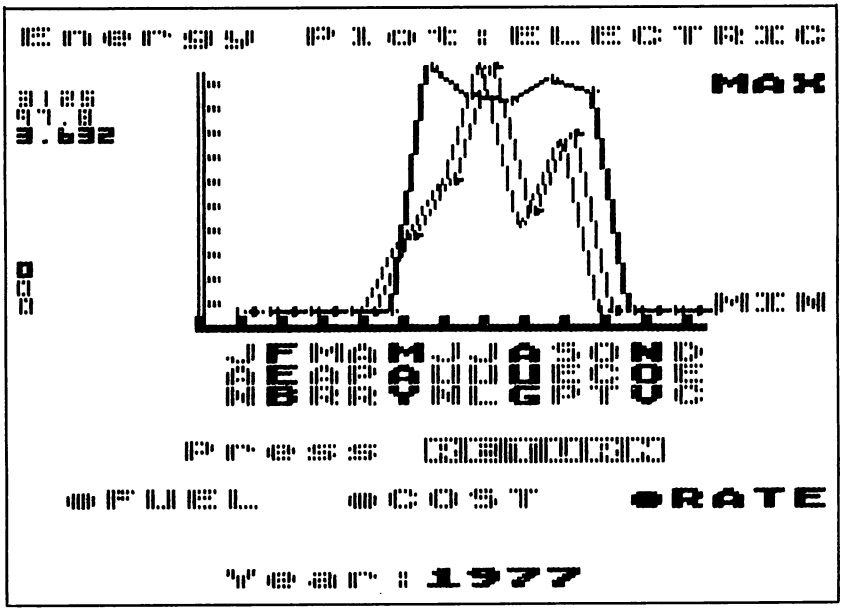

Figure. Sample Output For Atari Version.

Program 1. OSI Version.

```
10 REM ENERGYPLOT
30 REM LOADZ(YEAR,12) WITH PLOT VECTORS
35 FORI=57344TO59391:POKEI,14:NEXT
40 V=53248:D=64:E=4096:T=V+1871:POKE56832,5
50 FORI=1TO32:PRINT:NEXT:PRINT;TAB(20);"ENERGY PLOT":PRINT:PRINT:PRINT
55 PRINT"DEFAULT=5":INPUT"#YEARS OF DATA=";N:IFN=0THENN=5
60 DIMZ(N,12),M$(12),E(N,12),D(N,12)
70 FORI=1TO12:READM$(I):NEXT
80 PRINT:PRINT"INSERT A DISKETTE WITH ONE OF THE FOLLOWING FILES"
90 PRINT:PRINT"1)NATGAS":PRINT"2)ELECT":PRINT"3)COAL":PRINT"4)OIL"
100 PRINT"5)WOOD":PRINT:PRINT"          <CHOOSE ONE>"
110 INPUTY$
120 IFY$="1"THENC$="NATGAS"
130 IFY$="2"THENC$="ELECT"
140 IFY$="3"THENC$="COAL"
150 IFY$="4"THENC$="OIL"
160 IFY$="5"THENC$="WOOD"
170 GOSUB230
180 FORI=1TON:FORM=1TO12:Z(I,M)=E(I,M):NEXT:NEXT
185 C$="ENERGY":GOSUB250:REM PLOT ENERGY
190 FORI=1TON:FORM=1TO12:Z(I,M)=D(I,M):NEXT:NEXT
195 C$="COST":GOSUB250:REM PLOT COST
200 FORI=1TON:FORM=1TO12:Z(I,M)=0:IFE(I,M)>0THENZ(I,M)=100*D(I,M)/E(I,M)
205 NEXT:NEXT:C$="RATE":GOSUB250:REM RATE
210 POKE56832,1:END
220 REM GET DATA, N=#YRS, BY=BEG YR, EY=END YR, E()=ENERGY,D()=COST
230 DISK OPEN,6,C$:INPUT#6,N,BY,EY:FORI=1TON:FORM=1TO12
```

```
235 INPUT#6,E(I,M),D(I,M):NEXT:NEXT
240 RETURN
250 REM PLOT SUBROUTINE, MX=MAX, MI=MIN, Z(YEAR,MONTH)=DATA
260 GOSUB360:GOSUB400
270 FORI=1TON:CO=I+1:CH=135+I:FORM=1TO12
280 X=3*M:Y=(Z(I,M)-MI)*PR:GOSUB310:NEXT
290 IFPEEK(57088)=1THEN290
300 NEXT:RETURN
310 REM BARGRAPH ENTER WITH X & Y, CO=COLOR
320 XX=T+X-1:Y=INT(Y):IFY<=0THENRETURN
330 FORII=YTO1STEP-1:Q=XX-II*D:A=15ANDPEEK(Q+E):IFII=YTHENB=A
340 IFA=BTHENPOKEQ,CH:POKEQ+E,CO
350 NEXT:RETURN
360 REM SCALING
370 MX=Z(1,1):MI=MX:FORI=1TON:FORM=1TO12:X=Z(I,M):IFX>MXTHENMX=X
380 IFX<MITHENMI=X
390 NEXT:NEXT:MX=INT(MX+1):MI=INT(MI):PR=30*.8/(MX-MI):RETURN
400 FORI=1TO32:PRINT:NEXT:GOSUB460:REM AXES & LABELS
405 PRINTTAB(30);C$
410 FORI=5TO1STEP-1:PRINTINT(MI+I*5/PR):PRINT:PRINT:PRINT
415 PRINT:NEXT
420 FORI=TTOT+40:POKEI,131:POKEI+E,14:NEXT
430 FORI=1TO12:Q=T+63+I*3:POKEQ+E,14:POKEQ,ASC(M$(I)):NEXT
440 FORI=V+13TOTSTEPD:POKEI+E,14:POKEI,207:NEXT:RETURN
450 DATAJ,F,M,A,M,J,J,A,S,O,N,D
460 FORM=1TO12:FORI=1TO29:POKEE+T-1+M*3-I*64,14:NEXT:NEXT
470 RETURN
```

Program 2. VIC Version.

```
10 REM ENERPLOT  VIC VERSION
30 REM LOADZ(YEAR,12) WITH PLOT VECTORS
40 V=7680:D=22:E=30720:T=V+468
50 N=5:PRINT"{CLEAR}      ENERGY PLOT{03 DOWN}
    ":PRINT"DEFAULT=5":INPUT"# YEARS OF D
    ATA";N
60 DIMZ(N,12),M$(12),E(N,12),D(N,12)
70 FORI=1TO12:READM$(I):NEXT
80 PRINT"{DOWN}";"PLACE A TAPE WITH ONE OF TH
    E FOLLOWING FILES IN THE CASSETTE RDR
    "
90 PRINT"{02 DOWN}1)NATGAS":PRINT"2)ELECT":PR
    INT"3)COAL":PRINT"4)OIL"
100 PRINT"5)WOOD":PRINT"{DOWN}<CHOOSE ONE>"
110 GETY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"ANDY$<>
    "4"ANDY$<>"5"THEN110
120 IFY$="1"THENC$="NATGAS"
130 IFY$="2"THENC$="ELECT"
140 IFY$="3"THENC$="COAL"
150 IFY$="4"THENC$="OIL"
160 IFY$="5"THENC$="WOOD"
170 GOSUB230
180 FORI=1TON:FORM=1TO12:Z(I,M)=E(I,M):NEXT:NE
    XT:C$="ENERGY":GOSUB250:REM PLOT ENER
    GY
190 FORI=1TON:FORM=1TO12:Z(I,M)=D(I,M):NEXT:NE
    XT:C$="COST":GOSUB250:REM PLOT COST
200 FORI=1TON:FORM=1TO12:Z(I,M)=0:IFE(I,M)>0TH
    ENZ(I,M)=100*D(I,M)/E(I,M)
205 NEXT:NEXT:C$="RATE":GOSUB250:REM RATE
210 END
220 REM GET DATA,N=#YRS,BY=BEG YR,EY=ENDING YR
    ,E()=ENERGY,D()=COST
230 OPEN1,1,0,C$:INPUT#1,N,BY,EY:FORI=1TON:FOR
    M=1TO12:INPUT#1,E(I,M),D(I,M):NEXT:NE
    XT
240 CLOSE1:RETURN
250 REM PLOT SUBROUTINE, MX=MAX,MI=MIN,Z(YEAR,
    MONTH)=DATA
260 GOSUB360:GOSUB400
270 FORI=1TON:CO=I+1:FORM=1TO12
280 X=M:Y=(Z(I,M)-MI)*PR:GOSUB310:NEXT
290 GETY$:IFY$=""THEN290
```

3

```
300 NEXT:RETURN
310 REM BARGRAPH ENTER WITH X & Y,CO=COLOR
320 XX=445+V+X:Y=INT(Y)
330 FORII=YTO0STEP-1:Q=XX-II*D:A=7ANDPEEK(Q+E)
    :IFII=YTHENB=A
340 IFA=BTHENPOKEQ,160:POKEQ+E,CO
350 NEXT:RETURN
360 REM SCALING
370 MX=Z(1,1):MI=MX:FORI=1TON:FORM=1TO12:X=Z(I
    ,M):IFX>MXTHENMX=X
380 IFX<MITHENMI=X
390 NEXT:NEXT:MX=INT(MX+1):MI=INT(MI):PR=20*.9
    /(MX-MI):RETURN
400 PRINT"{CLEAR}";"          ";C$;"{HOME}";:REM
     AXES & LABELS
410 FORI=4TO1STEP-1:PRINTINT(MI+I*5/PR);"{04
    DOWN}":NEXT:PRINTMI
420 FORI=TTOT+11:POKEI,114:POKEI+E,0:NEXT
430 FORI=1TO12:Q=T+21+I:POKEQ+E,0:POKEQ,ASC(M$
    (I))-64:NEXT
440 FORI=V+5TOV+467STEP22:POKEI+E,0:POKEI,80:N
    EXT:RETURN
450 DATAJ,F,M,A,M,J,J,A,S,O,N,D
```

Program 3. Commodore 64 Version.

```
10 REM ENERPLOT
30 REM LOADZ(YEAR,12) WITH PLOT VECTORS
40 V=1024:D=40:E=54272:T=V+807:PRINTCHR$(5)
50 N=5:PRINT"{CLEAR}      ENERGY PLOT{03 DOWN}
    ":PRINT"DEFAULT=5":INPUT"# YEARS OF D
    ATA";N
60 DIMZ(N,12),M$(12),E(N,12),D(N,12)
70 FORI=1TO12:READM$(I):NEXT
80 PRINT"{DOWN}";"PLACE A TAPE WITH ONE OF TH
    E FOLLOWING FILES IN THE CASSETTE RDR
    "
90 PRINT"{02 DOWN}1)NATGAS":PRINT"2)ELECT":PR
    INT"3)COAL":PRINT"4)OIL"
100 PRINT"5)WOOD":PRINT"{DOWN}<CHOOSE ONE>"
110 GETY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"ANDY$<>
    "4"ANDY$<>"5"THEN110
120 IFY$="1"THENC$="NATGAS"
130 IFY$="2"THENC$="ELECT"
```

```
140 IFY$="3"THENC$="COAL"
150 IFY$="4"THENC$="OIL"
160 IFY$="5"THENC$="WOOD"
170 GOSUB230
180 FORI=1TON:FORM=1TO12:Z(I,M)=E(I,M):NEXT:NE
    XT:C$="ENERGY":GOSUB250:REM PLOT ENER
    GY
190 FORI=1TON:FORM=1TO12:Z(I,M)=D(I,M):NEXT:NE
    XT:C$="COST":GOSUB250:REM PLOT COST
200 FORI=1TON:FORM=1TO12:Z(I,M)=0:IFE(I,M)>0TH
    ENZ(I,M)=100*D(I,M)/E(I,M)
205 NEXT:NEXT:C$="RATE":GOSUB250:REM RATE
210 END
220 REM GET DATA,N=#YRS,BY=BEG YR,EY=ENDING YR
    ,E()=ENERGY,D()=COST
230 OPEN1,1,0,C$:INPUT#1,N,BY,EY:FORI=1TON:FOR
    M=1TO12:INPUT#1,E(I,M),D(I,M):NEXT:NE
    XT
240 CLOSE1:RETURN
250 REM PLOT SUBROUTINE, MX=MAX,MI=MIN,Z(YEAR,
    MONTH)=DATA
260 GOSUB360:GOSUB400
270 FORI=1TON:CO=I:FORM=1TO12
280 X=M*2:Y=(Z(I,M)-MI)*PR:GOSUB320:NEXT
290 GETY$:IFY$=""THEN290
300 NEXT:RETURN
310 REM BARGRAPH ENTER WITH X & Y,CO=COLOR
320 XX=T-42+X:Y=INT(Y)
330 FORII=YTO0STEP-1:Q=XX-II*D:A=7ANDPEEK(Q+E)
    :IFII=YTHENB=A
335 IFY=0THEN350
340 IFA=BTHENPOKEQ,160:POKEQ+E,CO
350 NEXT:RETURN
360 REM SCALING
370 MX=Z(1,1):MI=MX:FORI=1TON:FORM=1TO12:X=Z(I
    ,M):IFX>MXTHENMX=X
380 IFX<MITHENMI=X
390 NEXT:NEXT:MX=INT(MX+1):MI=INT(MI):PR=20*.9
    /(MX-MI):RETURN
400 PRINT"{CLEAR}";TAB(31);C$;"{HOME}";:REM AX
    ES & LABELS
410 FORI=4TO1STEP-1:PRINTINT(MI+I*5/PR);"{04
    DOWN}":NEXT:PRINTMI
415 FORI=T-1TOT+22:POKEI,67:POKEI+E,1:NEXT
420 FORI=TTOT+22STEP2:POKEI,114:NEXT
```

```
430 FORI=1TO12:Q=T+78+2*I:POKEQ+E,1:POKEQ,ASC(
    M$(I))-64:NEXT
440 FORI=V+5TOTSTEP40:POKEI+E,1:POKEI,115:NEXT
    :RETURN
450 DATAJ,F,M,A,M,J,J,A,S,O,N,D
500 REM V=UPPER LEFT CORNER OF SCREEN        E=
    COLOR SCREEN-SCREEN=55296-1024
510 REM D=SCREEN WIDTH, T IS THE POSITION OF T
    HE ORIGIN ON THE SCREEN
```

Program 4. PET/CBM Version.

```
10 REM ENERGYPLOT  PET/CBM VERSION
30 REM LOADZ(YEAR,12) WITH PLOT VECTORS
40 V=32768:D=80:T=V+21*D+6:POKE59468,12:REM U
    SE D=80 FOR 8032
50 N=5:PRINT"{CLEAR}     ENERGY PLOT{03 DOWN}
    ":INPUT"# YEARS OF DATA?_5{03 LEFT}";
    N
60 DIMZ(N,12),M$(12),E(N,12),D(N,12)
70 FORI=1TO12:READM$(I):NEXT
80 PRINT"{DOWN}";"PLACE A TAPE WITH ONE OF TH
    E FOLLOWING FILES IN THE CASSETTE RDR
    "
90 PRINT"{02 DOWN}1)NATGAS":PRINT"2)ELECT":PR
    INT"3)COAL":PRINT"4)OIL"
100 PRINT"5)WOOD":PRINT"{DOWN}<CHOOSE ONE>"
110 GETY$:IFY$<>"1"ANDY$<>"2"ANDY$<>"3"ANDY$<>
    "4"ANDY$<>"5"THEN110
120 IFY$="1"THENC$="NATGAS"
130 IFY$="2"THENC$="ELECT"
140 IFY$="3"THENC$="COAL"
150 IFY$="4"THENC$="OIL"
160 IFY$="5"THENC$="WOOD"
170 GOSUB230
180 FORI=1TON:FORM=1TO12:Z(I,M)=E(I,M):NEXT:NE
    XT:C$="ENERGY":GOSUB250:REM PLOT ENER
    GY
190 FORI=1TON:FORM=1TO12:Z(I,M)=D(I,M):NEXT:NE
    XT:C$="COST":GOSUB250:REM PLOT COST
200 FORI=1TON:FORM=1TO12:Z(I,M)=0:IFE(I,M)>0TH
    ENZ(I,M)=100*D(I,M)/E(I,M)
205 NEXT:NEXT:C$="RATE":GOSUB250:REM RATE
210 END
```

```
220 REM GET DATA,N=#YRS,BY=BEG YR,EY=ENDING YR
    ,E()=ENERGY,D()=COST
230 OPEN1,1,0,C$:INPUT#1,N,BY,EY:FORI=1TON:FOR
    M=1TO12:INPUT#1,E(I,M),D(I,M):NEXT:NE
    XT
240 CLOSE1:RETURN
250 REM PLOT SUBROUTINE, MX=MAX,MI=MIN,Z(YEAR,
    MONTH)=DATA
260 GOSUB360:GOSUB400
270 FORI=1TON:CO=I+1:FORM=1TO12
280 X=M:Y=(Z(I,M)-MI)*PR:GOSUB310:NEXT
290 GETY$:IFY$=""THEN290
300 NEXT:RETURN
310 REM BARGRAPH ENTER WITH X & Y
320 XX=20*D+5+V+X:Y=INT(Y)
330 FORII=YTO0STEP-1:Q=XX-II*D:A=7ANDPEEK(Q):I
    FII=YTHENB=A
340 IFA=BTHENPOKEQ,159+CO
350 NEXT:RETURN
360 REM SCALING
370 MX=Z(1,1):MI=MX:FORI=1TON:FORM=1TO12:X=Z(I
    ,M):IFX>MXTHENMX=X
380 IFX<MITHENMI=X
390 NEXT:NEXT:MX=INT(MX+1):MI=INT(MI):PR=20*.9
    /(MX-MI):RETURN
400 PRINT"{CLEAR}";"          ";C$;"{HOME}";:REM
     AXES & LABELS
410 FORI=4TO1STEP-1:PRINTINT(MI+I*5/PR);"{04
    DOWN}":NEXT:PRINTMI
420 FORI=TTOT+11:POKEI,114:NEXT
430 FORI=1TO12:Q=T+D+I-1:POKEQ,ASC(M$(I))-64:N
    EXT
440 FORI=V+5TOV+21*D+5STEPD:POKEI,80:NEXT:RETU
    RN
450 DATAJ,F,M,A,M,J,J,A,S,O,N,D
```

Program 5. Atari Version.

```
100 REM ENERGY PLOT -- ATARI VERSION
110 REM
115 DIM F$(14),Z$(4),E(10,12),D(10,12
    ),F(10,12),Z(12),MSG$(20)
117 Z$="■{M}{■}"
120 GRAPHICS 18:OPEN #1,4,0,"K:"
```

3

```
130 ? #6;"{CLEAR}":POSITION 5,0:? #6;
    "ENERGY PLOT"
140 POSITION 5,1:? #6;"select file:":
    ? #6
160 ? #6;"NATURAL GAS":? #6:? #6;"ELE
    CTRICITY":? #6:? #6;"COAL":? #6:?
     #6;"OIL":? #6:? #6;"WOOD"
170 GET #1,A:F$=""
180 IF A=78 THEN F$="D:NATGAS"
190 IF A=69 THEN F$="D:ELECTRIC"
200 IF A=67 THEN F$="D:COAL"
210 IF A=79 THEN F$="D:OIL"
220 IF A=87 THEN F$="D:WOOD"
225 IF F$="" THEN 170
230 POSITION 10,8:? #6;"READING":POSI
    TION 10,9:? #6;"FILE"
240 TRAP 250:OPEN #2,4,0,F$:TRAP 4000
    0:GOTO 260
250 CLOSE #2:? #6;"{CLEAR}CAN'T OPEN
    THE FILE.":? #6;"PRESS ANY KEY TO
    ":? #6;"TRY AGAIN.":GET #1,A:GOTO
     130
260 INPUT #2;N,BY,EY
270 FOR I=1 TO N
280 FOR M=1 TO 12
290 INPUT #2;A,B:E(I,M)=A:D(I,M)=B
298 FOR J=1 TO 4:POSITION 15,9:? #6;Z
    $(J,J):FOR W=1 TO 4:NEXT W:NEXT J
300 NEXT M
310 NEXT I
320 GRAPHICS 5+16:IF PEEK(1600)<>252
    THEN GOSUB 20000
321 DL=PEEK(560)+256*PEEK(561)+4
322 POKE DL-1,11+64:POKE 87,6
323 FOR I=2 TO 15:POKE DL+I,11:NEXT I
325 SETCOLOR 4,1,6:SETCOLOR 0,0,14:SE
    TCOLOR 1,4,10:SETCOLOR 2,3,12
330 MSG$="{Y START ":GC=3:GX=0:GY=0
    :GOSUB 1000
340 POKE 87,5:MSG$="Energy":GC=2:GX=2
    :GY=24:GOSUB 1000
350 MSG$="Plot":GC=3:GX=3:GY=40:GOSUB
     1000
360 FOR W=1 TO 1000:NEXT W
```

```
370 GRAPHICS 8+16:DL=PEEK(560)+256*PE
    EK(561)+4
375 MSG$="Transforming Screen":GX=1:G
    Y=96:GC=3:SETCOLOR 2,1,14:GOSUB 1
    000
380 FOR I=-1 TO 200:IF PEEK(DL+I)=15
    THEN POKE DL+I,14
385 IF PEEK(DL+I)=79 THEN POKE DL+I,7
    8
390 NEXT I
395 FOR YEAR=BY TO EY:? #6;"{CLEAR}"
397 Z=0:FOR I=1 TO 12 STEP 3:SETCOLOR
     Z,INT(3*RND(0)+I),Z*2+8:Z=Z+1:NE
    XT I
400 MSG$="Energy Plot:":GC=2:GX=0:GY=
    0:GOSUB 1000
410 MSG$=F$(3):GX=12:GY=0:GC=1:GOSUB
    1000
415 MSG$="MAX":GX=17:GY=16:GC=3:GOSUB
     1000
417 MSG$="MIN":GX=17:GY=88:GC=1:GOSUB
     1000
420 FOR I=2 TO 11:A=USR(1536,1,1,4,I*
    8):NEXT I
430 A=USR(1536,26,3,4,12*8)
440 FOR I=5 TO 16:A=USR(1536,24,3,I,1
    2*8):NEXT I
441 MSG$=" JFMAMJJASOND":GX=4:GY=13*8
    :GC=1:ALT=1:GOSUB 1000
442 MSG$=" AEAPAUUUECOE":GY=GY+7:GOSU
    B 1000
443 MSG$=" NBRRYNLGPTVC":GY=GY+7:GOSU
    B 1000:ALT=0
450 MSG$="{T}FUEL":GC=1:GX=1:GY=152:G
    OSUB 1000
460 MSG$="{T}COST":GC=2:GX=8:GY=152:G
    OSUB 1000
470 MSG$="{T}RATE":GC=3:GX=15:GY=152:
    GOSUB 1000
480 MSG$="Year:":GX=7-LEN(STR$(YEAR))
    /2:GY=178:GC=2:GOSUB 1000:MSG$=ST
    R$(YEAR):GC=7:GX=GX+5:GOSUB 1000
500 FOR I=1 TO 12:Z(I)=E(YEAR-BY+1,I)
    :NEXT I:C1=1:GOSUB 2000
```

3

```
510 FOR I=1 TO 12:Z(I)=D(YEAR-BY+1,I)
    :NEXT I:C1=2:GOSUB 2000
520 FOR I=1 TO 12:Z(I)=0:IF E(YEAR-BY
    +1,I)>0 THEN Z(I)=100*D(YEAR-BY+1
    ,I)/E(YEAR-BY+1,I)
530 NEXT I:C1=3:GOSUB 2000
550 MSG$="Press RETURN":GC=2:GX=4:GY=
    136:GOSUB 1000:GET #1,A
560 NEXT YEAR
999 RUN
1000 REM SUBROUTINE TO PRINT MSG$, US
     ING TEXTPLOT
1010 REM ENTER WITH GX,GY, THE X AND
     Y COORDINATES TO START THE MESSA
     GE
1015 REM AND GC, THE COLOR (0-3)
1017 GP=GC
1020 FOR GI=1 TO LEN(MSG$)
1030 GG=USR(1536,ASC(MSG$(GI)),GC,GX+
     GI-1,GY):IF ALT THEN GC=GC*(GC<3
     )+1
1040 NEXT GI:GC=GP
1050 RETURN
2000 MAX=0:MIN=1.0E+97
2010 FOR I=1 TO 12
2020 IF Z(I)>MAX THEN MAX=Z(I)
2030 IF Z(I)<MIN THEN MIN=Z(I)
2040 NEXT I:POKE 87,7
2050 N=INT(MIN*1000)/1000:ND=8:GX=0:G
     Y=96-C1*6:GC=C1:GOSUB 3500
2060 N=INT(MAX*1000)/1000:GX=0:GY=16+
     C1*6:GOSUB 3500
2100 C2=C1+1:IF C2>3 THEN C2=1
2107 IF MAX=MIN THEN MIN=MIN-1E-04
2110 FOR I=1 TO 12
2120 X=32+I*8+C1*3:A=Z(I)
2130 Y=94-((A-MIN)/(MAX-MIN))*80
2135 IF I>1 THEN COLOR C1:DRAWTO X-1,
     Y
2140 COLOR C2:PLOT X+1,Y:PLOT X,Y-1:P
     LOT X,Y+1:PLOT X,Y
2150 NEXT I
2160 RETURN
3000 REM PRINT A TINY NUMBER
```

3

```
3001 REM ENTER WITH A=0-9, OR -2 TO P
     RINT A PERIOD
3005 IF A<0 THEN 3020
3010 ON A+1 GOSUB 3100,3110,3120,3130
     ,3140,3150,3160,3170,3180,3190
3020 IF A=-2 THEN PLOT NX+1,NY+4
3030 RETURN
3100 PLOT NX,NY:DRAWTO NX+2,NY:DRAWTO
      NX+2,NY+4:DRAWTO NX,NY+4:DRAWTO
      NX,NY:RETURN
3110 PLOT NX+1,NY:DRAWTO NX+1,NY+4:RE
     TURN
3120 PLOT NX,NY:DRAWTO NX+2,NY:DRAWTO
      NX+2,NY+2:DRAWTO NX,NY+2:DRAWTO
      NX,NY+4:DRAWTO NX+2,NY+4:RETURN

3130 PLOT NX,NY:DRAWTO NX+2,NY:DRAWTO
      NX+2,NY+4:DRAWTO NX,NY+4:PLOT N
     X+2,NY+2:DRAWTO NX,NY+2:RETURN
3140 PLOT NX,NY:DRAWTO NX,NY+2:DRAWTO
      NX+2,NY+2:DRAWTO NX+2,NY+4:DRAW
     TO NX+2,NY:RETURN
3150 PLOT NX+2,NY:DRAWTO NX,NY:DRAWTO
      NX,NY+2:DRAWTO NX+2,NY+2:DRAWTO
      NX+2,NY+4:DRAWTO NX,NY+4:RETURN
3160 PLOT NX,NY:DRAWTO NX,NY+4:DRAWTO
      NX+2,NY+4:DRAWTO NX+2,NY+2:DRAW
     TO NX,NY+2:RETURN
3170 PLOT NX,NY:DRAWTO NX+2,NY:DRAWTO
      NX+2,NY+4:RETURN
3180 PLOT NX,NY:DRAWTO NX+2,NY:DRAWTO
      NX+2,NY+4:DRAWTO NX,NY+4:DRAWTO
      NX,NY
3185 PLOT NX,NY+2:DRAWTO NX+2,NY+2:RE
     TURN
3190 PLOT NX+2,NY+4:DRAWTO NX+2,NY:DR
     AWTO NX,NY:DRAWTO NX,NY+2:DRAWTO
      NX+2,NY+2:RETURN
3500 REM PRINTS A NUMBER (N) AT POSIT
     ION GX,GY IN COLOR GC
3505 REM STRING IS CLIPPED TO LENGTH
     ND (NUMBER OF DIGITS) LEAVE OUT
     LINE 3508 IF FEATURE NOT DESIRED
3507 COLOR GC:MSG$=STR$(N)
```

3

```
3508 IF LEN(MSG$)>ND THEN MSG$=MSG$(1
     ,ND)
3510 FOR GI=1 TO LEN(MSG$)
3520 A=ASC(MSG$(GI))-48:NX=GX+(GI-1)*
     4:NY=GY:GOSUB 3000
3530 NEXT GI:RETURN
20000 ML=1536:FOR I=0 TO 252:READ A:P
      OKE ML+I,A:NEXT I:RETURN
20010 DATA 104,240,10,201,4,240
20020 DATA 11,170,104,104,202,208
20030 DATA 251,169,253,76,164,246
20040 DATA 104,133,195,104,201,128
20050 DATA 144,4,41,127,198,195
20060 DATA 170,141,250,6,224,96
20070 DATA 176,15,169,64,224,32
20080 DATA 144,2,169,224,24,109
20090 DATA 250,6,141,250,6,104
20100 DATA 104,141,251,6,104,104
20110 DATA 141,252,6,14,252,6
20120 DATA 104,104,141,253,6,133
20130 DATA 186,166,87,169,10,224
20140 DATA 3,240,8,169,20,224
20150 DATA 5,240,2,169,40,133
20160 DATA 207,133,187,165,88,133
20170 DATA 203,165,89,133,204,32
20180 DATA 228,6,24,173,252,6
20190 DATA 101,203,133,203,144,2
20200 DATA 230,204,24,165,203,101
20210 DATA 212,133,203,165,204,101
20220 DATA 213,133,204,173,250,6
20230 DATA 133,187,169,8,133,186
20240 DATA 32,228,6,165,212,133
20250 DATA 205,173,244,2,101,213
20260 DATA 133,206,160,0,162,8
20270 DATA 169,0,133,208,133,209
20280 DATA 177,205,69,195,72,104
20290 DATA 10,72,144,8,24,173
20300 DATA 251,6,5,208,133,208
20310 DATA 224,1,240,8,6,208
20320 DATA 38,209,6,208,38,209
20330 DATA 202,208,228,104,152,72
20340 DATA 160,0,165,209,145,203
20350 DATA 200,165,208,145,203,104
20360 DATA 168,24,165,203,101,207
```

```
20370 DATA 133,203,144,2,230,204
20380 DATA 200,192,8,208,183,96
20390 DATA 169,0,133,212,162,8
20400 DATA 70,186,144,3,24,101
20410 DATA 187,106,102,212,202,208
20420 DATA 243,133,213,96,0,1
20430 DATA 28
```

Program 6. Color Computer Version.

```
10 REM ENERPLOT
20 REM LOAD Z(YEAR ,12) WITH PLOT VEC
   TORS
30 CLS:PRINT:PRINT"           ENERGY P
   LOT":PRINT:PRINT:INPUT"# YEARS OF
   DATA";N:IFN=OTHENN=5
40 DIMZ(N,12),LT$(42),M$(12),E(N,12),
   D(N,12)
50 FORI=1TO12:READM$(I):NEXT
60 FORI=1TO9:READLT$(I):NEXT:FORI=17T
   042:READLT$(I):NEXT
70 PRINT:PRINT" 1)NATURAL GAS":PRINT"
    2)ELECTRICITY":PRINT" 3)COAL":PRI
   NT" 4)OIL":PRINT" 5)WOOD":PRINT"
   {9 SPACES}<CHOOSE ONE>"
80 Y$=INKEY$:IFY$<>"1"ANDY$<>"2"ANDY$
   <>"3"ANDY$<>"4"ANDY$<>"5"THEN80
90 IFY$="1"THENC$="NATGAS"ELSEIFY$="2
   "THENC$="ELECT"ELSEIFY$="3"THENC$=
   "COAL"ELSEIFY$="4"THENC$="OIL"ELSE
   IFY$="5"THENC$="WOOD"ELSE80
100 GOSUB160
110 DATAJAN,FEB,MAR,APR,MAY,JUNE,JULY
    ,AUG,SEPT,OCT,NOV,DEC
120 FORI=1TON:FORM=1TO12:Z(I,M)=E(I,M
    ):NEXT:NEXT:GOSUB190:REM PLOT ENE
    RGY
130 FORI=1TON:FORM=1TO12:Z(I,M)=D(I,M
    ):NEXT:NEXT:GOSUB190:REM PLOT COS
    T
140 FORI=1TON:FORM=1TO12:Z(I,M)=100*D
```

```
    (I,M)/E(I,M):NEXT:NEXT:GOSUB190:R
    EM PLOT ENERGY RATE
150 END
160 OPEN "I",#1,C$:INPUT#1,N,BY,EY:FO
    RI=1TON:FORM=1TO12:INPUT#1,E(I,M)
    ,D(I,M):NEXT:NEXT:CLOSE#1:RETURN
170 ' PLOT SUBROUTINE
180 ' USES MX=MAXIMUM MI=MINIMUM Z(YE
    AR,MONTH)=DATA
190 PMODE3,1:PCLS:SCREEN1,1
200 AA$="J F M A M J J A S O N D":DRA
    W"BM52,170":GOSUB310
210 AA$="A E A P A U U U E C O E":DRA
    W"BM52,181":GOSUB310:AA$="N B R R
     Y N L G P T V C":DRAW"BM52,191":
    GOSUB310
220 LINE(50,0)-(50,161),PSET:LINE(50,
    161)-(255,161),PSET
230 MX=Z(1,1):MI=MX:FORY=1TON:FORZ=1T
    012:IFZ(Y,Z)>MX THENMX=Z(Y,Z)ELSE
    IFZ(Y,Z)<MI THENMI=Z(Y,Z)
240 NEXT:NEXT:MX=INT(MX):MI=INT(MI)
250 AA$=STR$(MX):DRAW"BM0,7":GOSUB310
    :AA$=STR$(MI):DRAW"BM0,160":GOSUB
    310:AA$=STR$(INT((MX-MI)/3+MI)):D
    RAW"BM1,107":GOSUB310:AA$=STR$(IN
    T((MX-MI)/3*2+MI)):DRAW"BM1,58":G
    OSUB310
260 PR=160/(MX-MI):CO=MI*PR
270 FORYE=1TON:COLORYE+1,4
280 FORZ=1TO11:LINE(55+17.9*(Z-1),ABS
    (160-PR*Z(YE,Z)+CO))-(72.9+17.9*(
    Z-1),ABS(160-PR*Z(YE,Z+1)+CO)),PS
    ET:NEXT
290 NEXTYE
300 IFINKEY$=""THEN300ELSERETURN
310 ' LETTERS ROUTINE
320 FORI=1TOLEN(AA$):IFMID$(AA$,I,1)=
    " "THENDRAW"BM+9,0":GOTO360
330 IFMID$(AA$,I,1)="0"THENDRAWLT$(31
    ):GOTO360
```

3

```
340 DRAW"S4;C3;"
350 DRAWLT$(ASC(MID$(AA$,I,1))-48)
360 DRAW"BM+1,0":NEXT:RETURN
370 END
380 DATA"BM+1,0;BR1;U6;BM+5,+6","NR4;
    U1;E1;R1;E2;U1;H1;L2;G1;BM+7,+5",
    "BM+0,-1;F1;R2;E1;H2;E2;H1;L3;BM+
    7,6","BM+3,0;U2;NR1;L3;U1;E3;D3;B
    M+4,3","BM+0,-1;F1;R2;E1;U2;H1;L3
    ;U2;R4;BM+3,+6"
390 DATA"BM+4,-5;H1;L2;G1;D4;F1;R2;E1
    ;U1;H1;L3;BM+7,+3","U1;E4;U1;L4;B
    M+7,+6","BM+1,-0;H1;U1;E1;H1;U1;E
    1;R2;F1;D1;G1;NL2;F1;D1;G1;L2;BM+
    6,0","BM+0,-1;F1;R2;E1;U4;H1;L2;G
    1;D1;F1;R2;BM+4,+3"
400 DATA"U4;E2;F2;D2;NL4;D2;BM+3,0","
    U6;R3;F1;D1;G1;NL3;F1;D1;G1;L3;BM
    +7,0","BM+1,-0;H1;U4;E1;R2;F1;BM+
    0,+4;G1;L2;BM+6,0","U6;R3;F1;D4;G
    1;L3;BM+7,0","NR4;U3;NR2;U3;R4;BM
    +3,+6","U3;NR2;U3;R4;BM+3,+6"
410 DATA"BM+1,-0;H1;U4;E1;R2;F1;BM+0,
    +2;NL1;D2;G1;L2;BM+6,0","U3;NU3;R
    4;NU3;D3;BM+3,0","BM+2,0;U6;BM+5,
    +6","R3;E1;U5;BM+3,6","U3;NU3;R1;
    NE3;F3;BM+3,0","NU6;R4;U1;BM+3,+1
    "
420 DATA"U6;F2;ND1;E2;D6;BM+3,0","U6;
    F1;D1;F2;D1;F1;NU6;BM+3,0","BM+1,
    0;H1;U4;E1;R2;F1;D4;G1;L2;BM+6,0"
    ,"U6;R3;F1;D1;G1;L3;BM+7,3","BM+1
    ,0;H1;U4;E1;R2;F1;D3;G1;NH1;NF1;G
    1;L1;BM+6,0","U6;R3;F1;D1;G1;L2;N
    L1;F3;BM+3,0"
430 DATA"BM+0,-1;F1;R2;E1;U1;H1;L2;H1
    ;U1;E1;R2;F1;BM+3,+5","BM+2,+0;U6
    ;NL2;R2;BM+3,+6","BM+0,-1;NU5;F1;
    R2;E1;U5;BM+3,6","BM+0,-6;D2;F1;D
    1;F1;ND1;E1;U1;E1;U2;BM+3,+6","NU
    6;E2;NU1;F2;U6;BM+3,6"
```

3

```
440 DATA"U1;E4;U1;BM-4,0;D1;F4;D1;BM+
    3,0","BM+0,-6;D2;F2;ND2;E2;U2;BM+
    3,7","NR4;U1;E4;U1;L4;BM+7,6"
```

Program 7. TI-99 Version.

```
1 REM energyplot, TI version
3 REM load z(year,12) with plot vecto
  rs
10 CALL COLOR(12,4,7)
12 CALL COLOR(13,16,4)
14 CALL COLOR(14,4,6)
16 CALL COLOR(15,4,16)
18 CALL COLOR(16,4,13)
32 DEF TRC(X)=INT(X*10)/10
33 CALL CHAR(128,"181818FFFF181818")
34 CALL CHAR(129,"000000FFFF000000")
35 CALL CHAR(130,"1818181818181818")
37 CALL CHAR(137,"55AA55AA55AA55AA")
38 CALL CHAR(147,"3C3C3C3C3C3C3C3C")
40 CALL CHAR(157,"C3C3C3C3C3C3C3C3")
49 CALL CLEAR
50 PRINT TAB(10);"ENERGY PLOT": : : :
    : :
60 DIM Z(10,12),E(10,12),D(10,12)
65 REM dim set for 10 yrs of data
70 READ M$
80 PRINT "insert a tape with one of
   {3 SPACES}the following files"
85 PRINT "1) natgas, 2) elect, 3) coa
   14) oil, 5) wood": : : : :
90 PRINT "PRESS ANY KEY TO CONTINUE"
100 GOSUB 500
170 GOSUB 230
180 FOR I=1 TO N
184 FOR M=1 TO 12
186 Z(I,M)=E(I,M)
188 NEXT M
189 NEXT I
190 D$="ENERGY"
```

```
192 GOSUB 250
194 FOR I=1 TO N
196 FOR M=1 TO 12
198 Z(I,M)=D(I,M)
199 NEXT M
200 NEXT I
202 D$="COST"
203 GOSUB 250
204 FOR I=1 TO N
205 FOR M=1 TO 12
206 Z(I,M)=0
207 IF E(I,M)=0 THEN 209
208 Z(I,M)=100*D(I,M)/E(I,M)
209 NEXT M
210 NEXT I
211 D$="RATE"
212 GOSUB 250
214 END
220 REM get data, n=# yrs, by=beg yr,
     ey=end yr, e()=energy, d()=cost
230 OPEN #2:"CS1",INTERNAL,INPUT ,FIX
    ED 128
232 INPUT #2:C$,N,BY,EY
234 FOR I=1 TO N
236 INPUT #2:E(I,1),D(I,1),E(I,2),D(I
    ,2),E(I,3),D(I,3),E(I,4),D(I,4),E
    (I,5),D(I,5),E(I,6),D(I,6),E(I,7)
    ,D(I,7)
237 INPUT #2:E(I,8),D(I,8),E(I,9),D(I
    ,9),E(I,10),D(I,10),E(I,11),D(I,1
    1),E(I,12),D(I,12)
238 NEXT I
239 CLOSE #2
240 RETURN
250 REM plot subroutine, mx = max, mi
    =min, z(year,month)=data
260 GOSUB 360
265 GOSUB 400
270 FOR I=1 TO N
271 S=10*(I-1)
```

```
272 IF S<31 THEN 276
273 S=-10*(I-4)
276 FOR M=1 TO 12
280 X=2*M
282 Y=21-(Z(I,M)-MI)*PR
284 GOSUB 310
286 NEXT M
290 GOSUB 500
300 NEXT I
305 RETURN
310 REM bargraph enter with x & y, co
    =color
320 XX=X+8
322 Y=INT(Y)
323 CALL GCHAR(Y,XX,QQ)
325 IF Y<22 THEN 330
326 RETURN
330 FOR II=Y TO 21
332 CALL GCHAR(II,XX,Q)
334 IF Q<>QQ THEN 337
335 NEXT II
337 II=II-1
350 CALL VCHAR(Y,XX,127+S,II-Y+1)
355 RETURN
360 REM scaling
370 MX=Z(1,1)
371 MI=MX
372 FOR I=1 TO N
373 FOR M=1 TO 12
374 X=Z(I,M)
375 IF X<MX THEN 378
376 MX=X
378 IF X>MI THEN 390
379 MI=X
390 NEXT M
392 NEXT I
394 MX=INT(MX+1)
396 MI=INT(MI)
398 PR=20/(MX-MI)
399 RETURN
400 CALL CLEAR
404 PRINT D$&"{6 SPACES}"&C$
```

```
410 FOR I=4 TO 1 STEP -1
412 Y=TRC(MI+I*4/PR)
413 PRINT STR$(Y)
415 PRINT : : : :
416 NEXT I
417 PRINT STR$(MI)
418 PRINT M$
420 CALL HCHAR(22,9,129,25)
425 CALL VCHAR(2,9,130,21)
427 FOR I=2 TO 22 STEP 5
429 CALL VCHAR(I,9,128,1)
430 NEXT I
435 CALL HCHAR(23,32,100,1)
440 RETURN
450 DATA "{7 SPACES}j f m a m j j a s
     o n"
462 CALL VCHAR(2,I,32,19)
500 CALL KEY(3,Y,ST)
510 IF ST=0 THEN 500
515 Y=Y-48
520 RETURN
1000 CALL COLOR(11,16,4)
1002 CALL CHAR(117,"181818FFFF181818"
     )
1005 CALL HCHAR(12,16,117,5)
1010 GOTO 1010
```

Program 8. Apple Version.

```
100  REM  ENERGY PLOT - APPLE VERSION
101  LOMEM: 24576
110 D$ =  CHR$ (4)
115  DIM E(10,12),D(10,12),F(10,12),Z(12)
117  DIM CS$(26),NS$(9)
120  TEXT : HOME
130  INVERSE : HTAB 15: PRINT "ENERGY PLOT":
      NORMAL
140  PRINT : PRINT : PRINT "SELECT FILE:": PRINT
     : PRINT
160  PRINT " ATURAL GAS": PRINT : PRINT " LE
     CTRICITY": PRINT : PRINT " OAL": PRINT
```

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```
     : PRINT " IL": PRINT : PRINT " OOD"
165  INVERSE : VTAB 7: PRINT "N": PRINT : PRINT
     "E": PRINT : PRINT "C": PRINT : PRINT "
     O": PRINT : PRINT "W"
170  PRINT : NORMAL : PRINT "PRESS ONE LETTE
     R:";: GET A$: IF A$ =  CHR$ (27) THEN  HOME
     : END
175 F$ = ""
180  IF A$ = "N" THEN F$ = "NATGAS"
190  IF A$ = "E" THEN F$ = "ELECT"
200  IF A$ = "C" THEN F$ = "COAL"
210  IF A$ = "O" THEN F$ = "OIL"
220  IF A$ = "W" THEN F$ = "WOOD"
225  IF F$ = "" THEN  RUN
230  FLASH : PRINT : PRINT : PRINT "READING
     FILE": NORMAL
235  ONERR  GOTO 250
240  PRINT D$;"OPEN";F$: PRINT D$;"READ";F$
245  GOTO 260
250  PRINT D$;"CLOSE";F$: HOME : INVERSE : PRINT
     "CAN'T READ THE FILE!": PRINT : NORMAL
     : PRINT "PRESS A KEY TO TRY AGAIN...";:
      GET A$: RUN
260  INPUT N,BY,EY
270  FOR I = 1 TO N
280  FOR M = 1 TO 12
290  INPUT E(I,M): INPUT D(I,M)
300  NEXT M
310  NEXT I
311  PRINT D$;"CLOSE";F$
312  POKE 216,0
320  HGR : HOME : GOSUB 20000
330 MSG$ = "APPLE II":GC = 7:GX = 0:GY = 0:S
     C = 4: GOSUB 1000
340 MSG$ = "ENERGY":GX = 1:GY = 60: GOSUB 10
     00
350 MSG$ = "PLOT":GX = 2:GY = 100: GOSUB 100
     0
360  FOR W = 1 TO 1000: NEXT W
380  FOR YEAR = BY TO EY
390  HGR : HOME
400 MSG$ = "ENERGY PLOT":GC = 7:GX = 0:GY =
     0:SC = 2: GOSUB 1000
410 MSG$ = F$:GX = 24:GY = 0:GC = 7:SC = 1: GOSUB
     1000
415 MSG$ = "MAX":SC = 1:GX = 20:GY = 16:GC =
     7: GOSUB 1000
```

```
417 MSG$ = "MIN":GX = 20:GY = 88:GC = 7: GOSUB
    1000
420  HCOLOR= 7: HPLOT 40,16 TO 40,96: FOR I =
    2 TO 11: HPLOT 40,I * 8 TO 44,I * 8: NEXT

440  HPLOT 40,96 TO 152,96: FOR I = 7 TO 18:
     HPLOT I * 8 + 4,96 TO I * 8 + 4,94: NEXT

441 MSG$ = "JFMAMJJASOND":GX = 7:GY = 13 * 8
    :GC = 7: GOSUB 1000
442 MSG$ = "AEAPAUUUECOE":GY = GY + 7: GOSUB
    1000
443 MSG$ = "NBRRYNLGPTVC":GY = GY + 7: GOSUB
    1000
450 GG = 64:GC = 1:GX = 8:GY = 152: GOSUB 15
    00:MSG$ = "FUEL":GC = 7:GX = 2: GOSUB 1
    000
460 GG = 64:GC = 2:GX = 64:GY = 152: GOSUB 1
    500:MSG$ = "COST":GC = 7:GX = 9: GOSUB
    1000
470 GG = 64:GC = 3:GX = 120:GY = 152: GOSUB
    1500:MSG$ = "RATE":GC = 7:GX = 16: GOSUB
    1000
480 MSG$ = "YEAR":GX = 11 -  LEN ( STR$ (YEA
    R)) / 2:GY = 140:GC = 7: GOSUB 1000:ND =
    4:N = YEAR:SC = 1:GX = GX + 14: GOSUB 3
    500
500  FOR I = 1 TO 12:Z(I) = E(YEAR - BY + 1,
    I): NEXT :C1 = 1: GOSUB 2000
510  FOR I = 1 TO 12:Z(I) = D(YEAR - BY + 1,
    I): NEXT :C1 = 2: GOSUB 2000
520  FOR I = 1 TO 12:Z(I) = 0: IF E(YEAR - B
    Y + 1,I) > 0 THEN Z(I) = 100 * D(YEAR -
    BY + 1,I) / E(YEAR - BY + 1,I)
530  NEXT I:C1 = 3: GOSUB 2000
550  VTAB 23: PRINT "PRESS ";: INVERSE : PRINT
    "RETURN";: NORMAL : PRINT "...";: GET A
    $
560  NEXT YEAR
999  RUN
1000  REM  SUBROUTINE TO PRINT ALPHA TEXT IN
     MSG$
1010  REM  ENTER WITH GX,GY THE X,Y COORDINA
    TES TO START THE MESSAGE
1015  REM  AND GC, THE HCOLOR
1016  IF MSG$ = "" THEN  RETURN
```

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```
1017 X2 = GX:GX = GX * 8 * SC
1020  FOR GI = 1 TO  LEN (MSG$)
1030 GG =  ASC ( MID$ (MSG$,GI)): IF GG > 63
     THEN  GOSUB 1500
1037 GX = GX + 8 * SC
1040  NEXT GI:GX = X2
1050  RETURN
1400  REM  SUBROUTINE TO PRINT CHARACTER GG
     AT GX,GY IN COLOR GC
1500  HCOLOR= GC:CS$ = CS$(GG - 64)
1510  FOR CI = 1 TO  LEN (CS$) STEP 2
1520 D1$ =  MID$ (CS$,CI,1):D2$ =  MID$ (CS$
     ,CI + 1,1)
1530 X =  VAL (D1$) * SC:Y =  VAL (D2$) * SC

1540  IF D1$ = "/" THEN STP = 1: GOTO 1580
1550  IF CI > 1 AND STP = 0 THEN  HPLOT  TO
     GX + X,GY + Y
1560  HPLOT GX + X,GY + Y:STP = 0
1580  NEXT CI
1590  RETURN
2000 MAX = 0:MIN =  - 1
2010  FOR I = 1 TO 12
2020  IF Z(I) > MAX THEN MAX = Z(I)
2030  IF (Z(I) < MIN) THEN MIN = Z(I)
2040  NEXT
2050 N =  INT (MIN * 1000) / 1000:ND = 8:GX =
     1:GY = 96 - C1 * 7: GOSUB 3500: HCOLOR=
     C1: HPLOT 0,GY TO 1,GY TO 1,GY + 1 TO 0
     ,GY + 1
2060 N =  INT (MAX * 1000) / 1000:GX = 1:GY =
     16 + C1 * 7: GOSUB 3500: HCOLOR= C1: HPLOT
     0,GY TO 1,GY TO 1,GY + 1 TO 0,GY + 1
2100 C2 = C1 + 4
2107  IF (MAX = MIN) THEN MIN = MIN - .0001
2110  FOR I = 1 TO 12
2120 X = 52 + I * 8 + C1 * 3:A = Z(I)
2130 Y = 94 - ((A - MIN) / (MAX - MIN)) * 80

2135  IF I > 1 THEN  HCOLOR= C1: HPLOT  TO X
      - 1,Y
2140  HPLOT X + 1,Y TO X + 1,Y + 1 TO X - 1,
     Y + 1 TO X - 1,Y TO X,Y
2150  NEXT
2160  RETURN
3000  REM  PRINTS SMALL NUMBER IN A
```

```
3010  REM    (0-9). A=-2 PLOTS PERIOD
3020  IF A > 57 THEN  RETURN
3030  IF A =  - 2 THEN  HPLOT GX + 1,GY + 5:
      RETURN
3040 CS$ = NS$(A): HCOLOR= 7: GOTO 1510
3500  REM  PRINTS A FULL NUMBER
3510  REM  (N) AT GX,GY.  ND
3520  REM  CLIPS STRING TO GIVEN LENGTH
3530  REM  SET ND=255 IF YOU DON'T USE IT
3540 MSG$ =  LEFT$ ( STR$ ( ABS (N)),ND)
3550 X2 = GX:GX = GX * 5 * SC
3560  FOR I = 1 TO  LEN (MSG$)
3570 A =  ASC ( MID$ (MSG$,I)) - 48
3580  GOSUB 3000:GX = GX + 5 * SC
3590  NEXT :GX = X2
3600  RETURN
20000  REM  LOADS CS$ WITH LETTERS
20005  RESTORE
20010  FOR I = 0 TO 26: READ CS$(I): NEXT
20011  FOR I = 0 TO 9: READ NS$(I): NEXT
20012  RETURN
20015  DATA  0050//0151//0252//0353//0454//0
     555
20020  DATA  05005055//0353
20030  DATA  33300005555303
20040  DATA  50000555
20050  DATA  533000055553
20060  DATA  50000555//0333
20070  DATA  050050//0333
20080  DATA  500005555333
20090  DATA  0005//5055//0353
20100  DATA  0050//0555//3035
20110  DATA  053530//0050
20120  DATA  0005//0350//0355
20130  DATA  000555
20140  DATA  05005055//3033
20150  DATA  050030355550
20160  DATA  0050550500
20170  DATA  0500505303
20180  DATA  0050550500//3355
20185  DATA  050030335355//0333
20190  DATA  500003535505
20200  DATA  0050//3035
20210  DATA  00055550
20220  DATA  000333355550
20230  DATA  00055550//3533
```

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```
20240   DATA   0055//5005
20250   DATA   00035350//3335
20260   DATA   00500555
20270   REM   NUMBERS 0-9
20280   DATA   0030350500,3035,003033030535,00
      30333505//3303,00033335//3033,300003333
      505,300005353303,003035,003035050333//0
      003,3530000333
```

4

Electric Usage Estimator

4

Electric Usage Estimator

As electric rates continue to rise, it is important to understand how much electricity each of our electrical appliances uses so that we can better manage our personal resources. This program will allow you to make a quick estimate of the cost you incur each year from each appliance, based upon your current (or projected) utility rate. The program will also sum these costs by appliance group and calculate a grand total for all appliances.

The data used in this program are the watts and kilowatt-hours for each appliance. (I have added several appliances to the list based upon my usage.) The wattage of each appliance is easily obtained by reading the specification plate on the appliance (it usually gives the wattage or the amperage). Otherwise, you can measure the amperage with an amp meter and multiply that by the voltage to get watts.

However, it is more difficult to determine the number of hours per year that an appliance runs in order to calculate the kilowatt-hours. Some appliances — such as television sets, radios, washing machines, etc. — are turned on and off, so you can make an estimate of the number of hours the appliance is in use. Refrigerators and freezers are a notable exception, however, since the on/off cycle is dictated by a thermostat. Because of this, we are restricted to using the published figures for an average household for these items.

The data in the program are organized according to the appliance name, followed by the average watts and kilowatt hours. The average watts are not used by the program, but are included so that the user can modify the watts or the number of hours the appliance is operated per year (and thereby modify the number of kilowatt-hours). Each of the seven appliance groups is separated in the data statements by a xxx (followed by two zeros). When this condition is met, the cost of that appliance group (SK) is printed, is reset to zero, and another group is processed. After the seventh group is printed, the total cost for all appliances is printed. Organizing the program and DATA statements in this way allows

the user to add to or delete items from each of the seven groups without having to reset counters for each appliance group.

Two significant electrical usage items are omitted from the program: central air conditioning and lighting. Lighting costs are highly variable due to the situation and people involved, and air conditioning is a function of the region as well as of the personal taste of the homeowner.

Reference

Hart, G. K., and the Editors of U. S. News & World Report Books. *How to Cut Your Energy Costs, A Guide to Major Savings at Home and on the Road.* Washington, D. C.: U. S. News & World Report Books, 1978.

Sample Run.

```
                ELECTRIC USAGE ESTIMATOR

------------------------------------------------------------
ELECTRICITY COST IN CENTS/KWH (E.G., 5.14)= ? 6.55

------------------------------------------------------------
RESPOND WITH NUMBER OF APPLIANCES USED IN HOME

------------------------------------------------------------
             FOOD PREPARATION APPLIANCES
BLENDER? 1
                                ANNUAL COST = $0.06
BROILER? 0
CARVING KNIFE? 0
COFFEE MAKER? 1
                                ANNUAL COST = $6.94
DEEPFRYER? 1
                                ANNUAL COST = $5.43
DISHWASHER? 1
                                ANNUAL COST = $23.77
EGG COOKER? 0
FRYING PAN? 1
                                ANNUAL COST = $6.55
HOT PLATE? 0
MIXER? 1
                                ANNUAL COST = $0.13
MICROWAVE OVEN? 1
                                ANNUAL COST = $12.44
OVEN? 1
                                ANNUAL COST = $78.92
ROASTER? 0
SANDWICH GRILL? 0
TOASTER? 1
                                ANNUAL COST = $2.55
TRASH COMPACTOR? 0
```

```
WAFFLE IRON? 1
                                ANNUAL COST = $1.31
DISPOSAL? 1
                                ANNUAL COST = $0.45

------------------------------------------------------------
COST OF FOOD PREPARATION APPLIANCES PER YEAR = $138.59

------------------------------------------------------------
                FOOD PRESERVATION APPLIANCES
FREEZER(MANUAL DEFROST)? 0

FREEZER(AUTO DEFROST)? 1
                                ANNUAL COST = $128.7
REFRIGERATOR/FREEZER(AUTO DEFROST)? 1
                                ANNUAL COST = $117.57
REFRIGERATOR/FREEZER(MANUAL DEFROST)? 0


------------------------------------------------------------
COST OF FOOD PRESERVATION APPLIANCES PER YEAR = $246.28

------------------------------------------------------------
                LAUNDRY APPLIANCES
CLOTHES DRYER? 1
                                ANNUAL COST = $65.04
HAND IRON? 1
                                ANNUAL COST = $3.93
WASHING MACHINE? 1
                                ANNUAL COST = $6.74
ELECTRIC WATER HEATER? 0

QUICK RECOVERY ELECTRIC WATER HEATER? 0


------------------------------------------------------------
COST OF LAUNDRY APPLIANCES PER YEAR = $75.71

------------------------------------------------------------
                AIR CONDITIONING APPLIANCES
AIR CLEANER? 0

ROOM AIRCONDITIONER? 0

ELECTRIC BLANKET? 0

DEHUMIDIFIER? 0

ATTIC FAN? 1
                                ANNUAL COST = $19.06
CIRCULATING FAN? 0

ROLLAWAY FAN? 0

CEILING FAN? 1
                                ANNUAL COST = $2.62
FAN(WINDOW)? 0

HEATER(PORTABLE)? 0

HEATING PAD? 0

HUMIDIFIER? 0
```

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```
------------------------------------------------------------
COST OF AIR CONDITIONING APPLIANCES PER YEAR = $21.68
------------------------------------------------------------
                HEALTH & BEAUTY APPLIANCES
GERMICIDAL LAMP? 0

HAIRDRYER? 2
                                ANNUAL COST = $1.83
INFRARED HEAT LAMP? 0

SHAVER? 0

SUNLAMP? 0

ELECTRIC TOOTHBRUSH? 0

VIBRATOR? 1
                                ANNUAL COST = $0.13
------------------------------------------------------------
COST OF HEALTH & BEAUTY APPLIANCES PER YEAR = $1.96
------------------------------------------------------------
                HOME ENTERTAINMENT APPLIANCES
RADIO? 2
                                ANNUAL COST = $11.26
RADIO-RECORD PLAYER? 2
                                ANNUAL COST = $14.27
MICROCOMPUTER? 2
                                ANNUAL COST = $9.17
B & W TV (SOLID STATE)? 2
                                ANNUAL COST = $13.1
B & W (TUBE TYPE)? 0

COLOR TV (TUBE TYPE)? 0

COLOR TV (SOLID STATE)? 2
                                ANNUAL COST = $13.1
------------------------------------------------------------
COST OF HOME ENTERTAINMENT APPLIANCES PER YEAR = $60.91
------------------------------------------------------------
                HOUSEWARES APPLIANCES
CLOCK? 4
                                ANNUAL COST = $4.45
FLOOR POLISHER? 0

SEWING MACHINE? 1
                                ANNUAL COST = $0.72
VACUUM CLEANER? 2
                                ANNUAL COST = $6.02
------------------------------------------------------------
COST OF HOUSEWARES APPLIANCES PER YEAR = $11.2
------------------------------------------------------------

------------------------------------------------------------
TOTAL ANNUAL APPLIANCE COST = $556.35
```

Program 1. OSI Version.

```
10 DEFFNA(X)=INT(X*100)/100:REM ELECTRIC USAGE ESTIMATOR
30 FORI=1TO20:PRINT:NEXT
40 PRINTTAB(20);"ELECTRIC USAGE ESTIMATOR":GOSUB450
50 INPUT"ELECTRICITY COST IN CENTS/KWH(E.G. 5.14)= ";C:GOSUB450
60 PRINT"RESPOND WITH NUMBER OF APPLIANCES USED IN HOME"
70 C=C/100:FORI=1TO7:READQ$(I):NEXT:GOSUB450
80 SW=0:FORJ=1TO7:SK=0:PRINTTAB(15);Q$(J);" APPLIANCES"
90 READA$,W,K:IFASC(A$)=42ANDK=0THEN130
100 PRINTA$;:INPUTN
110 IFN>0THENSK=SK+K*N:PRINTTAB(25);"ANNUAL COST= $";FNA(C*K*N):GOTO90
120 PRINT:GOTO90
130 GOSUB450:PRINT"COST OF ";Q$(J);" APPLIANCES PER YEAR = $";FNA(C*SK)
140 GOSUB450:SW=SW+SK:NEXT:GOSUB450
150 PRINT"TOTAL ANNUAL APPLIANCE COST= ";FNA(SW*C):END
160 DATAFOOD PREPARATION,FOOD PRESERVATION,LAUNDRY, AIRCONDITIONING
170 DATAHEALTH & BEAUTY, HOME ENTERTAINMENT, HOUSEWARES
180 DATABLENDER,300,1,BROILER,1140,85,CARVING KNIFE,92,8
190 DATACOFFEE MAKER,894,106,DEEP FRYER,1448,83,DISHWASHER,1201,363
200 DATAEGG COOKER,516,14,FRYING PAN,1196,100,HOT PLATE,1200,90
210 DATAMIXER,127,2,MICROWAVE OVEN,1450,190,OVEN,12200,1205
220 DATAROASTER,1333,60,SANDWICH GRILL,1161,33,TOASTER,1146,39
230 DATATRASH COMPACTOR,400,50,WAFFLE IRON,1200,20,DISPOSAL,445,7
240 DATA***,0,0
250 DATAFREEZER(MANUAL DEFROST),480,1320,FREEZER(AUTO DEFROST),480,1965
260 DATAREFRIGERATOR/FREEZER(AUTO DEFROST),540,1795
270 DATAREFRIGERATOR/FREEZER(MANUAL DEFROST),540,700
```

```
280 DATA***,0,0,CLOTHES DRYER,4856,993,HAND IRON,1100,60
290 DATAWASHING MACHINE,512,103,ELECTRIC WATER HEATER,2475,4219
300 DATAQUICK RECOVERY ELECTRIC WATER HEATER,4474,4811,***,0,0
310 DATAAIR CLEANER,50,216,ROOM AIRCONDITIONER,860,860
320 DATAELECTRIC BLANKET,177,147,DEHUMIDIFIER,257,377
330 DATAATTIC FAN,370,291,CIRCULATING FAN,88,43,ROLLAWAY FAN,171,138
340 DATACEILING FAN,70,40
350 DATAFAN(WINDOW),200,170,HEATER(PORTABLE),1322,176
360 DATAHEATING PAD,65,10,HUMIDIFIER,177,163
370 DATA***,0,0,GERMIDICAL LAMP,20,141,HAIRDRYER,381,14
380 DATAINFRARED HEAT LAMP,250,13,SHAVER,15,0.5,SUNLAMP,279,16
390 DATAELECTRIC TOOTHBRUSH,1.1,1,VIBRATOR,40,2,***,0,0
400 DATARADIO,71,86,RADIO-RECORD PLAYER,109,109,MICRO-COMPUTER,180,70
410 DATAB & W TV (SOLID STATE),45,100,B & W TV (TUBE TYPE),100,220
420 DATACOLOR TV (TUBE TYPE),240,528,COLOR TV (SOLID STATE),145,100
430 DATA***,0,0,CLOCK,2,17,FLOOR POLISHER,305,15,SEWING MACHINE,75,11
440 DATAVACUUM CLEANER,630,46,***,0,0
450 PRINT:GOSUB460:PRINT:RETURN
460 PRINT"------------------------------------------------------------------"
470 RETURN
480 REM A$=APPLIANCE, W=AVG WATTS, K=ANNUAL KWH, N=# OF APPLIANCES
490 REM K MAY BE ADJUSTED BY THE USER  BY DETERMINING
500 REM THE NUMBER OF HOURS PER YEAR THE APPLIANCE IS USED AND
510 REM CALCULATING K=WATTS*HOURS/1000.
520 REM SW= SUM ANNUAL KWH FOR ALL APPLIANCES
530 REM SK= SUM ANNUAL KWH FOR EACH APPLIANCE GROUP
540 REM Q$= NAME OF EACH OF 7 GROUPS OF APPLIANCES
```

Program 2. VIC Version.

```
5 REM ELECTRIC USAGE ESTIMATOR  VIC VERSION
10 DEF FNA(X)=INT(X*100)/100:DEF FNP1(A)=L-LE
    N(STR$(A))+1
30 L=18:PRINT"ELECTRC USAGE ESTIMATR":GOSUB46
    0
50 PRINT"ELECTRICITY COST IN":PRINT"CENTS/KWH
    (E.G. 5.14)=":INPUTC:PRINT"{CLEAR}"
60 PRINT"RESPOND WITH NUMBER OFAPPLIANCES USE
    D IN    HOME"
70 C=C/100:FORI=1TO7:READQ$(I):NEXT:GOSUB460
80 SW=0:FORJ=1TO7:SK=0:PRINTQ$(J):PRINT"    A
    PPLIANCES":PRINTTAB(15);"COST"
90 READA$,W,K:IFASC(A$)=42ANDK=0THEN125
100 N=0:PRINTA$;:INPUTN
110 V=FNA(C*K*N):X=V:IFN>0THENSK=SK+K*N:GOSUB4
    50:PRINT"$";X:GOTO90
120 PRINT:GOTO90
125 PRINTTAB(8);"WAIT":FORX=1TO2000:NEXT
130 GOSUB460:PRINT"COST OF ";Q$(J);" APPLIANCE
    S PER YEAR = ":PRINT"$";FNA(C*SK)
140 GOSUB460:SW=SW+SK:NEXT:GOSUB460
150 PRINT"TOTAL ANNUAL APPLIANCE COST= ";FNA(S
    W*C):END
160 DATA FOOD PREPARATION,FOOD PRESERVATION,LA
    UNDRY,AIR CONDITIONING
170 DATAHEALTH & BEAUTY,HOME ENTERTAINMENT,HOU
    SEWARES
180 DATABLENDER,300,1,BROILER,1140,85,CARVING ~
    KNIFE,92,8
190 DATACOFFEE MAKER,894,106,DEEP FRYER,1448,8
    3,DISHWASHER,1201,363
200 DATAEGG COOKER,516,14,FRYING PAN,1196,100,
    HOT PLATE,1200,90
210 DATAMIXER,127,2,MICROWAVE OVEN,1450,190,OV
    EN,12200,1205
220 DATAROASTER,1333,60,SANDWICH GRILL,1161,33
    ,TOASTER,1146,39
230 DATATRASH COMPACTOR,400,50,WAFFLE IRON,120
    0,20,DISPOSAL,445,7
240 DATA***,0,0
250 DATAFREEZER(MAN DEFROST),480,1320,FREEZER(
    AUTODEFROST),480,1965
260 DATAREFRIGFREEZR-AUTODEF,540,1795
```

```
270 DATAREFRIG/FREEZR-MANDEF,540,700
280 DATA***,0,0,CLOTHES DRYER,4856,993,HAND IR
    ON,1100,60
290 DATAWASHING MACHINE,512,103,ELEC WATER HEA
    TER,2475,4219
300 DATAQUICK REC WATR HEATR,4474,4811,***,0,0

310 DATAAIR CLEANER,50,216,ROOM AIRCONDITIONER
    ,860,860
320 DATAELECTRIC BLANKET,177,147,DEHUMIDIFIER,
    257,377
330 DATAATTIC FAN,370,291,CIRCULATING FAN,88,4
    3,ROLLAWAY FAN,171,138
340 DATACEILING FAN,70,40
350 DATAFAN(WINDOW),200,170,HEATER(PORTABLE),1
    322,176
360 DATAHEATING PAD,65,10,HUMIDIFIER,177,163
370 DATA***,0,0,GERMICIDAL LAMP,20,141,HAIRDRY
    ER,381,14
380 DATAINFRARED HEAT LAMP,250,13,SHAVER,15,0.
    5,SUNLAMP,279,16
390 DATAELECTRIC TOOTHBRUSH,1.1,1,VIBRATOR,40,
    2,***,0,0
400 DATARADIO,71,86,RADIO-RECORD PLAYER,109,10
    9,MICROCOMPUTER,180,70
410 DATAB&W TV(SOLID STATE),45,100,B&W TV(TUB
    TYPE),100,220
420 DATACOLOR TV(TUBE TYPE),240,528,COLOR TV(S
    OLID STATE,145,100
430 DATA***,0,0,CLOCK,2,17,FLOOR POLISHER,305,
    15,SEWING MACHINE,75,11
440 DATAVACUUM CLEANER,630,46,***,0,0
450 V=FNP1(V):PRINTTAB(V);:RETURN
460 PRINT"----------------------":RETURN
```

Program 3. Microsoft Version.

```
5 REM ELECTRIC USAGE ESTIMATOR
10 DEF FNA(X)=INT(X*100)/100
30 L=18:PRINT"{CLEAR}          ELECTRC USAGE ES
    TIMATOR":GOSUB460
50 PRINT"ELECTRICITY COST IN":INPUT"CENTS/KWH
    (E.G. 5.14)=";C:PRINT""
60 PRINT"RESPOND WITH NUMBER OF APPLIANCES US
```

```
    ED{RIGHT} IN HOME"
70 C=C/100:FORI=1TO7:READQ$(I):NEXT:GOSUB460
80 SW=0:FORJ=1TO7:SK=0:PRINTQ$(J);" APPLIANCE
    S";:PRINTTAB(30);"COST":GOSUB460
90 READA$,W,K:IFASC(A$)=42ANDK=0THEN125
100 N=0:PRINTA$;:INPUTN
110 V=FNA(C*K*N):X=V:IFN>0THENSK=SK+K*N:GOSUB4
    50:PRINT"{UP}$";X:GOTO90
120 PRINT:GOTO90
125 PRINTTAB(16);"WAIT":FORX=1TO2000:NEXT
130 PRINT"{CLEAR}":GOSUB460:PRINT"COST OF ";Q$
    (J);" APPLIANCES PER YEAR = ":PRINT"$
    ";FNA(C*SK)
140 GOSUB460:SW=SW+SK:NEXT:GOSUB460
150 PRINT"TOTAL ANNUAL APPLIANCE COST= ";FNA(S
    W*C):END
160 DATA FOOD PREPARATION,FOOD PRESERVATION,LA
    UNDRY,AIR CONDITIONING
170 DATAHEALTH & BEAUTY,HOME ENTERTAINMENT,HOU
    SEWARES
180 DATABLENDER,300,1,BROILER,1140,85,CARVING ~
    KNIFE,92,8
190 DATACOFFEE MAKER,894,106,DEEP FRYER,1448,8
    3,DISHWASHER,1201,363
200 DATAEGG COOKER,516,14,FRYING PAN,1196,100,
    HOT PLATE,1200,90
210 DATAMIXER,127,2,MICROWAVE OVEN,1450,190,OV
    EN,12200,1205
220 DATAROASTER,1333,60,SANDWICH GRILL,1161,33
    ,TOASTER,1146,39
230 DATATRASH COMPACTOR,400,50,WAFFLE IRON,120
    0,20,DISPOSAL,445,7
240 DATA***,0,0
250 DATAFREEZER(MAN DEFROST),480,1320,FREEZER(
    AUTODEFROST),480,1965
260 DATAREFRIGFREEZR-AUTODEF,540,1795
270 DATAREFRIG/FREEZR-MANDEF,540,700
280 DATA***,0,0,CLOTHES DRYER,4856,993,HAND IR
    ON,1100,60
290 DATAWASHING MACHINE,512,103,ELEC WATER HEA
    TER,2475,4219
300 DATAQUICK REC WATR HEATR,4474,4811,***,0,0

310 DATAAIR CLEANER,50,216,ROOM AIR CONDITIONE
    R,860,860
```

```
320 DATAELECTRIC BLANKET,177,147,DEHUMIDIFIER,
    257,377
330 DATAATTIC FAN,370,291,CIRCULATING FAN,88,4
    3,ROLLAWAY FAN,171,138
340 DATACEILING FAN,70,40
350 DATAFAN(WINDOW),200,170,HEATER(PORTABLE),1
    322,176
360 DATAHEATING PAD,65,10,HUMIDIFIER,177,163
370 DATA***,0,0,GERMICIDAL LAMP,20,141,HAIRDRY
    ER,381,14
380 DATAINFRARED HEAT LAMP,250,13,SHAVER,15,0.
    5,SUNLAMP,279,16
390 DATAELECTRIC TOOTHBRUSH,1.1,1,VIBRATOR,40,
    2,***,0,0
400 DATARADIO,71,86,RADIO-RECORD PLAYER,109,10
    9,MICROCOMPUTER,180,70
410 DATAB&W TV(SOLID STATE),45,100,B&W TV(TUB ~
    TYPE),100,220
420 DATACOLOR TV(TUBE TYPE),240,528,COLOR TV(S
    OLID STATE,145,100
430 DATA***,0,0,CLOCK,2,17,FLOOR POLISHER,305,
    15,SEWING MACHINE,75,11
440 DATAVACUUM CLEANER,630,46,***,0,0
450 PRINTTAB(30);:RETURN
460 PRINT"-----------------------------------
    ---":RETURN
```

Program 4. Atari Version.

```
5 REM ** ELECTRIC USAGE ESTIMATOR **
8 REM *** ATARI VERSION ***
10 DIM Q$(20*8),QL(7),TT$(40),A$(40)
20 ? CHR$(125)
30 POKE 85,4:? "ELECTRIC USAGE ESTIMA
   TOR":GOSUB 430
40 ? "ELECTRICITY COST IN CENTS/KWH":
   ? "(E.G., 5.14)= ";:INPUT C
50 GOSUB 430:? "RESPOND WITH NUMBER O
   F APPLIANCES":? "USED IN HOME"
60 C=C/100:GOSUB 430:FOR I=1 TO 7:REA
   D TT$:Q$(I*20+1)=TT$:QL(I)=LEN(TT$
   ):NEXT I
70 SW=0:FOR J=1 TO 7:SK=0:POKE 85,5:?
```

```
    Q$(J*20+1,J*20+QL(J));" APPLIANCE
   S"
80 ? :READ A$,W,K:IF ASC(A$)=42 AND K
   =0 THEN 120
90 TRAP 90:? A$;:INPUT N:TRAP 40000
100 IF N>0 THEN SK=SK+K*N:? "ANNUAL C
    OST=$";
105 IF N>0 THEN TT=C*K*N:PRINT INT(TT
    *100)/100:GOTO 80
110 ? :GOTO 80
120 GOSUB 430:? "COST OF ";Q$(J*20+1,
    J*20+QL(J)):? "APPLIANCES PER YEA
    R = $";
125 TT=INT(C*SK*100)/100:PRINT TT
130 GOSUB 430:SW=SW+SK:NEXT J:GOSUB 4
    30
140 PRINT "TOTAL ANNUAL APPLIANCE COS
    T= $";INT(SW*C*100)/100:END
150 DATA FOOD PREPARATION,FOOD PRESER
    VATION,LAUNDRY,AIR CONDITIONING
160 DATA HEALTH & BEAUTY,HOME ENTERTA
    INMENT,HOUSEWARES
170 DATA BLENDER,300,1,BROILER,1140,8
    5,CARVING KNIFE,92,8
180 DATA COFFEE MAKER,894,107,DEEPFRY
    ER,1448,83,DISHWASHER,1201,363
190 DATA EGG COOKER,516,14,FRYING PAN
    ,1196,100,HOT PLATE,1200,90
200 DATA MIXER,127,2,MICROWAVE OVEN,1
    450,190,OVEN,12200,1205
210 DATA ROASTER,1333,60,SANDWICH GRI
    LL,1161,33,TOASTER,1146,39
220 DATA TRASH COMPACTOR,400,50,WAFFL
    E IRON,1200,20,DISPOSAL,445,7
230 DATA ***,0,0
240 DATA FREEZER(MANUAL DEFROST),480,
    1320,FREEZER(AUTO DEFROST),480,19
    65
250 DATA REFRIGERATOR/FREEZER(AUTO DE
    FROST),540,1795
260 DATA REFRIGERATOR/FREEZER(MANUAL
    DEFROST),540,700
```

4

```
270 DATA ***,0,0,CLOTHES DRYER,4856,9
    93,HAND IRON,1100,60
280 DATA WASHING MACHINE,512,103,ELEC
    TRIC WATER HEATER,2475,4219
290 DATA QUICK RECOVERY ELECTRIC WATE
    R HEATER,4474,4811,***,0,0
300 DATA AIR CLEANER,50,216,ROOM AIRC
    ONDITIONER,860,860
310 DATA ELECTRIC BLANKET,177,147,DEH
    UMIDIFIER,257,377
320 DATA ATTIC FAN,370,291,CIRCULATIN
    G FAN,88,43,ROLLAWAY FAN,171,138
325 DATA CEILING FAN,70,40
330 DATA FAN(WINDOW),200,170,HEATER(P
    ORTABLE),1322,176
340 DATA HEATING PAD,65,10,HUMIDIFIER
    ,177,163
350 DATA ***,0,0,GERMICIDAL LAMP,20,1
    41,HAIRDRYER,381,14
360 DATA INFRARED HEAT LAMP,250,13,SH
    AVER,15,0.5,SUNLAMP,279,16
370 DATA ELECTRIC TOOTHBRUSH,1.1,1,VI
    BRATOR,40,2,***,0,0
380 DATA RADIO,71,86,RADIO-RECORD PLA
    YER,109,109,MICROCOMPUTER,180,70
390 DATA B & W TV (SOLID STATE),45,10
    0,B & W (TUBE TYPE),100,220
400 DATA COLOR TV (TUBE TYPE),240,528
    ,COLOR TV (SOLID STATE),145,100
410 DATA ***,0,0,CLOCK,2,17,FLOOR POL
    ISHER,305,15,SEWING MACHINE,75,11
420 DATA VACUUM CLEANER,630,46,***,0,
    0
430 ? :? "-----------------------------
    ------------"
440 RETURN
450 PRINT :PRINT :RETURN
460 REM THE NUMBER OF HOURS PER YEAR
480 REM A$=APPLIANCE, W=AVG WATTS, K=
    ANNUAL KWH, N=# OF APPLIANCES
490 REM K MAY BE ADJUSTED BY THE USER
     BY DETERMINING
```

```
500 REM THE NUMBER OF HOURS PER YEAR
    THE APPLIANCE IS USED AND
510 REM CALCULATING K=WATTS*HOURS/100
520 REM SW=SUM ANNUAL KWH FOR ALL APP
    LIANCES
530 REM SK=SUM ANNUAL KWH FOR EACH AP
    PLIANCE GROUP
540 REM Q$=NAME OF EACH OF 7 GROUPS O
    F APPLIANCES
```

Program 5. Color Computer Version.

```
5 REM ELECTRIC USAGE ESTIMATOR  COLOR COMPUT
    ER VERSION
10 DEFFNA(X)=INT(X*100)/100:REM ELECTRIC USAG
    E ESTIMATOR
20 CLS
30 PRINTTAB(4)"ELECTRIC USAGE ESTIMATOR":GOSU
    B430
40 INPUT"ELECTRICITY COST IN CENTS/KWH   (E.G
    . 5.14)= ";C:GOSUB430
50 GOSUB430:PRINT"RESPOND WITH NUMBER OF      ~
        APPLIANCES USED IN HOME"
60 C=C/100:GOSUB430:FORI=1TO7:READQ$(I):NEXT:
    GOSUB430
70 SW=0:FORJ=1TO7:SK=0:PRINT:PRINTTAB(10);Q$(
    I);" APPLIANCES"
80 PRINT:READA$,W,K:IFASC(A$)=42ANDK=0THEN120

90 PRINTA$;:INPUTN
100 IFN>0THENSK=SK+K*N:PRINTTAB(10)"ANNUAL COS
    T= ";
105 PRINTUSING"$####.##";FNA(C*K*N):GOTO80
110 PRINT:GOTO80
120 GOSUB430:PRINT"COST OF ";Q$(J);" APPLIANCE
    S PER YEAR = ";
125 PRINTUSING"$####.##";FNA(C*SK)
130 GOSUB430:SW=SW+SK:NEXT:GOSUB430
140 PRINT"TOTAL ANNUAL APPLIANCE COST =    ";:P
    RINTUSING"$####.##";FNA(SW*C):END
150 DATAFOOD PREPARATION,FOOD PRESERVATION,LAU
    NDRY,AIR CONDITIONING
160 DATAHEALTH & BEAUTY,HOME ENTERTAINMENT,HOU
```

4

```
    SEWARES
170 DATABLENDER,300,1,BROILER,1140,85,CARVING ~
    KNIFE,92,8
180 DATACOFFEE MAKER,894,107,DEEPFRYER,1448,83
    ,DISHWASHER,1201,363
190 DATAEGG COOKER,516,14,FRYING PAN,1196,100,
    HOT PLATE,1200,90
200 DATAMIXER,127,2,MICROWAVE OVEN,1450,190,OV
    EN,12200,1205
210 DATAROASTER,1333,60,SANDWICH GRILL,1161,33
    ,TOASTER,1146,39
220 DATATRASH COMPACTOR,400,50,WAFFLE IRON,120
    0,20,DISPOSAL,445,7
230 DATA***,0,0
240 DATAFREEZER(MANUAL DEFROST),480,1320,FREEZ
    ER(AUTO DEFROST),480,1965
250 DATAREFRIGERATOR/FREEZER(AUTO DEFROST),540
    ,1795
260 DATAREFRIGERATOR/FREEZER(MANUAL DEFROST),5
    40,700
270 DATA***,0,0,CLOTHES DRYER,4856,993,HAND IR
    ON,1100,60
280 DATAWASHING MACHINE,512,103,ELECTRIC WATER
     HEATER,2475,4219
290 DATAQUICK RECOVERY ELECTRIC WATER HEATER,4
    474,4811,***,0,0
300 DATAAIR CLEANER,50,216,ROOM AIR CONDITIONE
    R,860,860
310 DATAELECTRIC BLANKET,177,147,DEHUMIDIFIER,
    257,377
320 DATAATTIC FAN,370,291,CIRCULATING FAN,88,4
    3,ROLLAWAY FAN,171,138
325 DATACEILING FAN,70,40
330 DATAFAN(WINDOW),200,170,HEATER(PORTABLE),1
    322,176
340 DATAHEATING PAD,65,10,HUMIDIFIER,177,163
350 DATA***,0,0,GERMICIDAL LAMP,20,141,HAIRDRY
    ER,381,14
360 DATAINFRARED HEAT LAMP,250,13,SHAVER,15,0.
    5,SUNLAMP,279,16
370 DATAELECTRIC TOOTHBRUSH,1.1,1,VIBRATOR,40,
    2,***,0,0
380 DATARADIO,71,86,RADIO-RECORD PLAYER,109,10
    9,MICRO-COMPUTER,180,70
390 DATAB & W TV (SOLID STATE),45,100,B & W (T
```

```
    UBE TYPE),100,220
400 DATACOLOR TV (TUBE TYPE),240,528,COLOR TV ~
    (SOLID STATE),145,100
410 DATA***,0,0,CLOCK,2,17,FLOOR POLISHER,305,
    15,SEWING MACHINE,75,11
420 DATAVACUUM CLEANER,630,46,***,0,0
430 PRINT:PRINT:RETURN
440 REM A$=APPLIANCE, W=AVG WATTS, K=ANNUAL KW
    H, N=# OF APPLIANCES
450 REM K MAY BE ADJUSTED BY THE USER BY DETER
    MINING
460 REM THE NUMBER OF HOURS PER YEAR THE APPLI
    ANCE IS USED AND
470 REM CALCULATING K=WATTS*HOURS/1000.
480 REM SK= SUM ANNUAL KWH
```

Program 6. TI-99 Version.

```
10 REM electric usage estimator, TI v
   ersion
20 DEF FNA(X)=INT(X*100)/100
30 CALL CLEAR
40 PRINT "  electric usage estimator"
   : : : : :
41 GOSUB 450
50 INPUT "electricity cost in cents/
    kwh (e.g. 5.14)= ":C
51 GOSUB 450
60 PRINT "respond with number of
   {6 SPACES}appliances used in home"
70 C=C/100
71 FOR I=1 TO 7
72 READ Q$(I)
73 NEXT I
74 GOSUB 450
80 SW=0
81 FOR J=1 TO 7
82 SK=0
83 PRINT Q$(J);" appliances "
85 PRINT TAB(17);"annual cost"
90 READ A$,W,K
92 IF ASC(A$)<>42 THEN 100
```

4

```
95 IF K=0 THEN 130
100 PRINT A$;
101 INPUT N
110 IF N<=0 THEN 114
111 SK=SK+K*N
112 YY=FNA(C*K*N)
113 PRINT TAB(20);"$";YY
114 GOTO 90
120 PRINT
121 GOTO 90
130 GOSUB 450
131 YY=FNA(C*SK)
132 PRINT "cost of ";Q$(J);" applianc
    es per year ="
135 PRINT "$";YY
140 GOSUB 450
141 SW=SW+SK
142 NEXT J
143 GOSUB 450
148 YY=FNA(SW*C)
150 PRINT "total annual appliance
    {6 SPACES}cost = ";YY
152 END
160 DATA food preparation,food preser
    vation,laundry,air conditioning
170 DATA health & beauty,home enterta
    inment,housewares
180 DATA blender,300,1,broiler,1140,8
    5,carving knife,92,8
190 DATA coffee maker,894,106,deep fr
    yer,1448,83,dishwasher,1201,363
200 DATA egg cooker,516,14,frying pan
    ,1196,100,hot plate,1200,90
210 DATA mixer,127,2,microwave oven,1
    450,190,oven,12200,1205
220 DATA roaster,1333,60,sandwich gri
    ll,1161,33,toaster,1146,39
230 DATA trash compactor,400,50,waffl
    e iron,1200,20,disposal,445,7
240 DATA ***,0,0
250 DATA freezer (manual defrost),480
    ,1320,freezer (auto defrost),480,
```

```
    1965
260 DATA refrigerator/freezer (auto d
    efrost),540,1795
270 DATA refrigerator/freezer (manual
     defrost),540,700
280 DATA ***,0,0,clothes dryer,4856,9
    93,hand iron,1100,60
290 DATA washing machine,512,103,elec
    tric water heater,2475,4219
300 DATA quick recovery electric wate
    r heater,4474,4811,***,0,0
310 DATA air cleaner,50,216,room airc
    onditioner,860,860
320 DATA electric blanket,177,147,deh
    umidifier,257,377
330 DATA attic fan,370,291,circulatin
    g fan,88,43,rollaway fan,171,138
340 DATA ceiling fan,70,40
350 DATA fan(window),200,170,heater(p
    ortable),1322,176
360 DATA heating pad,65,10,humidifier
    ,177,163
370 DATA ***,0,0,germicidal lamp,20,1
    41,hairdryer,381,14
380 DATA infrared heat lamp,250,13,sh
    aver,15,0.5,sunlamp,279,16
390 DATA electric toothbrush,1.1,1,vi
    brator,40,2,***,0,0
400 DATA radio,71,86,radio-record pla
    yer,109,109,micro-computer,180,70
410 DATA b & w tv (solid state),45,10
    0,b & w tv (tube type),100,220
420 DATA color tv (tube type),240,528
    ,color tv (solid state),145,100
430 DATA ***,0,0,clock,2,17,floor pol
    isher,305,15,sewing machine,75,11
440 DATA vacuum cleaner,630,46,***,0,
    0
450 PRINT :
451 GOSUB 460: : :
452 RETURN
```

4

```
460 PRINT "-------------------------
    -"
470 RETURN
480 REM a$=appliance, w=avg watts, k=
    annual kwh, n=# of appliances
490 REM k may be adjusted by the user
     by determining
500 REM the number of hours per year
    the appliance is used and
510 REM calculating k=watts*hours/100
    0.
520 REM sw=sum annual kwh for all app
    liances
530 REM sk=sum annual kwh for each ap
    pliance group
540 REM q$= name of each of 7 groups
    of appliances
```

5

Home Heating And Cooling Audit

5

Home Heating And Cooling Audit

Note: For all computers except the unexpanded VIC-20, add the DATA statements in lines 2000-2995 (Program 7) to your version of the heating audit program. Add the DATA statements of lines 2000-3000 (Program 14) to your version of the cooling audit program. For the VIC-20 add only DATA statements (from Programs 7 and 14) for the cities nearest your home plus *line 2990 for the heating audit or line 2995 for the cooling audit.*

Have you, like thousands of Americans, added insulation, storm windows, a setback thermostat, and caulking to improve the energy efficiency of your home? Other than the 15% energy credit you could claim on your taxes starting in 1979, it is difficult to know what savings you are achieving with these substantial investments of time and money. A colder than normal winter will cause increased fuel use for heating, which may or may not overshadow the energy savings by insulating. On the other hand, the winter of 1979-80 was so mild in most parts of the United States that it brought significant fuel savings for most homeowners whether they insulated or not. However, energy costs have increased so much in some areas and for some fuels that these consumers may not have achieved a monetary savings.

The cost for heating or cooling a house is due to three things:

1) outside temperature
2) thermostat setting
3) insulation (including air infiltration)

Only the last two are under your control. The most cost-effective action you can take is to raise the thermostat in the summer and lower the thermostat in winter. The next most effective is to increase the insulation. But even after you have done this, the fuel use will still be driven by the outside temperature. In order to compare the severity and predict fuel use, meteorologists have developed two concepts:

1) Heating degree day
2) Cooling degree day

5

Heating degree day is an estimate of the heating necessary in the winter, and cooling degree day is an estimate of the cooling necessary in the summer. Both are calculated from the maximum and minimum temperatures and summed each day to accumulate monthly and yearly totals.

Heating degree days accumulate on days with an average temperature cooler than 65°F, and cooling degree days accumulate on days with an average temperature warmer than 65°F. These data are recorded for several hundred stations in the United States and are available in "Local Climatological Data," a publication from the U. S. Dept. of Commerce, National Climatic Center, Federal Building, Asheville, NC 28801. The concepts of the cooling and heating degree days have shown excellent correlation with fuel use in my residence (see Figures 1 and 2) both in heating and air conditioning on a month by month basis, and an even higher correlation for an entire season. This correlation prompted me to develop a BASIC program for calculating an energy use rate for one year and predicting energy use in the following years based on degree days. Using this technique, you can calculate energy fuel savings as well as economic savings, even though the weather, energy cost, and energy efficiency of your home are changing month by month and year by year.

Each program requires less than 8K and can be shortened considerably by selectively eliminating DATA statements to restrict the geographical coverage. Each program requires the homeowner to have records of fuel use and cost for two years or more. The programs can evaluate efficiency from the years 1974 through and including 1980. Any type of fuel can be used; just remember that the units you input will be the units calculated for the fuel savings. Similarly, the rate is given as cost/fuel units, and so is dependent upon the units you input. Changing fuels or changing residences invalidates the technique.

The heating season is from October 1 to May 1, and the cooling season is from April 1 to November 1; seasons are made extra long in order to accommodate the wide range of climates in the United States. Because many fuels are used for other purposes such as hot water heating, home lighting, etc., the off season minimum usage is used to remove these factors from the seasonal weather effects. Thus the heating program requests the July fuel use, and the cooling program requests the January fuel use. Should a user live between cities, listed runs for all cities in that region will allow interpolation. Following are some key variables:

ST$ = state
CT$ = city
H(1,I) = degree days for 1974 for city I
x = fuel use/degree days for base year
H = predicted fuel use minus actual fuel used
RATE(k) = cost/fuel unit
F(k) = fuel unit
D(k) = cost
k = year
MI = fuel used in minimum month

The precision of this technique is good, but may predict only small savings or even loss in years when no energy conservation practices were in effect. This uncertainty is due to the variance between day and night temperatures, which is not always well represented by the mean temperature for the day.

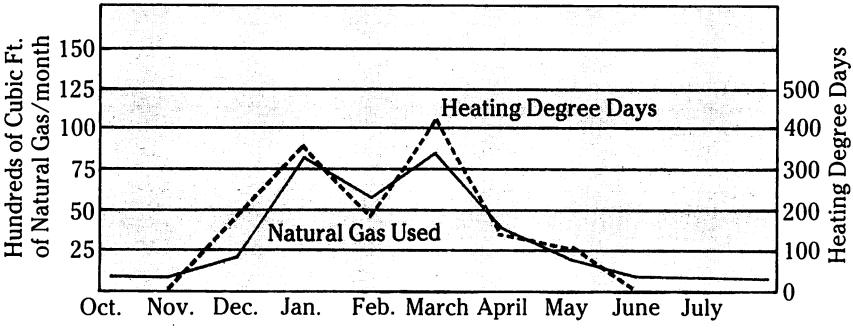

Figure 1. Heating Degree Days by Month for 1979-80 in Houston, TX and Natural Gas Used in the Author's Residence.

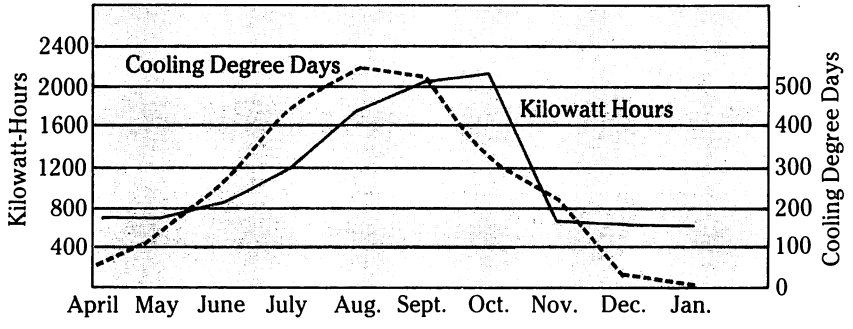

Figure 2. Cooling Degree Days by Month for 1979 in Houston, TX and Kilowatt Hours used in the Author's Residence.

5

Table 1. Sample Run Of Heating Fuel Audit.

```
                    HEATING FUEL AUDIT

-----------------------------------------------------------
STATE (DON'T ABBREVIATE)? TEXAS

THE WINTER OF 73-74 IS CALLED 74, CHOICES   ARE 74 TO 80

STARTING YEAR?  78
LAST YEAR?  80

CHOICES OF INPUT ARE  BY YEAR OR MONTH

BY YEAR (Y OR N)? Y

UNITS OF FUEL CAN BE  ANYTHING: GALLONS, KWH, CUFT,
ALL FUEL ENTRIES MUST BE THE SAME UNITS
-----------------------------------------------------------

YEAR=  78
FUEL USE FOR OCT 1 TO MAY 1?  650
COST(DOLLARS)?  205.05
-----------------------------------------------------------
YEAR=  79
FUEL USE FOR OCT 1 TO MAY 1?  526
COST(DOLLARS)?  182.7
-----------------------------------------------------------
YEAR=  80
FUEL USE FOR OCT 1 TO MAY 1?  318
COST(DOLLARS)?  120.6
-----------------------------------------------------------
FUEL USE FOR JULY?  10
        STATE             CITY

      1 TEXAS             BROWNSVILLE
      2 TEXAS             AMARILLO
      3 TEXAS             FORT WORTH
      4 TEXAS             HOUSTON

CHOOSE # OF CITY?  4

-----------------------------------------------------------


CHOSEN CITY= HOUSTON
RATE(1ST YR)=  .31

YEAR      RATE       FUEL SAVED       DOLLARS SAVED
 79       .34            15              5.51
 80       .37            178            67.54

-----------------------------------------------------------
(+ = SAVINGS,- = LOSS)
```

Table 2. Sample Run Of Cooling Fuel Audit.

```
                COOLING FUEL AUDIT

-------------------------------------------------------
STATE (DON'T ABBREVIATE)? TEXAS

THE SUMMER OF 1974 IS CALLED 74, CHOICES ARE74 TO 80

STARTING YEAR?  78
LAST YEAR?  80

CHOICES OF INPUT ARE  BY YEAR OR MONTH

BY YEAR (Y OR N)? Y

UNITS OF FUEL CAN BE  ANYTHING: GALLONS, KWH, CUFT, 100 CUFT
ALL FUEL ENTRIES MUST BE THE SAME UNITS
-------------------------------------------------------

YEAR=  78
FUEL USE FOR APR 1 TO NOV 1?  10422
COST(DOLLARS)?  374.28
-------------------------------------------------------
YEAR=  79
FUEL USE FOR APR 1 TO NOV 1?  9483
COST(DOLLARS)?  402.56
-------------------------------------------------------
YEAR=  80
FUEL USE FOR APR 1 TO NOV 1?  10204
COST(DOLLARS)?  528.08
-------------------------------------------------------
FUEL USE FOR JANUARY?  679

        STATE            CITY
 1      TEXAS            BROWNSVILLE
 2      TEXAS            AMARILLO
 3      TEXAS            FORT WORTH
 4      TEXAS            HOUSTON

CHOOSE # OF CITY?  4

-------------------------------------------------------

CHOSEN CITY= HOUSTON
RATE(1ST YR)=  .03

YEAR      RATE      FUEL SAVED      DOLLARS SAVED
 79       .04          367              15.59
 80       .05          734              37.99

-------------------------------------------------------
(+ = SAVINGS,- = LOSS)
```

Program 1. OSI Version.

```
1 REM HEATING FUEL AUDIT
10 REM
11 REM PROGRAM REQUIRES HEATING FUEL USE(ANNUAL OR BY MONTH)
12 REM HEATING MONTHS ARE OCT 1 TO MAY 1, 2 YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
15 REM **********************************************
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINTTAB(12);"YEAR BY YEAR HEATING CONSERVATION AUDIT":PRINT:PRINT
22 GOSUB500:INPUT"STATE (DON'T ABBREVIATE)";B$
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE WINTER OF 1973-74 IS CALLED 74, CHOICES ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:INPUT"LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE BY YEAR OR MONTH":PRINT
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89THEN100
41 PRINT:PRINT"UNITS OF FUEL CAN BE ANYTHING: GALLONS, KWH, CUFT,
   100CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UNITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 PRINT"FUEL USE FOR OCT 1 TO MAY 1";:INPUTF(I):INPUT"COST(DOLLARS)"
   ;D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I-1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"COST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JULY";MI:I=1
```

```
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I),H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 J=I-1:LL=YS-74+1:PRINTTAB(15);"STATE";TAB(25);"CITY"
255 FORI=1TOJ
260 PRINTTAB(10);I;TAB(15);B$;TAB(25);CT$(I):NEXT
270 INPUT"CHOOSE # OF CITY";I:PRINT:GOSUB500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=FNTRC(RATE(1))
282 PRINT"CHOSEN CITY= ";CT$(I);TAB(37);"RATE(1ST YEAR)=";TAB(58);H
285 PRINT:PRINTTAB(5);"YEAR";
290 PRINTTAB(16);"RATE";TAB(25);"FUEL SAVINGS";TAB(42);"SAVINGS
    (DOLLARS)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(C)
320 PRINTTAB(5);INT(YS+K-1);TAB(15);RATE(K);TAB(28);H;TAB(42);C
340 NEXT:PRINT:GOSUB500:PRINTTAB(20);"(+ = SAVINGS)(- = LOSS)":GOTO255
500 PRINT"-----------------------------------------------------------":
    RETURN
1999 DATAOCTOBER,NOVEMBER,DECEMBER,JANUARY,FEBRUARY,MARCH,APRIL
```

5

Program 2. VIC Version.

```
1 REM HEATING FUEL AUDIT VIC VERSION
11 REM PROGRAM REQUIRES HEATING FUEL USE (ANN
    UAL OR BY MONTH)"
12 REM HEATING MONTHS ARE OCT 1 TO MAY 1, 2 Y
    RS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINT"{CLEAR}  HEATING FUEL AUDIT{DOWN}"
22 PRINT"STATE (DON'T ":INPUT"ABBREVIATE)";B$

23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE WINTER OF 73-74 IS CALLED 74, CH
    OICES   ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:PRINT:INPUT"
    LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE  BY Y
    EAR OR MONTH"
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89TH
    EN100
41 PRINT"{CLEAR}UNITS OF FUEL CAN BE  ANYTHIN
    G: GALLONS, KWH, CUFT, 100 CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UN
    ITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 PRINT"FUEL USE FOR OCT 1 TO":INPUT"MAY 1";
    F(I):INPUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I
    -1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"C
    OST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 PRINT"FUEL USE FOR":INPUT" JULY";MI:I=1
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 PRINT"{CLEAR}":J=I-1:LL=YS-74+1:PRINT"   S
    TATE";TAB(12);"CITY{DOWN}"
255 FORI=1TOJ
260 PRINTI;B$;TAB(10);CT$(I):NEXT
270 PRINT"{DOWN}":INPUT"CHOOSE # OF CITY";I:PR
    INT:GOSUB500
```

```
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"{CLEAR}CHOSEN CITY= ";CT$(I):PRINT"R
    ATE(1ST YR)= ";H
285 PRINT"{DOWN}YEAR RATE FUEL  SAVED"
290 PRINT"          SAVED  ($)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);TAB(4);RATE(K);TAB(9);INT
    (H);TAB(15);C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS,- =
     LOSS)":GOTO255
500 PRINT"--------------------":RETURN
1999 DATAOCT,NOV,DEC,JAN,FEB,MAR,APR
```

Program 3. Microsoft Version.

```
1 REM HEATING FUEL AUDIT--ADD DATA LINES 2000
   UP.
11 REM PROGRAM REQUIRES HEATING FUEL USE (ANN
    UAL OR BY MONTH)"
12 REM HEATING MONTHS ARE OCT 1 TO MAY 1, 2 Y
    RS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINT"{CLEAR}";TAB(9);"HEATING FUEL AUDIT{
    04 DOWN}"
22 INPUT"STATE (DON'T ABBREVIATE)";B$
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE WINTER OF 73-74 IS CALLED 74,
       CHOICES ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:PRINT:INPUT"
    LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE  BY Y
    EAR OR MONTH"
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89TH
    EN100
41 PRINT"{CLEAR}UNITS OF FUEL CAN BE  ANYTHIN
    G: GALLONS, KWH, CUFT, 100 CUFT"
```

5

```
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UN
    ITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 INPUT"FUEL USE FOR OCT 1 TO MAY 1";F(I):IN
    PUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I
    -1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"C
    OST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JULY";MI:I=1:PRINT"{CLE
    CLEAR}";TAB(17);"WAIT"
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 PRINT"{CLEAR}":J=I-1:LL=YS-74+1:PRINT"
        STATE";TAB(21);"CITY{DOWN}"
255 FORI=1TOJ
260 PRINTI;TAB(9);B$;TAB(20);CT$(I):NEXT
270 PRINT"{DOWN}":INPUT"CHOOSE # OF CITY";I:PR
    INT
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"{CLEAR}";TAB(9);"CHOSEN CITY= ";CT$(
    I):PRINTTAB(9);"RATE(1ST YR)= ";H
285 PRINT"{DOWN}YEAR     RATE      FUEL
    SAVED"
290 PRINT"                    SAVED       ($)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);TAB(7);RATE(K);TAB(18);IN
    T(H);TAB(29);C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS,- =
     LOSS)":GOTO255
500 PRINT"-----------------------------------
    --":RETURN
1999 DATAOCT,NOV,DEC,JAN,FEB,MAR,APR
```

5

Program 4. Atari Version.

```
1 REM HEATING FUEL AUDIT (ATARI VERSI
  ON)
5 DIM ML(7),CTL(20),F(20),D(20),RATE(
  20),H(7,20)
10 DIM T$(20),B$(20),M$(8*20),A$(20),
   ST$(20),CT$(20*20),TT$(20)
11 REM PROGRAM REQUIRES HEATING FUEL
   USE(ANNUAL OR BY MONTH)
12 REM HEATING MONTHS ARE OCT 1 TO MA
   Y 1, 2 YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $
   SAVINGS
15 REM **************************
17 GRAPHICS 0
20 PRINT "[illegible]":? "[illegible]
   [illegible]":PRINT :PRINT
22 GOSUB 500:PRINT "STATE (DON'T ABBR
   EVIATE)";:INPUT B$
23 FOR I=1 TO 7:READ TT$:M$(I*20+1,I*
   20+20)=TT$:ML(I)=LEN(TT$):NEXT I:P
   RINT
25 PRINT "THE WINTER OF 1973-74 IS CA
   LLED 74, CHOICES ARE 74 TO 80"
27 PRINT :PRINT "STARTING YEAR";:INPU
   T YS:PRINT "LAST YEAR";:INPUT YE:P
   RINT
30 L=YE-YS+1:PRINT "CHOICES OF INPUT
   ARE BY YEAR OR MONTH":PRINT
40 PRINT "BY YEAR";:INPUT A$:IF A$(1,
   1)<>"Y" THEN 100
41 PRINT :PRINT "UNITS OF FUEL CAN BE
    ANYTHING:":? "GALLONS, KWH, CUFT,
    100CUFT"
43 PRINT "ALL FUEL ENTRIES MUST BE":?
    "IN THE SAME UNITS":GOSUB 500:PRI
   NT
47 FOR I=1 TO L:PRINT "YEAR= ";INT(YS
   +I-1)
48 PRINT "FUEL USE FOR OCT 1 TO MAY 1
   ";:INPUT T:F(I)=T:PRINT "COST(DOLL
```

5

```
   ARS)";:INPUT T:D(I)=T
90 GOSUB 500:NEXT I:GOTO 200
100 FOR I=1 TO L:GOSUB 500:PRINT "YEA
    R= ";INT(YS+I-1):FOR J=1 TO 7
105 PRINT "FUEL USE FOR ";M$(J*20+1,J
    *20+ML(J));:INPUT F:PRINT "COST";
    :INPUT D
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT J:NE
    XT I
200 PRINT "FUEL USE FOR JULY":INPUT M
    I:I=1
220 READ ST$,TT$:CT$(I*20+1,I*20+20)=
    TT$:CTL(I)=LEN(TT$)
225 FOR K=1 TO 7:READ T:H(K,I)=T:NEXT
     K
230 TRAP 240:IF ST$=B$(1,LEN(ST$)) TH
    EN I=I+1
240 TRAP 40000:IF ST$="END" THEN 250
245 GOTO 220
250 J=I-1:LL=YS-74+1:PRINT "
    {3 SPACES}STATE{14 SPACES}CITY"
255 FOR I=1 TO J
260 PRINT I;"  ";B$;:POKE 85,22:? CT$
    (I*20+1,I*20+CTL(I)):NEXT I
270 PRINT "CHOOSE # OF CITY";:INPUT I
    :PRINT :GOSUB 500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1
    )/F(1):H=INT(RATE(1)*100)/100
282 PRINT "CHOSEN CITY= ";CT$(I*20+1,
    I*20+CTL(I)):PRINT "RATE(1ST YEAR
    )=";H
285 ? :? "YEAR  RATE  FUEL SAV. $ SAV
    INGS"
295 FOR K=2 TO L
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)
    =D(K)/F(K):C=H*RATE(K)
312 H=INT(H*100)/100:RATE(K)=INT(RATE
    (K)*100)/100:C=INT(C*100)/100
320 PRINT " ";INT(YS+K-1);"{TAB} ";RA
    TE(K);"{TAB}";H;"{TAB}{3 SPACES}"
    ;C
```

```
340 NEXT K:PRINT :GOSUB 500:PRINT "(+
      = SAVINGS)(- = LOSS)":GOTO 255
500 PRINT "-------------------------
    -----":RETURN
1999 DATA OCTOBER,NOVEMBER,DECEMBER,J
     ANUARY,FEBRUARY,MARCH,APRIL
```

Program 5. Color Computer Version.

```
1 REM HEATING FUEL AUDIT
10 REM
11 REM PROGRAM REQUIRES HEATING FUEL USE(ANNU
    AL OR BY MONTH)
12 REM HEATING MONTHS ARE OCT 1 TO MAY 1, 2 Y
    RS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
15 REM ************************
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINT"YEAR BY YEAR HEATING CONSERVATION AU
    DIT":PRINT:PRINT
22 GOSUB500:INPUT"STATE (DON'T ABBREVIATE)";B
    $
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE WINTER OF 1973-74 IS CALLED 74, ~
    CHOICES ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:INPUT"LAST Y
    EAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE BY YE
    AR OR MONTH":PRINT
40 INPUT"BY YEAR";A$:IFLEFT$(A$,1)<>"Y"THEN10
    0
41 PRINT:PRINT"UNITS OF FUEL CAN BE ANYTHING:
     GALLONS, KWH, CUFT, 100CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE    SAME
     UNITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 PRINT"FUEL USE FOR OCT 1 TO MAY 1";:INPUTF
    (I):INPUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR= ";INT(YS+I-
    1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);INPUTF:PRINT"CO
    ST FOR ";M$(J);:INPUTD
```

5

```
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JULY";MI:I=1
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 J=I-1:LL=YS-74+1:PRINTTAB(3);"STATE       C
    ITY"
255 FORI=1TOJ
260 PRINTI;"  ";B$;"  ";CT$(I):NEXT
270 INPUT"CHOOSE # OF CITY";I:PRINT:GOSUB500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"CHOSEN CITY= ";CT$(I):PRINT"RATE(1ST
     YEAR)=";H
285 PRINT:PRINT"YEAR  RATE  FUEL SAV.  SAVINGS
    "
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);"  ";RATE(K);"    ";H;"    ~
    ";C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS)(- ~
    = LOSS)":GOTO255
500 PRINT"------------------------------":RET
    URN
1999 DATAOCTOBER,NOVEMBER,DECEMBER,JANUARY,FEBR
    UARY,MARCH,APRIL
```

Program 6. TI-99 Version.

```
1 REM heating fuel audit, TI version
11 REM  program requires heating fuel
    use (annual or by month)
12 REM  heating months are oct 1 to m
   ay 1, 2 yrs or more required
13 REM output is fuel savings, and $
   savings{6 SPACES}
15 REM  ********************
17 CALL CLEAR
```

5

```
18 CALL SCREEN(9)
19 DEF TRC(E)=INT(E*100)/100
20 PRINT "year by year heating audit"
   : : : : : :
22 GOSUB 500
23 INPUT "state (don't abbreviate)? "
   :B$
24 FOR I=1 TO 7
25 READ M$(I)
27 NEXT I
29 PRINT
31 PRINT "the winter of 1973-74 is
   {4 SPACES}called 74, choices are 7 °
   4 to80 ": :
35 INPUT "starting year? ":YS
37 INPUT "last year? ":YE
39 PRINT
41 L=YE-YS+1
42 PRINT "units of fuel can be
   {8 SPACES}anything: gallon, kwh, c
   uft,100 cuft"
43 PRINT "all fuel entries must be th
   esame units": : : :
44 PRINT "choices of input are by yea
   ror month": :
47 INPUT "by year (y or n)? ":A$
49 IF (ASC(A$)<>89)*(ASC(A$)<>121)THE
   N 100
51 PRINT
57 GOSUB 500
59 PRINT
61 FOR I=1 TO L
63 PRINT "year= ";INT(YS+I-1)
65 PRINT "fuel use for oct 1 to may 1
    ";
67 INPUT F(I)
69 INPUT "cost (dollars)? ":D(I)
90 GOSUB 500
94 NEXT I
96 GOTO 150
100 FOR I=1 TO L
101 GOSUB 500
```

5

```
102 PRINT "year = ";INT(YS+I-1)
104 FOR J=1 TO 7
105 PRINT "fuel use for ";M$(J);
107 INPUT FF
108 PRINT "cost for ";M$(J);
109 INPUT DD
110 F(I)=F(I)+FF
112 D(I)=D(I)+DD
114 NEXT J
116 NEXT I
150 CALL CLEAR
200 INPUT "fuel use for july? ":MI
201 CALL CLEAR
202 I=1
220 READ ST$,CT$(I),H(1,I),H(2,I),H(3
    ,I),H(4,I),H(5,I),H(6,I),H(7,I)
230 IF SEG$(ST$,1,7)<>SEG$(B$,1,7)THE
    N 240
235 I=I+1
240 IF ST$="end" THEN 250
245 GO TO 220
250 J=I-1
251 LL=YS-74+1
252 PRINT TAB(5);"state";TAB(15);"cit
    y"
255 FOR I=1 TO J
260 PRINT I;TAB(5);B$;TAB(15);CT$(I)
265 NEXT I
270 INPUT "choose # of city ":I
272 CALL CLEAR
274 GOSUB 500
280 X=(F(1)-7*MI)/H(LL,I)
281 RATE(1)=D(1)/F(1)
282 YY=TRC(RATE(1))
283 PRINT "chosen city= ";CT$(I)
284 PRINT "rate (1st year)= ";YY: :
290 PRINT "year";TAB(6);"rate";TAB(13
    );"fuel";TAB(21);"savings"
292 PRINT TAB(12);"savings";TAB(20);"
    (dollars)"
295 FOR K=2 TO L
300 HH=H(LL+K-1,I)*X+7*MI-F(K)
```

```
302 RATE(K)=D(K)/F(K)
304 C=HH*RATE(K)
312 HH=TRC(HH)
314 RATE(K)=TRC(RATE(K))
316 C=TRC(C)
320 PRINT INT(YS+K-1);TAB(5);RATE(K);
    TAB(12);HH;TAB(21);C
340 NEXT K
342 PRINT
344 GOSUB 500
346 PRINT " (+ = savings) (- = loss)"
348 GOTO 255
500 PRINT "-------------------------
    --"
502 RETURN
1999 DATA october,november,december,j
     anuary,february,march,april
```

Program 7. Heating Audit DATA Statements.

```
2000 DATATEXAS,BROWNSVILLE,418,520,518,974,800,
    728,640
2010 DATATEXAS,AMARILLO,3389,4163,3484,4515,408
    4,4540,4219
2020 DATATEXAS,FORT WORTH,1854,2281,1841,2967,2
    941,2730,2375
2030 DATATEXAS,HOUSTON,1157,1190,1309,2276,2103
    ,1711,1545
2032 DATAALABAMA,BIRMINGHAM,2138,2570,2527,3488
    ,3295,2777,2766
2034 DATAALABAMA,MOBILE,1037,1365,1393,2400,220
    6,1617,1608
2036 DATAALABAMA,MONTGOMERY,1643,1967,2119,3038
    ,2403,1987,2028
2038 DATAARIZONA,FLAGSTAFF,6080,6740,6158,6032,
    4882,6813,6100
2040 DATAARIZONA,PHOENIX,1093,1558,1089,1071,69
    2,1428,1022
2042 DATAARIZONA,TUCSON,1652,2183,1453,1644,119
    4,1840,1349
2044 DATAARKANSAS,LITTLEROCK,2645,3059,2763,359
    0,3723,3528,3142
2046 DATACALIFORNIA,LOSANGELES,1232,1305,1160,9
```

```
    69,705,1452,808
2048 DATACALIFORNIA,SANFRANCISCO,2752,2918,2929
    ,2594,1972,2774,2116
2050 DATACOLORADO,DENVER,5569,5826,5117,5258,48
    82,5937,5333
2052 DATACONNECTICUTT,HARTFORD,5540,5890,5349,6
    164,5711,6286,5569
2054 DATADELAWARE,WILMINGTON,3910,4676,4177,520
    6,4980,4883,4364
2056 DATAFLORIDA,JACKSONVILLE,933,1168,1390,206
    1,1791,1525,1406
2058 DATAFLORIDA,MIAMI,131,59,202,311,331,185,2
    04
2060 DATAFLORIDA,TALLAHASSEE,1106,1547,1594,219
    9,2166,1746,1692
2062 DATAGEORGIA,ATLANTA,2305,2873,2697,3834,32
    98,2757,2737
2064 DATAGEORGIA,SAVANNAH,1274,1537,1735,2527,2
    253,1751,1881
2066 DATAIDAHO,BOISE,4977,5318,5376,5715,4287,5
    984,4792
2068 DATAIDAHO,POCATELLO,6387,6713,6252,6474,51
    03,7109,5839
2070 DATAILLINOIS,CHICAGO,5634,6039,5135,5613,6
    322,6686,5537
2072 DATAILLINOIS,SPRINGFIELD,4998,5433,4693,61
    57,6057,6075,5308
2074 DATAINDIANA,EVANSVILLE,3873,4424,3960,5236
    ,5113,4979,4676
2076 DATAINDIANA,FORTWAYNE,5660,6093,5198,6723,
    6472,6271,6046
2078 DATAINDIANA,INDIANAPOLIS,4698,5477,4762,62
    60,5698,5748,5484
2080 DATAIOWA,DESMOINES,5908,6468,5268,6418,660
    6,7041,5827
2082 DATAIOWA,SIOUXCITY,6120,6924,5946,6961,702
    0,7912,6263
2084 DATAKANSAS,TOPEKA,4873,5225,4408,5455,5556
    ,6023,5045
2086 DATAKANSAS,WICHITA,4540,4820,4035,4702,485
    5,5310,4620
2088 DATAKENTUCKY,LOUISVILLE,3697,4289,3694,501
    6,4896,4583,4392
2090 DATALOUISIANA,BATONROUGE,1050,1458,1548,21
    33,1996,1744,1762
2092 DATALOUISIANA,NEWORLEANS,931,1295,1430,205
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    7,1860,1453,1447
2094 DATAMAINE,CARIBOU,8980,9024,8947,9140,8152
    ,8638,7860
2096 DATAMAINE,PORTLAND,6472,6747,6709,7492,660
    0,7040,6427
2098 DATAMARYLAND,BALTIMORE,4241,4264,3857,4940
    ,4542,4508,4271
2100 DATAMASSACHUSETTS,BOSTON,4998,5230,4620,54
    92,4963,5425,5017
2102 DATAMICHIGAN,DETROIT,5923,6375,5583,6754,6
    408,6538,6088
2104 DATAMICHIGAN,GRANDRAPIDS,6338,6987,5933,71
    67,6605,6944,5898
2106 DATAMICHIGAN,SAULST,MARIE,8576,8602,8079,9
    047,8245,8848,8021
2108 DATAMINNESOTA,DULUTH,9292,9435,8662,9310,8
    657,9577,8351
2110 DATAMINNESOTA,INT.FALLS,9844,9755,9435,100
    44,9858,10745,9442
2112 DATAMINNESOTA,MINNEAPOLIS,7560,7969,6785,7
    800,7789,8132,7140
2114 DATAMISSISSIPPI,JACKSON,1746,2066,2058,296
    1,2881,2451,2568
2116 DATAMISSOURI,KANSASCITY,4775,5407,4401,555
    0,5671,5811,5106
2118 DATAMISSOURI,ST.LOUIS,4507,5001,4173,5466,
    5410,5368,4574
2120 DATAMISSOURI,SPRINGFIELD,3982,4659,3837,50
    33,4973,5116,4140
2122 DATAMONTANA,BILLINGS,6294,7106,6118,6076,7
    068,7878,5814
2124 DATAMONTANA,GREATFALLS,6810,7482,6503,6006
    ,7606,8138,6164
2126 DATAMONTANA,MISSOULA,6797,7104,6668,6896,6
    423,8068,6439
2128 DATANEBRASKA,LINCOLN,6067,6504,5302,6131,6
    484,6881,5562
2130 DATANEBRASKA,OMAHA,6069,6316,5037,6045,614
    0,6391,5954
2132 DATANEVADA,LASVEGAS,2418,2610,2298,2150,16
    64,2517,2147
2134 DATANEVADA,RENO,5184,5820,5548,5196,4228,5
    679,4625
2136 DATANEW HAMPSHIRE,CONCORD,6924,7304,7194,7
    732,7094,7229,6479
2138 DATANEW JERSEY,TRENTON,4373,4763,4172,5355
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    ,5056,4818,4595
2140 DATANEW MEXICO,ALBUQUERQUE,4206,4707,4328,
    4761,3543,4020,3735
2142 DATANEW MEXICO,ROSWELL,3015,3660,2771,3469
    ,2712,3585,3297
2144 DATANEW YORK,ALBANY,6539,6835,5999,6989,63
    15,6806,6023
2146 DATANEW YORK,NEWYORK,4333,4643,4131,5195,4
    804,4950,4434
2148 DATANEW YORK,SYRACUSE,6241,6439,5917,6806,
    6234,6573,5895
2149 DATANORTH CAROLINA,ASHEVILLE,3375,3947,384
    3,4755,4281,3882,3793
2150 DATANORTH CAROLINA,RALEIGH,2758,3550,2895,
    4258,3801,3286,3464
2154 DATANORTH CAROLINA,WILMNGTN,1683,2249,1908
    ,2849,2658,2256,2464
2156 DATANORTH DAKOTA,FARGO,9171,8502,7937,8893
    ,9012,9915,8402
2158 DATANORTH DAKOTA,WILLISTON,8714,8616,8081,
    8192,8867,9784,7787
2160 DATAOHIO,COLUMBUS,4701,5314,4860,6494,5860
    ,5653,5253
2162 DATAOHIO,TOLEDO,5996,6243,5674,7093,6673,6
    520,5992
2164 DATAOKLAHOMA,OKLACITY,3278,3762,2950,3835,
    3977,4142,3543
2166 DATAOREGON,BURNS,6395,6587,6880,6102,5711,
    7093,5830
2168 DATAOREGON,PORTLAND,4070,3993,3992,4057,37
    15,4577,3690
2170 DATAPENNSYLVANIA,HARRISBURG,4509,5199,4498
    ,5437,5059,4915,4422
2172 DATAPENNSYLVANIA,PITTSBURG,5005,5516,5105,
    6822,5636,5964,5536
2174 DATAPENNSYLVANIA,SCRANTON,5950,5691,5251,6
    642,5963,6348,5417
2176 DATARHODE ISLAND,PROVIDENCE,5184,5531,5172
    ,6035,5497,5867,5029
2178 DATASOUTH CAROLINA,CHARLESTON,1393,1941,18
    37,2702,2340,1972,2195
2180 DATASOUTH CAROLINA,GREENVILLE,2730,3199,29
    20,3851,3392,3122,3166
2182 DATASOUTH DAKOTA,RAPIDCITY,6477,7045,6111,
    6622,6923,7626,6050
2184 DATASOUTH DAKOTA,SIOUXFALLS,7088,7598,6685
```

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    ,7484,7822,8393,6799
2186 DATATENNESSEE,CHATTANOOGA,2898,3694,3313,4
    113,3729,3349,3483
2188 DATATENNESSEE,KNOXVILLE,2833,3418,3340,414
    8,3822,3520,3467
2190 DATATENNESSEE,MEMPHIS,2500,2878,2526,3442,
    3355,3205,3013
2192 DATAUTAH,SALTLAKECITY,5402,5495,5392,5370,
    3982,5526,4722
2194 DATAVERMONT,BURLINGTON,7276,7306,6945,7726
    ,7257,7623,6615
2196 DATAVIRGINIA,NORFOLK,2674,3210,2827,3817,3
    478,3432,3358
2198 DATAVIRGINIA,RICHMOND,3265,3944,3232,4389,
    4033,3861,3532
2200 DATAWASHINGTON,SEATTLE,4369,4537,4200,3699
    ,3650,4414,3995
2202 DATAWASHINGTON,SPOKANE,6171,6613,6104,5978
    ,5826,7368,5650
2204 DATAWEST VIRGINIA,CHRLSTON,3807,4813,3832,
    5487,4896,4534,4526
2206 DATAWISCONSIN,GREENBAY,7324,7794,7079,8319
    ,7616,8227,7040
2208 DATAWYOMING,CHEYENNE,6561,7106,6274,6540,6
    100,6851,6179
2210 DATAWYOMING,LANDER,7122,7482,7058,6961,644
    5,8528,6891
2990 DATAEND,END,0,0,0,0,0,0,0
2995 END
```

Program 8. OSI Version.

```
1 REM COOLING FUEL AUDIT
10 REM
11 REM PROGRAM REQUIRES COOLING FUEL USE (ANNUAL OR BY MONTH)
12 REM COOLING MONTHS ARE APRIL 1 TO NOV 1, 2 YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
15 REM **********************************************
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINTTAB(12);"YEAR BY YEAR COOLING CONSERVATION AUDIT":PRINT:PRINT
22 GOSUB500:INPUT"STATE (DON'T ABBREVIATE)";B$
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE SUMMER OF 1974 IS CALLED 74, CHOICES ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:INPUT"LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE BY YEAR OR MONTH":PRINT
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89THEN100
41 PRINT:PRINT"UNITS OF FUEL CAN BE ANYTHING: GALLONS, KWH, CUFT,
   100CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UNITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 PRINT"FUEL USE FOR APR 1 TO NOV 1";:INPUTF(I):INPUT"COST(DOLLARS)";
   D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I-1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"COST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JANUARY";MI:I=1
```

```
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I),H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 J=I-1:LL=YS-74+1:PRINTTAB(15);"STATE";TAB(25);"CITY"
255 FORI=1TOJ
260 PRINTTAB(10);I;TAB(15);B$;TAB(25);CT$(I):NEXT
270 INPUT"CHOOSE # OF CITY";I:PRINT:GOSUB500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=FNTRC(RATE(1))
282 PRINT"CHOSEN CITY= ";CT$(I);TAB(37);"RATE(1ST YEAR)=";TAB(58);H
285 PRINT:PRINTTAB(5);"YEAR";
290 PRINTTAB(16);"RATE";TAB(25);"FUEL SAVINGS";TAB(42);"SAVINGS
    (DOLLARS)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(C)
320 PRINTTAB(5);INT(YS+K-1);TAB(15);RATE(K);TAB(28);H;TAB(42);C
340 NEXT:PRINT:GOSUB500:PRINTTAB(20);"(+ = SAVINGS)(- = LOSS)":GOTO255
500 PRINT"------------------------------------------------------------------------";
    RETURN
1999 DATAAPRIL,MAY,JUNE,JULY,AUGUST,SEPTEMBER,OCTOBER
```

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Program 9. VIC Version.

```
1 REM COOLING FUEL AUDIT VIC VERSION
11 REM PROGRAM REQUIRES COOLING FUEL USE (ANN
    UAL OR BY MONTH)"
12 REM COOLING MONTHS ARE APRIL 1 TO NOV 1, 2
     YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
17 DEFFNTRC(E)=INT(E*100)/100
21 PRINT"{CLEAR}  COOLING FUEL AUDIT{DOWN}"
22 PRINT"STATE (DON'T ":INPUT"ABBREVIATE)";B$

23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE SUMMER OF 1974 IS CALLED 74, CHO
    ICES ARE74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:PRINT:INPUT"
    LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE  BY Y
    EAR OR MONTH"
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89TH
    EN100
41 PRINT"{CLEAR}UNITS OF FUEL CAN BE  ANYTHIN
    G: GALLONS, KWH, CUFT, 100 CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UN
    ITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 PRINT"FUEL USE FOR APR 1 TO":INPUT"NOV 1";
    F(I):INPUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I
    -1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"C
    OST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 PRINT"FUEL USE FOR":INPUT" JANUARY";MI:I=1

220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 PRINT"{CLEAR}":J=I-1:LL=YS-74+1:PRINT"   S
    TATE";TAB(12);"CITY{DOWN}"
255 FORI=1TOJ
260 PRINTI;B$;TAB(10);CT$(I):NEXT
270 PRINT"{DOWN}":INPUT"CHOOSE # OF CITY";I:PR
```

```
    INT:GOSUB500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"{CLEAR}CHOSEN CITY= ";CT$(I):PRINT"R
    ATE(1ST YR)= ";H
285 PRINT"{DOWN}YEAR RATE FUEL  SAVED"
290 PRINT"          SAVED  ($)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);TAB(4);RATE(K);TAB(9);INT
    (H);TAB(15);C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS,- =
     LOSS)":GOTO255
500 PRINT"--------------------":RETURN
1999 DATAAPRIL,MAY,JUNE,JULY,AUG,SEPT,OCT
```

Program 10. Microsoft Version.

```
1 REM COOLING FUEL AUDIT (ADD DATA LINES 2000
   UP.)
11 REM PROGRAM REQUIRES COOLING FUEL USE (ANN
    UAL OR BY MONTH)"
12 REM COOLING MONTHS ARE APRIL 1 TO NOV 1, 2
     YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
17 DEFFNTRC(E)=INT(E*100)/100
20 PRINT"YEAR BY YEAR COOLING CONSERVATION AU
    DIT{02 DOWN}"
21 PRINT"{CLEAR}";TAB(9);"COOLING FUEL AUDIT{
    DOWN}"
22 INPUT"STATE (DON'T ABBREVIATE)";B$
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE SUMMER OF 1974 IS CALLED 74,
       CHOICES ARE74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:PRINT:INPUT"
    LAST YEAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE  BY Y
    EAR OR MONTH"
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89TH
    EN100
```

5

```
41 PRINT"{CLEAR}UNITS OF FUEL CAN BE  ANYTHIN
    G: GALLONS, KWH, CUFT, 100 CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE SAME UN
    ITS":GOSUB500:PRINT
47 FORI=1TOL:PRINT"YEAR= ";INT(YS+I-1)
48 INPUT"FUEL USE FOR APR 1 TO NOV 1";F(I):IN
    PUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR = ";INT(YS+I
    -1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"C
    OST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JANUARY";MI:I=1:PRINT"{
    CLEAR}";TAB(17);"WAIT"
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I),H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 PRINT"{CLEAR}":J=I-1:LL=YS-74+1:PRINT"
        STATE";TAB(21);"CITY{DOWN}"
255 FORI=1TOJ
260 PRINTI;TAB(9);B$;TAB(20);CT$(I):NEXT
270 PRINT"{DOWN}":INPUT"CHOOSE # OF CITY";I:PR
    INT
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"{CLEAR}";TAB(9);"CHOSEN CITY= ";CT$(
    I):PRINTTAB(9);"RATE(1ST YR)= ";H
285 PRINT"{DOWN}YEAR     RATE      FUEL
    SAVED"
290 PRINT"                    SAVED       ($)"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);TAB(7);RATE(K);TAB(18);IN
    T(H);TAB(29);C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS,- =
     LOSS)":GOTO255
500 PRINT"-----------------------------------
    --":RETURN
1999 DATAAPRIL,MAY,JUNE,JULY,AUG,SEPT,OCT
```

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Program 11. Atari Version.

```
1 REM COOLING FUEL AUDIT (ATARI VERSI
  ON)
5 DIM ML(7),CTL(20),F(20),D(20),RATE(
  20),H(7,20)
10 DIM T$(20),B$(20),M$(8*20),A$(20),
   ST$(20),CT$(20*20),TT$(20)
11 REM PROGRAM REQUIRES COOLING FUEL
   USE(ANNUAL OR BY MONTH)
12 REM COOLING MONTHS ARE APRIL 1 TO
   NOV 1, 2 YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $
   SAVINGS
15 REM ****************************
17 GRAPHICS 0
20 PRINT "YEAR BY YEAR COOLING":?
   " CONSERVATION AUDIT":PRINT
   :PRINT
22 GOSUB 500:PRINT "STATE (DON'T ABBR
   EVIATE)";:INPUT B$
23 FOR I=1 TO 7:READ TT$:M$(I*20+1,I*
   20+20)=TT$:ML(I)=LEN(TT$):NEXT I:P
   RINT
25 PRINT "THE SUMMER OF 1974 IS CALLE
   D 74,":? "CHOICES ARE 74 TO 80"
27 PRINT :PRINT "STARTING YEAR";:INPU
   T YS:PRINT "LAST YEAR";:INPUT YE:P
   RINT
30 L=YE-YS+1:PRINT "CHOICES OF INPUT
   ARE BY YEAR OR MONTH":PRINT
40 PRINT "BY YEAR";:INPUT A$:IF A$(1,
   1)<>"Y" THEN 100
41 PRINT :PRINT "UNITS OF FUEL CAN BE
    ANYTHING:":? "GALLONS, KWH, CUFT,
    100CUFT"
43 PRINT "ALL FUEL ENTRIES MUST BE":?
    "IN THE SAME UNITS":GOSUB 500:PRI
   NT
47 FOR I=1 TO L:PRINT "YEAR= ";INT(YS
   +I-1)
48 PRINT "FUEL USE FOR APR 1 TO NOV 1
```

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```
   ";:INPUT T:F(I)=T:PRINT "COST(DOLL
   ARS)";:INPUT T:D(I)=T
90 GOSUB 500:NEXT I:GOTO 200
100 FOR I=1 TO L:GOSUB 500:PRINT "YEA
    R= ";INT(YS+I-1):FOR J=1 TO 7
105 PRINT "FUEL USE FOR ";M$(J*20+1,J
    *20+ML(J));:INPUT F:PRINT "COST";
    :INPUT D
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT J:NE
    XT I
200 PRINT "FUEL USE FOR JANUARY":INPU
    T MI:I=1
220 READ ST$,TT$:CT$(I*20+1,I*20+20)=
    TT$:CTL(I)=LEN(TT$)
225 FOR K=1 TO 7:READ T:H(K,I)=T:NEXT
     K
230 TRAP 240:IF ST$=B$(1,LEN(ST$)) TH
    EN I=I+1
240 TRAP 40000:IF ST$="END" THEN 250
245 GOTO 220
250 J=I-1:LL=YS-74+1:PRINT "
    {3 SPACES}STATE{14 SPACES}CITY"
255 FOR I=1 TO J
260 PRINT I;"  ";B$;:POKE 85,22:? CT$
    (I*20+1,I*20+CTL(I)):NEXT I
270 PRINT "CHOOSE # OF CITY";:INPUT I
    :PRINT :GOSUB 500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1
    )/F(1):H=INT(RATE(1)*100)/100
282 PRINT "CHOSEN CITY= ";CT$(I*20+1,
    I*20+CTL(I)):PRINT "RATE(1ST YEAR
    )=";H
285 ? :? "YEAR  RATE  FUEL SAV. $ SAV
    INGS"
295 FOR K=2 TO L
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)
    =D(K)/F(K):C=H*RATE(K)
312 H=INT(H*100)/100:RATE(K)=INT(RATE
    (K)*100)/100:C=INT(C*100)/100
320 PRINT " ";INT(YS+K-1);"{TAB} ";RA
    TE(K);"{TAB}";H;"{TAB}{3 SPACES}"
    ;C
```

```
340 NEXT K:PRINT :GOSUB 500:PRINT "(+
    = SAVINGS)(- = LOSS)":GOTO 255
500 PRINT "-------------------------
    -----":RETURN
1999 DATA APRIL,MAY,JUNE,JULY,AUGUST,
    SEPTEMBER,OCTOBER
```

Program 12. Color Computer Version.

```
1 REM COOLING FUEL AUDIT
10 REM
11 REM PROGRAM REQUIRED COOLING FUEL USE (ANN
    UAL OR BY MONTH)
12 REM COOLING MONTHS ARE APRIL 1 TO NOV 1, 2
    YRS OR MORE REQUIRED
13 REM OUTPUT IS FUEL SAVINGS, AND $ SAVINGS
15 REM ************************
17 DEFFNTRC(E)=INT(E*100)/100
18 CLS
20 PRINTTAB(6);"YEAR BY YEAR COOLING":PRINTTA
    B(7)"CONSERVATION AUDIT":PRINT:PRINT
22 GOSUB500:INPUT"STATE (DON'T ABBREVIATE)";B
    $
23 FORI=1TO7:READM$(I):NEXT:PRINT
25 PRINT"THE SUMMER OF 1974 IS CALLED 74,CHOI
    CES ARE 74 TO 80"
27 PRINT:INPUT"STARTING YEAR";YS:INPUT"LAST Y
    EAR";YE:PRINT
30 L=YE-YS+1:PRINT"CHOICES OF INPUT ARE BY YE
    AR OR MONTH":PRINT
40 INPUT"BY YEAR (Y OR N)";A$:IFASC(A$)<>89TH
    EN100
41 PRINT:PRINT"UNITS OF FUEL CAN BE ANYTHING:
    GALLONS, KWH, CUFT, 100 CUFT"
43 PRINT"ALL FUEL ENTRIES MUST BE THE    SAME
    UNITS":GOSUB500:PRINT
47 FORI=1TOL:GOSUB500:PRINT"YEAR =";INT(YS+I-
    1)
48 PRINT"FUEL USE FOR APR 1 TO NOV 1";:INPUTF
    (I):INPUT"COST(DOLLARS)";D(I)
90 GOSUB500:NEXT:GOTO200
100 FORI=1TOL:GOSUB500:PRINT"YEAR =";INT(YS+I-
```

```
    1):FORJ=1TO7
105 PRINT"FUEL USE FOR ";M$(J);:INPUTF:PRINT"C
    OST FOR ";M$(J);:INPUTD
110 F(I)=F(I)+F:D(I)=D(I)+D:NEXT:NEXT
200 INPUT"FUEL USE FOR JANUARY";MI:I=1
220 READST$,CT$(I),H(1,I),H(2,I),H(3,I),H(4,I)
    ,H(5,I),H(6,I)M,H(7,I)
230 IFLEFT$(ST$,7)=LEFT$(B$,7)THENI=I+1
240 IFST$="END"THEN250
245 GOTO220
250 J=I-1:LL=YS-74+1:PRINT"    STATE       CITY
    "
255 FORI=1TOJ
260 PRINTI;" ";B$;"  ";CT$(I):NEXT
270 INPUT"CHOOSE # OF CITY";I:PRINT:GOSUB500
280 X=(F(1)-7*MI)/H(LL,I):RATE(1)=D(1)/F(1):H=
    FNTRC(RATE(1))
282 PRINT"CHOSEN CITY= ";CT$(I):PRINT"RATE(1ST
     YEAR)=";H
285 PRINT:PRINT"YEAR RATE FUEL SAV. SAVING(DOL
    )"
295 FORK=2TOL
300 H=H(LL+K-1,I)*X+7*MI-F(K):RATE(K)=D(K)/F(K
    ):C=H*RATE(K)
312 H=FNTRC(H):RATE(K)=FNTRC(RATE(K)):C=FNTRC(
    C)
320 PRINTINT(YS+K-1);" ";RATE(K);" ";H;" ";C
340 NEXT:PRINT:GOSUB500:PRINT"(+ = SAVINGS)(- ~
    = LOSS)":GOTO255
500 PRINT"------------------------------":RET
    URN
1999 DATAAPRIL,MAY,JUNE,JULY,AUGUST,SEPTEMBER,O
    CTOBER
```

Program 13. TI-99 Version.

```
1 REM cooling fuel audit,TI version
11 REM program requires cooling fuel
   use (annual or by month)
12 REM cooling months are april 1 to
   nov 1, 2 yrs or more required
13 REM output is fuel savings, and $
   savings
```

5

```
15 REM  ********************
17 CALL CLEAR
18 CALL SCREEN(13)
19 DEF TRC(E)=INT(E*100)/100
20 PRINT "year by year cooling audit"
   : : : : : :
22 GOSUB 500
23 INPUT "state (don't abbreviate)? "
   :B$
24 FOR I=1 TO 7
25 READ M$(I)
27 NEXT I
29 PRINT
31 PRINT "the summer of 1974 is calle
   d74, choices are 74 to 80 ": :
35 INPUT "starting year? ":YS
37 INPUT "last year? ":YE
39 PRINT
41 L=YE-YS+1
42 PRINT "units of fuel can be
   {8 SPACES}anything: gallon, kwh, c
   uft,100 cuft"
43 PRINT "all fuel entries must be th
   esame units": : : :
44 PRINT "choices of input are by yea
   ror month": :
47 INPUT "by year (y or n)? ":A$
49 IF (ASC(A$)<>89)*(ASC(A$)<>121)THE
   N 100
51 PRINT
57 GOSUB 500
59 PRINT
61 FOR I=1 TO L
63 PRINT "year= ";INT(YS+I-1)
65 PRINT "fuel use for apr 1 to nov 1
    ";
67 INPUT F(I)
69 INPUT "cost (dollars)? ":D(I)
90 GOSUB 500
94 NEXT I
96 GOTO 150
100 FOR I=1 TO L
```

5

```
101 GOSUB 500
102 PRINT "year = ";INT(YS+I-1)
104 FOR J=1 TO 7
105 PRINT "fuel use for ";M$(J);
107 INPUT FF
108 PRINT "cost for ";M$(J);
109 INPUT DD
110 F(I)=F(I)+FF
112 D(I)=D(I)+DD
114 NEXT J
116 NEXT I
150 CALL CLEAR
200 INPUT "fuel use for january? ":MI
201 CALL CLEAR
202 I=1
220 READ ST$,CT$(I),H(1,I),H(2,I),H(3
    ,I),H(4,I),H(5,I),H(6,I),H(7,I)
230 IF SEG$(ST$,1,7)<>SEG$(B$,1,7)THE
    N 240
235 I=I+1
240 IF ST$="end" THEN 250
245 GO TO 220
250 J=I-1
251 LL=YS-74+1
252 PRINT TAB(5);"state";TAB(15);"cit
    y"
255 FOR I=1 TO J
260 PRINT I;TAB(5);B$;TAB(15);CT$(I)
265 NEXT I
270 INPUT "choose # of city ":I
272 CALL CLEAR
274 GOSUB 500
280 X=(F(1)-7*MI)/H(LL,I)
281 RATE(1)=D(1)/F(1)
282 YY=TRC(RATE(1))
283 PRINT "chosen city= ";CT$(I)
284 PRINT "rate (1st year)= ";YY: :
290 PRINT "year";TAB(6);"rate";TAB(13
    );"fuel";TAB(21);"savings"
292 PRINT TAB(12);"savings";TAB(20);"
    (dollars)"
295 FOR K=2 TO L
```

```
300 HH=H(LL+K-1,I)*X+7*MI-F(K)
302 RATE(K)=D(K)/F(K)
304 C=HH*RATE(K)
312 HH=TRC(HH)
314 RATE(K)=TRC(RATE(K))
316 C=TRC(C)
320 PRINT INT(YS+K-1);TAB(5);RATE(K);
    TAB(12);HH;TAB(21);C
340 NEXT K
342 PRINT
344 GOSUB 500
346 PRINT " (+ = savings) (- = loss)"
348 GOTO 255
500 PRINT "-------------------------
    --"
502 RETURN
1999 DATA april,may,june,july,august,
     september,october
```

Program 14. Cooling Audit DATA Statements.

```
2000 DATATEXAS,BROWNSVILLE,3871,3857,3327,4023,
    4188,3689,3756
2001 DATATEXAS,ARMARILLO,1396,1235,1013,1700,15
    56,1168,1666
2020 DATATEXAS,FORT WORTH,2578,2609,2251,3017,2
    965,2509,3142
2030 DATATEXAS,HOUSTON,2821,2656,2225,2751,2866
    ,2577,3127
2032 DATAALABAMA,BIRMINGHAM,1640,1858,1427,2272
    ,1975,1719,2177
2034 DATAALABAMA,MOBILE,2548,2732,2405,2846,288
    4,2442,2680
2036 DATAALABAMA,MONTGOMERY,1941,2349,1730,2630
    ,2388,2033,2375
2038 DATAARIZONA,FLAGSTAFF,232,88,98,191,152,85
    ,334
2040 DATAARIZONA,PHOENIX,4285,3785,3965,4521,43
    43,4186,3872
2042 DATAARIZONA,TUCSON,2788,2592,2760,3099,318
    4,3052,2844
2044 DATAARKANSAS,LITTLEROCK,1787,1941,1602,226
```

```
    6,2358,1926,2486
2046 DATACALIFORNIA,LOSANGELES,627,505,864,602,
    827,845,494
2048 DATACALIFORNIA,SANFRANCISCO,127,80,192,88,
    144,182,102
2050 DATACOLORADO,DENVER,715,554,667,799,748,66
    1,950
2052 DATACONNECTICUTT,HARTFORD,764,870,819,905,
    657,811,787
2054 DATADELAWARE,WILMINGTON,1109,1101,1003,112
    0,1016,990,1333
2056 DATAFLORIDA,JACKSONVILLE,2460,2784,2179,27
    17,2559,2483,2647
2058 DATAFLORIDA,MIAMI,4657,4570,4014,4202,4183
    ,4218,3486
2060 DATAFLORIDA,TALLAHASSEE,2472,2604,2292,249
    8,2480,2198,2458
2062 DATAGEORGIA,ATLANTA,1506,1600,1254,1735,17
    73,1762,2370
2064 DATAGEORGIA,SAVANAH,2289,2574,1954,2643,25
    70,2390,2501
2066 DATAIDAHO,BOISE,851,789,535,822,597,752,51
    1
2068 DATAIDAHO,POCATELLO,460,440,372,519,369,47
    9,225
2070 DATAILLINOIS,CHICAGO,770,1124,906,1218,982
    ,812,929
2072 DATAILLINOIS,SPRINGFIELD,984,1200,1021,136
    9,1253,1201,1452
2074 DATAINDIANA,EVANSVILLE,1229,1500,1112,1779
    ,1550,1238,1672
2076 DATAINDIANA,FORTWAYNE,727,833,664,1032,898
    ,677,844
2078 DATAINDIANA,INDIANAPOLIS,850,1046,770,1363
    ,1300,882,1142
2080 DATAIOWA,DESMOINES,974,1237,1050,1342,1226
    ,984,1262
2082 DATAIOWA,SIOUXCITY,980,1013,969,862,928,86
    5,1071
2084 DATAKANSAS,TOPEKA,1173,1474,1294,1563,1434
    ,1275,1810
2086 DATAKANSAS,WICHITA,1466,1512,1417,1841,204
    7,1663,2286
2088 DATAKENTUCKY,LOUISVILLE,1055,1506,1130,171
    7,1539,1236,1676
2090 DATALOUISIANA,BATONROUGE,2641,2618,2248,27
```

```
    72,2781,2379,2670
2092 DATALOUISIANA,NEWORLEANS,2655,2637,2390,29
    62,3059,2895,3030
2094 DATAMAINE,CARIBOU,116,271,231,223,264,290,
    211
2096 DATAMAINE,PORTLAND,296,351,308,308,336,316
    ,468
2098 DATAMARYLAND,BALTIMORE,1038,1245,1149,1474
    ,1274,1137,1407
2100 DATAMASSACHUSETTS,BOSTON,646,862,895,897,6
    68,789,894
2102 DATAMICHIGAN,DETROIT,620,731,706,873,760,5
    22,672
2104 DATAMICHIGAN,GRANDRAPIDS,400,619,638,714,5
    88,614,667
2106 DATAMICHIGAN,SAULST.MARIE,126,243,167,86,1
    25,145,96
2108 DATAMINNESOTA,DULUTH,149,229,271,122,224,1
    69,241
2110 DATAMINNESOTA,INT.FALLS,259,328,281,187,21
    9,131,327
2112 DATAMINNESOTA,MINNEAPOLIS,619,850,950,691,
    811,651,776
2114 DATAMISSISSIPPI,JACKSON,2036,2300,1943,253
    5,2421,1947,2578
2116 DATAMISSOURI,KANSASCITY,1159,1534,1296,140
    3,1535,1174,1721
2118 DATAMISSOURI,ST.LOUIS,1175,1431,1229,1667,
    1519,1578,1907
2120 DATAMISSOURI,SPRINGFIELD,1095,1349,1085,16
    92,1565,1122,1850
2122 DATAMONTANA,BILLINGS,572,478,547,545,429,7
    16,670
2124 DATAMONTANA,GREATFALLS,473,315,389,293,332
    ,396,302
2126 DATAMONTANA,MISSOULA,303,258,158,295,185,3
    90,125
2128 DATANEBRASKA,LINCOLN,1128,1282,1178,1250,1
    175,1098,1552
2130 DATANEBRASKA,OMAHA,1021,1389,1249,1364,132
    1,1124,1374
2132 DATANEVADA,LASVEGAS,3403,2973,2809,3332,33
    00,3387,3035
2134 DATANEVADA,RENO,258,348,236,500,340,404,40
    0
2136 DATANEW HAMPSHIRE,CONCORD,302,553,419,488,
```

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    521,519,450
2138 DATANEW JERSEY,TRENTON,977,1070,1053,1163,
    976,936,1288
2140 DATANEW MEXICO,ALBUQUERQUE,1353,1100,1141,
    1335,1398,1508,1519
2142 DATANEW MEXICO,ROSWELL,1655,1437,1786,2428
    ,1991,1684,2061
2144 DATANEW YORK,ALBANY,386,597,476,574,456,63
    6,561
2146 DATANEW YORK,NEWYORK,1017,953,1158,1097,91
    9,1049,1276
2148 DATANEW YORK,SYRACUSE,405,555,357,520,623,
    595,687
2150 DATANORTH CAROLINA,ASHEVILLE,731,795,545,1
    007,973,792,1166
2152 DATANORTH CAROLINA,RALEIGH,1325,1452,1459,
    1701,1671,1275,1742
2154 DATANORTH CAROLINA,WILMNGTON,1978,2373,193
    6,2310,2097,1966,2230
2156 DATANORTH DAKOTA,FARGO,444,553,766,487,604
    ,504,580
2158 DATANORTH DAKOTA,WILLISTON,440,376,507,410
    ,421,415,600
2160 DATAOHIO,COLUMBUS,836,1147,608,1073,968,80
    8,1008
2162 DATAOHIO,TOLEDO,608,692,599,784,741,602,74
    0
2164 DATAOKLAHOMA,OKLACITY,1651,1615,1702,2163,
    2418,1805,2479
2166 DATAOREGON,BURNS,406,347,227,451,277,367,1
    06
2168 DATATENNESSEE,KNOXVILLE,1340,1530,1133,181
    1,1612,1355,1814
2170 DATAPENNSYLVANIA,HARRISBURG,1163,1026,901,
    1053,1015,828,1183
2172 DATAPENNSYLVANIA,PITTSBURG,657,721,358,623
    ,836,620,876
2174 DATAPENNSYLVANIA,PHILADELPHIA,1165,1243,12
    11,1237,1247,1097,1410
2176 DATARHODE ISLAND,PROVIDENCE,666,694,631,82
    1,610,640,789
2178 DATASOUTH CAROLINA,CHARLESTON,2044,2408,18
    85,2584,2319,2204,2258
2180 DATASOUTH CAROLINA,GREENVILLE,1435,1547,11
    35,1958,1559,1296,1710
2182 DATASOUTH DAKOTA,RAPIDCITY,697,583,676,574
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    ,669,550,665
2184 DATASOUTH DAKOTA,SIOUXFALLS,751,910,1040,8
    54,743,724,793
2186 DATATENNESSEE,CHATTANOOGA,1058,1365,1165,2
    095,1847,1432,1778
2192 DATAUTAH,SALTLAKECITY,1191,900,943,1108,10
    18,1274,990
2194 DATAVERMONT,BURLINGTON,442,699,483,507,489
    ,531,503
2196 DATAVIRGINIA,NORFOLK,1531,1744,1558,1930,1
    535,1433,1788
2198 DATAVIRGINIA,RICHMOND,1259,1433,1385,1814,
    1573,1375,1681
2200 DATAWASHINGTON,SEATTLE,196,197,129,232,210
    ,171,57
2202 DATAWASHINGTON,SPOKANE,405,340,293,472,326
    ,496,228
2204 DATAWEST VIRGINIA,CHRLSTON,910,1074,801,12
    27,1114,894,1123
2206 DATAWISCONSIN,GREENBAY,323,514,520,534,440
    ,380,451
2208 DATAWISCONSIN,MADISON,457,742,627,622,589,
    450,630
2210 DATAWYOMING,CHEYENNE,349,193,217,252,297,3
    52,415
2990 DATAWYOMING,LANDER,467,333,394,410,408,436
    ,423
2995 DATAEND,END,0,0,0,0,0,0,0
3000 END
```

6

Heat Conduction

6

Heat Conduction

If you have ever been in your attic in the summer or have felt a cold window with your hand in the winter, you probably wondered how much the conduction through the window or the ceiling was costing you. The first inch of insulation does the most good at resisting heat flow, and each inch after that is less and less effective. Even with today's rapidly increasing energy prices, a point is reached when it is not economical to keep adding insulation.

The conduction program will allow you to determine how much heat you are losing in the winter or how much heat you are gaining in the summer and how this affects your utility bills. The program requires that you know the temperature on each side of the wall or window in question. This can be done by using simple thermometers which are shaded from the sun and are manually recorded every few hours during a day.

Calculating The EER

The program requires that the hot side (T1) always be hotter than the cold side (T2); no reversals are permitted. The energy efficiency of the air conditioner must be known. It will be either an EER or SEER. If you don't know the rating, you can calculate it after you determine the number of amps it draws by reading the specification plate. Use the following formula to calculate the EER:

EER = TONS * 12000/(volts * amps)

It should fall between 6 and 12 for a typical unit.

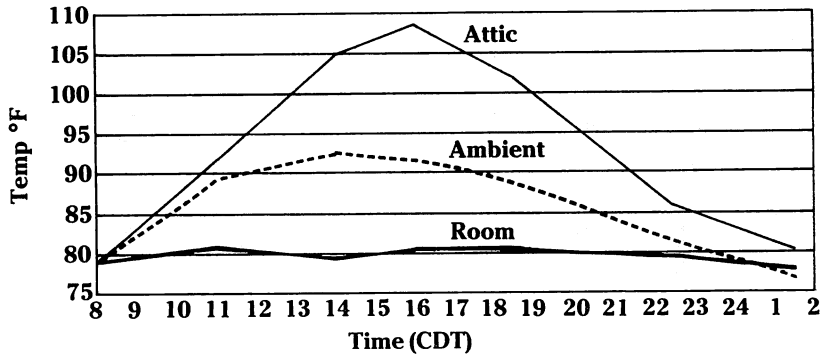
The area and the R value of the wall or window must be known, along with the price of electricity for cooling or natural gas for heating. Books listing the R values of various materials are widely available from public libraries and from power companies. The following is a small sample to get you started.

Material	R-value
Sheet Rock wall board	.32
Single window	1.0
Double window	2.0
1/4" plywood	.3
Brick	.4
air space >.75 in	.9

The figure shows the attic, ambient (outside), and room temperature for July 19, 1982 in the author's house. The attic is ventilated by turbine vents, and the ceiling has an R value of about 19. If it were not for the prevailing winds and the ventilators, the attic temperatures would have been much hotter, thereby increasing the heat flow into the house. In fact, the more insulation placed in the ceiling, the hotter the attic will become, unless it is offset by better ventilation.

The sample run for this situation shows that about $9/month is being lost through the ceiling. At this rate, any further improvements would have to be fairly inexpensive in order to be cost effective. If the author could have achieved 100% ventilation, the temperature would have been almost 20 degrees cooler in the attic. Even so, this would have saved only about $4 per month.

Given this situation, the author will probably try to increase ventilation in the attic using additional soffit vents (grill-type vents under the eaves), but will probably not use power turbines until electric rates increase substantially.



Temperatures in the Author's House on July 19, 1982 in Houston, TX.

Sample Run.

```
                    HEAT CONDUCTION PROGRAM

CALCULATIONS ARE FOR:
                1) AIR CONDITIONING
                2) HEATING
CHOOSE ONE? 1

# OF TEMP DATA POINTS DESIRED? 7
R VALUE OF INSULATION? 19
AREA OF SURFACE(SQ FT)? 2000
COST OF ELECTRICITY (CENTS/KWH)? 8.5
SEER OR EER OF AIR CONDITIONER (6-12)? 7.5


IN THE FOLLOWING SECTION YOU SHOULD INPUT THE TIME
AND TEMPERATURES FOR THE HEAT CONDUCTION CALCULATIONS
DURING THAT PART OF A DAY WHEN TEMP1>= TEMP2

MILITARY TIME SHOULD BE USED (E.G. 1 PM IS 13)
TEMPERATURE SHOULD BE IN DEG F

HIT <RETURN> TO CONTINUE


HOUR = ? 8
MINUTES = ? 15
HOT SIDE TEMP = ? 80
COLD SIDE TEMP = ? 80

HOUR = ? 11
MINUTES = ? 0
HOT SIDE TEMP = ? 91.4
COLD SIDE TEMP = ? 80

HOUR = ? 13
MINUTES = ? 45
HOT SIDE TEMP = ? 104.9
COLD SIDE TEMP = ? 80

HOUR = ? 16
MINUTES = ? 0
HOT SIDE TEMP = ? 108.5
COLD SIDE TEMP = ? 80

HOUR = ? 18
MINUTES = ? 30
HOT SIDE TEMP = ? 102
COLD SIDE TEMP = ? 80

HOUR = ? 22
MINUTES = ? 30
HOT SIDE TEMP = ? 86
COLD SIDE TEMP = ? 80

HOUR = ? 25
MINUTES = ? 45
HOT SIDE TEMP = ? 80
COLD SIDE TEMP = ? 80


COST OF CONDUCTION OF HEAT INTO HOUSE
FOR 30 DAYS = $9.11
```

Program 1. OSI Version.

```
10 REM CONDUCTION PROGRAM, OSI VERSION
30 DEFFNTRC(E)=INT(E*100)/100
35 POKE2888,0:POKE8722,0:REM NULL INPUT ENABLE
40 GOSUB330:PRINTTAB(21);"HEAT CONDUCTION PROGRAM":PRINT
50 PRINT"CALCULATIONS ARE FOR:":PRINTTAB(15);"1) AIR CONDITIONING"
60 PRINTTAB(15);"2) HEATING":PRINT:INPUT"CHOOSE ONE";A$
70 PRINT:PRINT"# OF TEMPERATURE DATA POINTS";:INPUT" DESIRED";N
80 DIM HR(N),MIN(N),T1(N),T2(N)
90 PRINT:INPUT"R VALUE OF INSULATION";R
100 PRINT:INPUT"AREA OF SURFACE (SQ FT)";A
110 IFA$="2"THEN140
120 PRINT:INPUT"COST OF ELECTRICITY (CENTS/KWH)";C
130 PRINT:INPUT"SEER OR EER OF AIRCONDITIONER (6-12)";SEER:GOTO150
140 PRINT:INPUT"COST OF NATURAL GAS (CENTS/CU FT)";C
150 GOSUB330:PRINT"IN THE FOLLOWING SECTION YOU SHOULD INPUT THE TIME"
152 PRINT"AND TEMPERATURES FOR THE HEAT CONDUCTION CALCULATIONS"
154 PRINT"DURING THAT PART OF A DAY WHEN TEMP1 >= TEMP2"
160 PRINT:PRINT"MILITARY TIME SHOULD BE USED E.G. 1 PM IS 13"
162 PRINT"TEMPERATURE SHOULD BE IN DEG F."
170 PRINT:PRINT"HIT CARRIAGE RETURN TO CONTINUE"
180 INPUTB$:GOSUB270
200 FL=0:FORM=2TON:D1=T1(M-1)-T2(M-1):D2=T1(M)-T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-1)/60
220 FL=FL+(D1+D2)*DT/(2*R):NEXT
230 IFA$="2"THENGOTO250
```

```
240 GOSUB330:PRINT"COST OF CONDUCTION OF HEAT INTO HOUSE"
242 PRINT"FOR 30 DAYS = $";FNTRC(30*FL*A*C/(SEER*100000)):STOP
250 FORI=1TO32:PRINT:NEXT:PRINT"COST OF CONDUCTION OF HEAT OUT OF HOUSE"
252 PRINT"FOR 30 DAYS = $";FNTRC(FL*A*C*30/55000)
260 END
270 FORM=1TON:PRINT:INPUT"HOUR=";HR(M):IFL=0ANDHR(M)<HR(M-1)THENL=1
280 IFL=1THENHR(M)=HR(M)+24
290 INPUT"MINUTES= ";MIN(M)
300 INPUT"HOT SIDE TEMP= ";T1(M)
310 INPUT"COLD SIDE TEMP= ";T2(M)
320 IFT2(M)>T1(M)THENPRINT"ERROR IN ";M;"LINE":STOP
325 NEXT:RETURN
330 FORI=1TO10:PRINT:NEXT:RETURN
350 REM FL=HEAT FLUX BTU/SQ FT
360 REM C=COST OF FUEL
370 REM T1=HOT SIDE TEMP DEG F
380 REM T2=COLD SIDE TEMP DEG F
390 REM A=AREA OF SURFACE SQ FT
400 TRM HT()=HOURS, MIN()=MIN
410 REM D1 & D2 = TEMP DIFFERENTIAL
420 REM R= R VALUE OF INSULATION
430 REM SEER = EER OR SEER (EFFICIENCY) OF AIRCONDITIONER=(BTU/HR)/WATT
440 REM DT=TIME BETWEEN TWO TEMPERATURE MEASUREMENTS (HOURS)
```

6

Program 2. VIC Version.

```
10 REM CONDUCTION PROGRAM VIC VERSION
30 DEFFNTRC(E)=INT(E*100)/100
40 GOSUB330:PRINT"{CLEAR} HEAT CONDUCTION PRO
   G{DOWN}"
50 PRINT"CALCULATIONS ARE FOR":PRINT"1) AIR C
   ONDITIONING"
60 PRINT"2) HEATING{DOWN}":PRINT"   <CHOOSE O
   NE>":INPUTA$
70 PRINT"{DOWN}# OF TEMP DATA PTS":INPUT"DESI
   RED";N
80 DIM HR(N),MIN(N),T1(N),T2(N)
90 PRINT"{DOWN}R VALUE OF INSULATION":INPUTR
100 PRINT"{DOWN}AREA OF SURFACE(SQ FT)":INPUTA

110 IFA$="2"THEN140
120 PRINT"{DOWN}COST OF ELECTRICITY":INPUT"(CE
   NTS/KWH)";C
130 PRINT"{DOWN}SEER OR EER OF        AIRCONDI
   TIONER (6-12)":INPUTSEER:GOTO150
140 PRINT"{DOWN}COST OF NATURAL GAS (CENTS/CU
   FT)":INPUTC
150 GOSUB330:PRINT"{CLEAR}IN THE FOLLOWING SEC
   TION YOU SHOULD INPUT   THE TIME"
152 PRINT"AND TEMPERATURES FOR  THE HEAT CONDU
   CTION   CALCULATIONS"
154 PRINT"DURING THAT PART OF A DAY WHEN TEMP1
   >= TEMP2"
160 PRINT"MILITARY TIME SHOULD  BE USED E.G. 1
    PM IS  13"
162 PRINT"TEMPERATURE SHOULD BE IN DEG F"
170 PRINT"HIT CARRIAGE RETURN TOCONTINUE"
180 GETB$:IFB$=""THEN180
200 GOSUB270:FL=0:FORM=2TON:D1=T1(M-1)-T2(M-1)
   :D2=T1(M)-T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-1)/60
220 FL=FL+(D1+D2)*DT/(2*R):NEXT
230 IFA$="2"THEN250
240 GOSUB330:PRINT"{CLEAR}COST OF CONDUCTION O
   F HEAT INTO HOUSE"
242 PRINT"FOR 30 DAYS = $";FNTRC(30*FL*A*C/(SE
   ER*10↑5)):STOP
250 PRINT"{CLEAR}COST OF CONDUCTION OF HEAT OU
   T OF HOUSE"
```

```
252 PRINT"FOR 30 DAYS = $";FNTRC(FL*A*C*30/550
    00)
260 END
270 PRINT"{CLEAR}  HR MIN TEMP1 TEMP2":PRINT
275 FORM=1TON:INPUTHR(M):IFL=0ANDHR(M)<HR(M-1)
    THENL=1
280 IFL=1THENHR(M)=HR(M)+24
290 PRINT"{UP}";TAB(4);:INPUTMIN(M)
300 PRINT"{UP}";TAB(8);:INPUTT1(M)
310 PRINT"{UP}";TAB(15);:INPUTT2(M)
320 IFT2(M)>T1(M)THENPRINT"ERROR IN "M;"LINE":
    STOP
325 NEXT:RETURN
330 PRINT"{02 DOWN}":RETURN
350 REM FL=HEAT FLUX BTU/SQ FT
360 REM C=COST OF FUEL
370 REM T1=HOT SIDE TEMP DEG F
380 REM T2=COLD SIDE TEMP DEG F
390 REM A=AREA OF SURFACE SQ FT
400 REM HT()=HOURS, MIN()=MIN
410 REM D1 & D2 = TEMP DIFFERENTIAL
420 REM R= R VALUE OF INSULATION
430 REM SEER = EER OR SEER (EFFICIENCY) OF AIR
    CONDTIONER =(BTU/HR)/WATT
440 REM DT=TIME BETWEEN TWO TEMPERATURE MEASUR
    EMENTS (HOURS)
```

Program 3. Microsoft Version.

```
10 REM CONDUCTION PROGRAM
30 DEFFNTRC(E)=INT(E*100)/100
40 GOSUB330:PRINT"{CLEAR}        HEAT CONDUCTI
    ON PROGRAM{04 DOWN}"
50 PRINTTAB(8);"CALCULATIONS ARE FOR:{DOWN}":
    PRINTTAB(8);"1) AIR CONDITIONING{DOWN
    DOWN}"
60 PRINTTAB(8);"2) HEATING{DOWN}":PRINTTAB(11
    );"<CHOOSE ONE>";:INPUTA$
70 INPUT"{DOWN}# OF TEMP DATA PTS DESIRED,(=>
    5)";N
80 DIM HR(N),MIN(N),T1(N),T2(N)
90 INPUT"{DOWN}R VALUE OF INSULATION";R
100 INPUT"{DOWN}AREA OF SURFACE(SQ FT)";A
110 IFA$="2"THEN140
```

```
120 INPUT"{DOWN}COST OF ELECTRICITY (CENTS/KWH
    )";C
130 INPUT"{DOWN}SEER OR EER OF{RIGHT}AIRCONDIT
    IONER(6-12)";SEER:GOTO150
140 INPUT"{DOWN}COST OF NATURAL GAS (CENTS/CU ~
    FT)";C
150 GOSUB330:PRINT"{CLEAR}{06 DOWN}IN THE FOLL
    OWING SECTION YOU SHOULD"
152 PRINT"INPUT THE TIME AND TEMPERATURES FOR ~
    THE HEAT ";
154 PRINT"CONDUCTION CALCULATIONS DURING THATP
    ART OF A DAY WHEN TEMP1 >= TEMP2"
160 PRINT"{DOWN}MILITARY TIME SHOULD BE USED E
    .G. 1 PM  IS 13"
162 PRINT"{DOWN}TEMPERATURE SHOULD BE IN DEG F
    "
170 PRINT"{DOWN}<PRESS CARRIAGE RETURN TO CONT
    INUE>"
180 GETB$:IFB$=""THEN180
200 GOSUB270:FL=0:FORM=2TON:D1=T1(M-1)-T2(M-1)
    :D2=T1(M)-T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-1)/60
220 FL=FL+(D1+D2)*DT/(2*R):NEXT
230 IFA$="2"THEN250
240 GOSUB330:PRINT"{CLEAR}{05 DOWN}COST OF CON
    DUCTION OF HEAT INTO HOUSE"
242 PRINT"FOR 30 DAYS = $";FNTRC(30*FL*A*C/(SE
    ER*10↑5)):GOTO255
250 PRINT"{CLEAR}{05 DOWN}COST OF CONDUCTION O
    F HEAT OUT OF HOUSE"
252 PRINT"FOR 30 DAYS = $";FNTRC(FL*A*C*30/550
    00)
255 GOTO255
260 END
270 PRINT"{CLEAR}  HR       MIN     TEMP1      TE
    MP2{DOWN}"
275 FORM=1TON:INPUTHR(M):IFL=0ANDHR(M)<HR(M-1)
    THENL=1
280 IFL=1THENHR(M)=HR(M)+24
290 PRINT"{UP}";TAB(8);:INPUTMIN(M)
300 PRINT"{UP}";TAB(17);:INPUTT1(M)
310 PRINT"{UP}";TAB(27);:INPUTT2(M)
320 IFT2(M)>T1(M)THENPRINT"ERROR IN "M;"LINE, ~
    TEMP2>TEMP1":STOP
325 NEXT:RETURN
```

```
330 PRINT"{02 DOWN}":RETURN
350 REM FL=HEAT FLUX BTU/SQ FT
360 REM C=COST OF FUEL
370 REM T1=HOT SIDE TEMP DEG F
380 REM T2=COLD SIDE TEMP DEG F
390 REM A=AREA OF SURFACE SQ FT
400 REM HT()=HOURS, MIN()=MIN
410 REM D1 & D2 = TEMP DIFFERENTIAL
420 REM R= R VALUE OF INSULATION
430 REM SEER = EER OR SEER (EFFICIENCY) OF AIR
    CONDTIONER =(BTU/HR)/WATT
440 REM DT=TIME BETWEEN TWO TEMPERATURE MEASUR
    EMENTS (HOURS)
```

Program 4. Atari Version.

```
10 REM CONDUCTION PROGRAM ATARI VERSI
   ON
20 OPEN #1,4,0,"K:":DIM A$(20)
40 GOSUB 330:PRINT "{CLEAR} HEAT COND
   UCTION PROG{DOWN}"
50 PRINT "CALCULATIONS ARE FOR":PRINT
    "1) AIR CONDITIONING"
60 PRINT "2) HEATING{DOWN}":PRINT "
   {3 SPACES}<CHOOSE ONE>":INPUT A$
70 PRINT "{DOWN}# OF TEMP DATA PTS":P
   RINT "DESIRED";:INPUT N
80 DIM HR(N),MIN(N),T1(N),T2(N)
90 PRINT "{DOWN}R VALUE OF INSULATION
   ":INPUT R
100 PRINT "{DOWN}AREA OF SURFACE(SQ F
    T)":INPUT A
110 IF A$="2" THEN 140
120 PRINT "{DOWN}COST OF ELECTRICITY"
    :PRINT "(CENTS/KWH)";:INPUT C
130 PRINT "{DOWN}SEER OR EER OF AIR C
    ONDITIONER (6-12)":INPUT SEER:GOT
    O 150
140 PRINT "{DOWN}COST OF NATURAL GAS
    (CENTS/CU FT)":INPUT C
150 GOSUB 330:PRINT "{CLEAR}IN THE FO
```

```
    LLOWING SECTION YOU SHOULD":? "EN
    TER THE TIME"
152 PRINT "AND TEMPERATURES FOR THE H
    EAT":? "CONDUCTION CALCULATIONS"
154 PRINT "DURING THAT PART OF A DAY"
    :? "WHEN TEMP1>= TEMP2"
160 PRINT "MILITARY TIME SHOULD BE US
    ED":? "E.G. 1 PM IS 13"
162 PRINT "TEMPERATURE SHOULD BE IN D
    EG F"
170 ? :PRINT "HIT RETURN TO CONTINUE"
180 GET #1,ZZ
200 GOSUB 270:FL=0:FOR M=2 TO N:D1=T1
    (M-1)-T2(M-1):D2=T1(M)-T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-
    1)/60
220 FL=FL+(D1+D2)*DT/(2*R):NEXT M
230 IF A$="2" THEN 250
240 GOSUB 330:PRINT "{CLEAR}COST OF C
    ONDUCTION OF HEAT INTO HOUSE"
242 PRINT "FOR 30 DAYS = $";:V=(30*FL
    *A*C/(SEER*10^5)):V=INT(V*100+0.5
    )/100:? V:END
250 PRINT "{CLEAR}COST OF CONDUCTION
    OF HEAT OUT OF HOUSE"
252 PRINT "FOR 30 DAYS = $";:V=(FL*A*
    C*30/55000):V=INT(V*100+0.5)/100:
    ? V
260 END
270 PRINT "{CLEAR} HR{3 SPACES}MIN
    {3 SPACES}TEMP1{3 SPACES}TEMP2":P
    RINT
275 FOR M=1 TO N:INPUT TT:HR(M)=TT:IF
     L=0 AND HR(M)<HR(M-1) THEN L=1
280 IF L=1 THEN HR(M)=HR(M)+24
290 PRINT "{UP}";:POKE 85,8:INPUT TT:
    MIN(M)=TT
300 PRINT "{UP}";:POKE 85,14:INPUT TT
    :T1(M)=TT
310 PRINT "{UP}";:POKE 85,22:INPUT TT
    :T2(M)=TT
320 IF T2(M)>T1(M) THEN PRINT "ERROR
```

```
    IN  ";M;" LINE":END
325 NEXT M:RETURN
330 PRINT "{2 DOWN}":RETURN
350 REM FL=HEAT FLUX BTU/SQ FT
360 REM C=COST OF FUEL
370 REM T1=HOT SIDE TEMP DEG F
380 REM T2=COLD SIDE TEMP DEG F
390 REM A=AREA OF SURFACE SQ FT
400 REM HT()=HOURS, MIN()=MIN
410 REM D1 & D2 = TEMP DIFFERENTIAL
420 REM R= R VALUE OF INSULATION
430 REM SEER = EER OR SEER (EFFICIENC
    Y) OF AIRCONDTIONER =(BTU/HR)/WAT
    T
440 REM DT=TIME BETWEEN TWO TEMPERATU
    RE MEASUREMENTS (HOURS)
```

Program 5. Color Computer Version.

```
10 REM COLOR COMPUTER VERSION
20 REM CONDUCTION PROGRAM
30 DEFFNTRC(A)=INT(A*100)/100
40 CLS:PRINTTAB(5);"HEAT CONDUCTION PROGRAM":
   PRINT
50 PRINT"CALCULATIONS ARE FOR:":PRINT"      1
   ) AIR CONDITIONING":PRINT"       2) H
   EATING"
60 PRINT:INPUT"CHOOSE ONE";A$
70 PRINT:PRINT"# OF TEMPERATURE DATA POINTS":
   INPUT"DESIRED";N:IFN=0THEN70
80 DIM HR(N),MIN(N),T1(N),T2(N)
90 PRINT:INPUT"R VALUE OF INSULATION";R:CLS
100 PRINT:INPUT"AREA OF SURFACE (SQ FT)";A
110 IFA$="2"THEN140
120 PRINT:INPUT"COST OF ELECTRICITY (CENTS/KWH
    )";C
130 PRINT:INPUT"SEER OR EER OF AIRCONDITIONER ~
    (6-12)";SEER:GOTO150
140 PRINT:INPUT"COST OF NATURAL GAS (CENTS/CU ~
    FT)";C
150 CLS:PRINT"IN THE FOLLOWING SECTION YOU SHO
    ULD INPUT THE TIME AND TEMPERATURES"
155 PRINT"FOR THE HEAT CONDUCTION CALCULATIONS
```

```
     DURING THAT PART OF A DAY"
159 PRINT"WHEN TEMP1>= TEMP2"
160 PRINT:PRINT"MILITARY TIME SHOULD BE USED E
    .G. 1 PM IS 13"
165 PRINT"TEMPERATURE SHOULD BE IN DEG F"
170 PRINT:PRINT"HIT ANY KEY TO CONTINUE"
180 IF INKEY$=""THEN180
190 GOSUB270
200 FL=0:FORM=2TON:D1=T1(M-1)-T2(M-1):D2=T1(M)
    -T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-1)/60
220 FL=FL+(D1+D2)*DT/(2*R):NEXT
230 IFA$="2"THENGOTO250
240 CLS:PRINT"COST OF CONDUCTION OF HEAT INTO ~
    HOUSE"
245 PRINT"FOR 30 DAYS = $";FNTRC(30*FL*A*C/(SE
    ER*10 5)):STOP
250 CLS:PRINT"COST OF CONDUCTION OF HEAT OUT O
    F HOUSE"
255 PRINT"FOR 30 DAYS = $";FNTRC(FL*A*C*30/550
    00)
260 END
270 GOSUB330:FORM=1TON:INPUTHR(M):IFL=0ANDHR(M
    )<HR(M-1)THENL=1
280 IFL=1THENHR(M)>=HR(M)+24
290 PRINT@6+32*M,"";:INPUTMIN(M)
300 PRINT@15+32*M,"";:INPUTT1(M)
310 PRINT@24+32*M,"";:INPUTT2(M)
320 IFT2(M)>T1(M)THENPRINT@13+32*M,"          ~
    ":GOTO300ELSENEXT:RETURN
330 CLS:PRINT"HOURS   MIN";TAB(15);"TEMP1";TAB
    (24);"TEMP2"
340 RETURN
350 REM FL=HEAT FLUX BTU/SQ FT
360 REM C=COST OF FUEL
370 REM T1=HOT SIDE TEMP DEG F
380 REM T2=COLD SIDE TEMP DEG F
390 REM A=AREA OF SURFACE SQ FT
400 REM HR()=HOURS, MIN()=MIN
410 REM D1 & D2 = TEMP DIFFERENTIAL
420 REM R= R VALUE OF INSULATION
430 REM SEER=EER OR SEER (EFFICIENCY) OF AIRCO
    NDITIONER =(BTU/HR)/(WATTS)
440 REM DT=TIME BETWEEN TWO TEMPERATURE MEASUR
    MENTS (HOURS)
```

6

Program 6. TI-99 Version.

```
10 REM conduction program, ti-99 vers
   ion
30 DEF TRC(E)=INT(E*100)/100
40 CALL CLEAR
44 PRINT "{3 SPACES}heat conduction p
   rogram"
45 FOR I=1 TO 10
46 PRINT
47 NEXT I
50 PRINT "calculations are for"
52 PRINT "1) air conditioning"
54 PRINT "2) heating"
56 PRINT
58 INPUT "choose one ":A$
60 PRINT
70 INPUT "number of temperature data
    points desired? ":N
80 DIM HR(30),MIN(30),T1(30),T2(30)
84 CALL CLEAR
90 INPUT "r value of insulation? ":R
94 PRINT
95 PRINT
100 INPUT "area of surface (sq ft)? "
    :A
110 IF A$="2" THEN 140
114 PRINT
115 PRINT
120 INPUT "cost of electricity
    {9 SPACES}(cents/kwh)? ":C
124 PRINT
125 PRINT
130 INPUT "seer or eer of{14 SPACES}ai
    rconditioner (6-12)? ":SEER
134 GOTO 150
140 PRINT
141 PRINT
144 INPUT "cost of natural gas (cents
    /cu ft)? ":C
150 CALL CLEAR
152 PRINT "in the following section y
```

```
    oushould input the time"
154 PRINT "and the temperatures for t
    heheat conduction calculations"
156 PRINT "during that part of a day
    (3 SPACES)when temp1 >= temp2": :
     :
159 PRINT "military time should be us
    ede.g. 1 pm is 13": : :
162 PRINT "temperature should be in
    (4 SPACES)deg f.": : :
170 PRINT "press <enter> to continue"
180 INPUT B$
181 CALL CLEAR
182 GOSUB 270
200 FL=0
202 FOR M=2 TO N
204 D1=T1(M-1)-T2(M-1)
206 D2=T1(M)-T2(M)
210 DT=HR(M)+MIN(M)/60-HR(M-1)-MIN(M-
    1)/60
220 FL=FL+(D1+D2)*DT/(2*R)
222 NEXT M
230 IF A$="2" THEN 250
240 GOSUB 330
241 MO=TRC(30*FL*A*C/(SEER*100000))
242 PRINT "cost of conduction of heat
      into house for 30 days
    (6 SPACES)= $";MO
244 STOP
250 CALL CLEAR
251 MO=TRC(FL*A*C*30/55000)
252 PRINT "cost of conduction of heat
     out of house for 30 days = $ ";M
    O
260 END
270 FOR M=1 TO N
271 PRINT
272 INPUT "hour= ?":HR(M)
273 IF L<>0 THEN 280
276 IF HR(M)>=HR(M-1)THEN 280
277 L=1
280 IF L<>1 THEN 290
```

```
285 HR(M)=HR(M)+24
290 INPUT "minutes =? ":MIN(M)
300 INPUT "hot side temp =?":T1(M)
310 INPUT "cold side temp =?":T2(M)
320 IF T2(M)<=T1(M)THEN 325
322 PRINT "error in line ";M
323 PRINT "hot side temp cannot be le
    ssthan cold side temp, reentertem
    peratures" : : :
324 GOTO 300
325 NEXT M
326 RETURN
330 FOR I=1 TO 10
335 PRINT
338 NEXT I
340 RETURN
350 REM f1=heat flux btu/sq ft
    {3 SPACES}
360 REM c=cost of fuel
370 REM t1=hot side temp deg f
    {3 SPACES}
380 REM t2=cold side temp deg f
390 REM a=area of surface sq ft
400 REM ht()= hours, min()=min
    {3 SPACES}
410 REM d1 & d2 = temp differential
420 REM r=r value of insulation
430 REM  seer = eer or seer {efficien
    cy} of airconditioner = {btu/hr}/
    watt
440 REM dt=time between two temperatu
    re measurements {hours}
```

7

Buying A New Air Conditioner

7

Buying A New Air Conditioner

Note: This program requires a data file on electricity usage created by the "Energy Data Base" program in this book. For the OSI, Atari, Apple, and Color Computer versions, the program expects the file to be stored on a disk. The VIC, PET/CBM/64 and TI versions use a data file stored on tape.

If your air conditioner repairman has just said last rites over your condensing unit and has given you an estimate for a new unit, you are probably in a state of shock. More than likely, though, you received not one estimate, but several, each with different price tags and different efficiencies. Now what do you do? How can one choose between a higher cost, more efficient air conditioner and a lower cost, less efficient air conditioner?

The efficiency rating which is applicable to the majority of central air conditioners is the SEER (Seasonal Energy Efficiency Rating). It is defined as the total cooling of an air conditioner in BTUs during a normal use period (several months) divided by the total electric energy input in Watt-Hours.

If you know the SEER of each prospective unit and you have used the data base program to save at least one year of data on your electric use, then the air conditioner program will tell you what you will save each year by buying the high efficiency unit. Then it is up to you to determine if the additional cost of the high efficiency air conditioner will be paid back soon enough to warrant the extra expense.

One note of caution: this program as currently set up is applicable only if you use different fuels for heating and cooling (e.g., heating with natural gas and cooling with electricity). The reason for this will become clear in the description of the program.

Dramatic Rise And Fall

Although different measures of efficiency are used for air conditioners depending upon their size and age, the definitions of the EER (energy efficiency rating) and SEER are similar enough to

make the program adaptable to either efficiency rating. If you want to calculate the EER of your air conditioner, simply use the formula:

EER = TONS * 12000/(VOLTS * AMPS)

Be sure to include the amperage of the condensing unit fan motor by adding it to the amperage of the compressor.

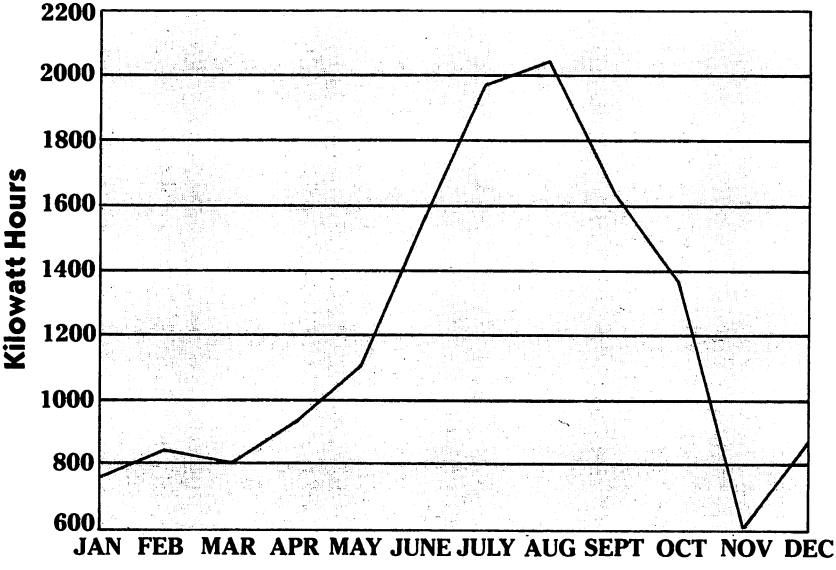
Since electricity has a wide variety of uses in the home, and since the air conditioner system is usually the largest user (52%), the electric use in an average home rises and falls dramatically during the year (see the figure). The first thing the air conditioner program does after reading in the data (lines 230-250) is to determine the minimum KWH in the latest year in the data base (lines 110-130). This is used as an estimate for all other uses of electricity in the house. This base is subtracted from all months in order to arrive at the electric use by the air conditoner (line 130).

The "old" air conditioner is presumed to be the least efficient (lower SEER or EER), and the "new" unit is defined as the most efficient (lines 150-160). If you have an all electric house, this technique would confuse cooling cost and heating cost and would thereby cause an overestimate of savings by buying the high efficiency air conditioner. The cost of electricity is input from the keyboard rather than by using last year's rates from the data base, since the user may want to extrapolate, using his estimate for the cost of electricity in the future.

Although the equation in line 200 looks a little complicated, it basically converts the air conditioning kilowatt hours into BTUs which the old unit removed during that year. The number of kilowatt hours required by the new air conditioner is then calculated by dividing these BTUs by the new SEER. The difference between the kilowatt hours used by the old (less efficient) unit and the new unit is multiplied by the utility rate which gives the annual savings.

Sample Run.

```
                CHOOSING AN AIR CONDITIONER

INSERT DISK WITH DATA FILE 'ELECT'

HIT <RETURN> AFTER INSERTING DISK

USING DATA FROM  1981  IN CALCULATIONS

SEER OF OLD AIR CONDITIONER? 6

SEER OF NEW AIR CONDITIONER? 8
CURRENT COST OF ELECTRICITY IN CENTS/KWH = ? 8.55


ANNUAL SAVINGS OF NEW AIR CONDITIONER
AS COMPARED TO THE OLD UNIT = $ 155.75
```



Electric Usage at the Author's Residence in Houston, TX in 1981.

Program 1. OSI Version.

```
10 REM CHOOSING AN AIRCONDITIONER
30 DEFFNTRC(X)=INT(X*100)/100:POKE2888,0:POKE8722,0:REM NULL INPUT
40 FORI=1TON:FORM=1TO12
50 MI=1E10:J=0:FORI=1TO15:PRINT:NEXT
60 PRINTTAB(20);"CHOOSING AN AIRCONDITIONER":FORI=1TO10:PRINT:NEXT
70 PRINT"INSERT DISK WITH DATA FILE 'ELECT'":PRINT:PRINT:PRINT
80 INPUT"HIT RETURN AFTER INSERTING DISK";I
90 GOSUB230
100 PRINT:PRINT:PRINT"USING DATA FROM ";EY;" IN CALCULATIONS"
110 I=N:FORM=1TO12:X=E(I,M)
120 IFX>0THENJ=J+1:S=S+E(I,M):IFX<MITHENMI=X
130 NEXT:S=S-MI*J
140 PRINT:PRINT:PRINT
150 INPUT"SEER OF OLD AIRCONDITIONER";BS:PRINT:PRINT:PRINT
160 INPUT"SEER OF NEW AIRCONDITIONER";NS:PRINT:PRINT:PRINT
170 INPUT"CURRENT COST OF ELECTRICITY IN CENTS/KWH=";CO:PRINT:PRINT:PRINT
180 PRINT"ANNUAL SAVINGS OF NEW AIRCONDITIONER"
190 PRINT"AS COMPARED TO THE OLD UNIT= $";
200 PRINTFNTRC(CO*S*BS*(1/BS-1/NS)/100)
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, EY=END YR,E()=ENERGY,D()=COST
230 DISK OPEN,6,"ELECT":INPUT#6,N,BY,EY:DIME(N,12),D(N,12)
240 FORI=1TON:FORM=1TO12
250 INPUT#6,E(I,M),D(I,M):NEXT:NEXT:RETURN
260 REM S=SUM OF KILOWATT HRS MINUS BASE KWATT HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

Program 2. VIC Version.

```
10 REM CHOOSING AN AIR CONDITIONER - VIC VERS
   ION
30 DEF FNTRC(X)=INT(X*100)/100
40 FORI=1TON:FORM=1TO12
50 MI=1E10:J=0
60 PRINT"{CLEAR}":PRINTTAB(05);"CHOOSING AN":
   PRINTTAB(4);"AIR CONDITIONER"
70 PRINT"{03 DOWN}INSERT TAPE WITH DATA FILE ~
   'ELECT'":PRINT"{02 DOWN}"
80 PRINT"HIT RETURN AFTER":PRINT"INSERTING TA
   PE"
85 GETA$:IFA$<>CHR$(13)THEN85
90 GOSUB230
100 PRINT"{02 DOWN}USING DATA FROM";EY:PRINT"I
   N CALCULATIONS"
110 I=N:FORM=1TO12:X=E(I,M)
120 IFX>0THENJ=J+1:S=S+E(I,M):IFX<MITHENMI=X
130 NEXT:S=S-MI*J
140 PRINT"{02 DOWN}"
150 PRINT"SEER OF OLD":INPUT"AIR CONDITIONER";
   BS:PRINT"{02 DOWN}"
160 PRINT"SEER OF NEW":INPUT"AIR CONDITIONER";
   NS:PRINT"{02 DOWN}"
170 PRINT"CURRENT COST OF":PRINT"ELECTRICITY I
   N CENTS/":INPUT"KWH =";CO
180 PRINT"{02 DOWN}ANNUAL SAVINGS OF NEW":PRIN
   T"AIR CONDITIONER"
190 PRINT"AS COMPARED TO THE OLD UNIT = $";
200 PRINTFNTRC(CO*S*BS*(1/BS-1/NS)/100)
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, EY=END YR,
    E()=ENERGY, D()=COST
230 OPEN1,1,0,"ELECT":INPUT#1,N,BY,EY:DIME(N,1
   2),D(N,12)
240 FORI=1TON:FORM=1TO12
250 INPUT#1,E(I,M),D(I,M):NEXT:NEXT:CLOSE1:RET
   URN
260 REM S=SUM OF KILOWATT HRS MINUS BASE KWATT
    HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

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Program 3. Microsoft Version.

```
10 REM CHOOSING AN AIR CONDITIONER
30 DEF FNTRC(X)=INT(X*100)/100
40 FORI=1TON:FORM=1TO12
50 MI=1E10:J=0
60 PRINT"{CLEAR}":PRINTTAB(13);"CHOOSING AN":
    PRINTTAB(11);"AIR CONDITIONER"
70 PRINT"{03 DOWN}INSERT TAPE WITH DATA FILE ~
    'ELECT'":PRINT"{02 DOWN}"
80 INPUT"HIT RETURN AFTER INSERTING TAPE";I
90 GOSUB230
100 PRINT"{02 DOWN}USING DATA FROM";EY:PRINT"I
    N CALCULATIONS"
110 I=N:FORM=1TO12:X=E(I,M)
120 IFX>0THENJ=J+1:S=S+E(I,M):IFX<MITHENMI=X
130 NEXT:S=S-MI*J
140 PRINT"{02 DOWN}"
150 INPUT"SEER OF OLD AIR CONDITIONER";BS:PRIN
    T"{02 DOWN}"
160 INPUT"SEER OF NEW AIR CONDITIONER";NS:PRIN
    T"{02 DOWN}"
170 PRINT"CURRENT COST OF ELECTRICITY IN CENTS
    /":INPUT"KWH =";CO:PRINT"{02 DOWN}
180 PRINT"ANNUAL SAVINGS OF NEW AIR CONDITIONE
    R"
190 PRINT"AS COMPARED TO THE OLD UNIT = $";
200 PRINTFNTRC(CO*S*BS*(1/BS-1/NS)/100)
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, EY=END YR,
     E()=ENERGY, D()=COST
230 OPEN1,1,0,"ELECT":INPUT#1,N,BY,EY:DIME(N,1
    2),D(N,12)
240 FORI=1TON:FORM=1TO12
250 INPUT#1,E(I,M),D(I,M):NEXT:NEXT:CLOSE1:RET
    URN
260 REM S=SUM OF KILOWATT HRS MINUS BASE KWATT
     HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

Program 4. Atari Version.

```
10 REM CHOOSING AN AIR CONDITIONER AT
   ARI VERSION
30 DIM A$(1)
40 FOR I=1 TO N:FOR M=1 TO 12
50 MI=1E+10:J=0
60 PRINT "{CLEAR}":POSITION 15,0:? "C
   hoosing Air":POSITION 13,1:? "Air C
   onditioner"
70 PRINT "{3 DOWN}Insert disk with da
   ta file 'ELECTRIC'":PRINT "{2 DOWN}
   "
80 PRINT "Hit RETURN after":PRINT "In
   serting disk";:INPUT A$
90 GOSUB 230
100 PRINT "{2 DOWN}Using data from ";
    EY:PRINT "in calculations"
110 I=N:FOR M=1 TO 12:X=E(I,M)
120 IF X>0 THEN J=J+1:S=S+E(I,M):IF X
    <MI THEN MI=X
130 NEXT M:S=S-MI*J
140 PRINT "{2 DOWN}"
150 PRINT "SEER OF OLD":PRINT "AIR CO
    NDITIONER";:INPUT BS:? :?
160 PRINT "SEER OF NEW":PRINT "AIR CO
    NDITIONER";:INPUT NS:? :?
170 PRINT "CURRENT COST OF":PRINT "EL
    ECTRICITY IN CENTS/":PRINT "KWH =
    ";:INPUT CO:? :?
180 PRINT "ANNUAL SAVINGS OF NEW":PRI
    NT "AIR CONDITIONER"
190 PRINT "AS COMPARED TO THE OLD UNI
    T = $";
200 V=(CO*S*BS*(1/BS-1/NS)/100):V=INT
    (V*100+0.5)/100:? V
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, E
    Y=END YR, E()=ENERGY, D()=COST
230 OPEN #1,4,0,"D:ELECTRIC":INPUT #1
    ,N,BY,EY:DIM E(N,12),D(N,12)
```

```
240 FOR I=1 TO N:FOR M=1 TO 12
250 INPUT #1,T1,T2:E(I,M)=T1:D(I,M)=T
    2:NEXT M:NEXT I:CLOSE #1:RETURN
260 REM S=SUM OF KILOWATT HRS MINUS B
    ASE KWATT HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

Program 5. Color Computer Version.

```
10 REM CHOOSING AN AIR CONDITIONER - COLOR CO
   MPUTER VERSION
30 DEFFNTRC(X)=INT(X*100)/100
40 FORI=1TON:FORM=1TO12
50 MI=1E10:J=0:CLS
60 PRINTTAB(2);"CHOOSING AN AIR CONDITIONER":
   FORI=1TO5:PRINT:NEXT
70 PRINT"INSERT DISK WITH DATA FILE'ELECT'":P
   RINT:PRINT:PRINT
80 PRINT"HIT RETURN AFTER INSERTING DISK"
85 A$=INKEY$:IFA$=""THEN85
90 GOSUB230
100 PRINT:PRINT:PRINT"USING DATA FROM ";EY:PRI
    NT"IN CALCULATIONS"
110 I=N:FORM=1TO12:X=E(I,M)
120 IFX>0THENJ=J+1:S=S+E(I,M):IFX<MI THENMI=X
130 NEXT:S=S-MI*J
140 PRINT:PRINT:PRINT
150 INPUT"SEER OF OLD AIR CONDITIONER";BS:PRIN
    T:PRINT:PRINT
160 INPUT"SEER OF NEW AIR CONTITIONER";NS:PRIN
    T:PRINT:PRINT
170 INPUT"CURRENT COST OF ELECTRICITY IN CENTS
    /KWH=";CO:PRINT:PRINT:PRINT
180 PRINT"ANNUAL SAVINGS OF NEW":PRINT"AIR CON
    DITIONER AS COMPARED"
190 PRINT"TO THE OLD UNIT= $";
200 PRINTFNTRC(CO*S*BS*(1/BS-1/NS)/100)
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, EY=END YR,
     E()=ENERGY, D()=COST
230 OPEN "I",#1,"ELECT":INPUT#1,N,BY,EY:DIME(N
    ,12),D(N,12)
```

```
240 FORI=1TON:FORM=1TO12
250 INPUT#1,E(I,M),D(I,M):NEXT:NEXT:CLOSE#1:RE
    TURN
260 REM S=SUM OF KILOWATT HRS MINUS BASE KWATT
     HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

Program 6. TI-99 Version.

```
10 REM choosing an airconditioner,TI
   version
30 DEF TRC(X)=INT(X*100)/100
35 MI=10^10
40 CALL CLEAR
45 DIM E(10,12),D(10,12)
46 REM currently set up to handle 10
   yrs of data
60 PRINT "choosing an air conditioner
   ": : : : : : : : :
70 PRINT "insert a data tape with dat
   afile <elect>": : : : :
80 PRINT "press any key to continue"
85 GOSUB 260
90 GOSUB 230
100 PRINT : : : :
105 PRINT "using ";C$;" data"
108 PRINT "from ";EY;" in calculation
    s": : : :
110 I=N
112 FOR M=1 TO 12
114 X=E(I,M)
116 IF X<=0 THEN 130
118 J=J+1
120 S=S+E(I,M)
122 IF X>MI THEN 130
125 MI=X
130 NEXT M
135 S=S-MI*J
140 PRINT : : : :
```

7

```
150 INPUT "seer of old air conditione
    r? ":BS
155 PRINT : : :
160 INPUT "seer of new air conditione
    r? ":NS
165 PRINT : : :
170 INPUT "current cost of electricit
    y in cents/kwh=? ":CO
175 PRINT : : :
180 Y=TRC(CO*S*BS*(1/BS-1/NS)/100)
190 PRINT "annual savings of new
    {7 SPACES}air conditioner as comp
    ared  to the old unit= $";Y
200 END
220 REM get data, c$=file name, n=yrs
    ,by=beg yr, ey=end yr,e()=energy,
     d()=cost
230 OPEN #2:"CS1",INTERNAL,INPUT ,FIX
    ED 128
235 INPUT #2:C$,N,BY,EY
240 FOR I=1 TO N
242 INPUT #2:E(I,1),D(I,1),E(I,2),D(I
    ,2),E(I,3),D(I,3),E(I,4),D(I,4),E
    (I,5),D(I,5),E(I,6),D(I,6),E(I,7)
    ,D(I,7)
244 INPUT #2:E(I,8),D(I,8),E(I,9),D(I
    ,9),E(I,10),D(I,10),E(I,11),D(I,1
    1),E(I,12),D(I,12)
246 NEXT I
248 CLOSE #2
250 RETURN
260 CALL KEY(3,KEY,ST)
270 IF ST=0 THEN 260
280 RETURN
290 REM s=sum of kilowatt hrs minus b
    ase kwatt hrs due to other uses
300 REM co=cost in cents/kwatt hr
```

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Program 7. Apple Version.

```
10 REM CHOOSING AN AIRCONDITIONER APPLE VERSI
   ON
20 D$=CHR$(4):TEXT:HOME
30 DEF FNTRC(X)=INT(X*100)/100
40 FORI=1TON:FORM=1TO12
50 MI=1E10:J=0
60 PRINTTAB(05);"CHOOSING AN":PRINTTAB(4);"AI
   RCONDITIONER"
70 PRINT:PRINT:PRINT"INSERT DISK WITH DATA FI
   LE 'ELECT'"
80 PRINT"HIT RETURN AFTER":PRINT"INSERTING TA
   PE"
85 GETA$:IFA$<>CHR$(13)THEN85
90 GOSUB230
100 PRINT:PRINT "USING DATA FROM";EY:PRINT"IN ~
   CALCULATIONS"
110 I=N:FORM=1TO12:X=E(I,M)
120 IFX>0THENJ=J+1:S=S+E(I,M):IFX<MITHENMI=X
130 NEXT:S=S-MI*J
140 PRINT:PRINT:PRINT
150 PRINT"SEER OF OLD":INPUT"AIRCONDITIONER";B
   S:PRINT:PRINT
160 PRINT"SEER OF NEW":INPUT"AIRCONDITIONER";N
   S:PRINT:PRINT
170 PRINT"CURRENT COST OF":PRINT"ELECTRICITY I
   N CENTS/":INPUT"KWH =";CO
180 PRINT:PRINT:PRINT"ANNUAL SAVINGS OF NEW":P
   RINT"AIRCONDITIONER"
190 PRINT"AS COMPARED TO THE OLD UNIT = $";
200 PRINTFNTRC(CO*S*BS*(1/BS-1/NS)/100)
210 END
220 REM GET DATA, N=YRS, BY=BEG YR, EY=END YR,
    E()=ENERGY, D()=COST
230 PRINT D$;"OPEN ELECT":PRINT D$;"READ ELECT
   "
234 INPUT N,BY,EY:DIME(N,12),D(N,12)
240 FORI=1TON:FORM=1TO12
250 INPUT E(I,M),D(I,M):NEXT:NEXT:PRINT D$;"CL
   OSE ELECT":RETURN
260 REM S=SUM OF KILOWATT HRS MINUS BASE KWATT
    HRS DUE TO OTHER USES
270 REM CO=COST IN CENTS/KWATT HR
```

8

Window Heat Loss/ Gain

8

Window Heat Loss/Gain

In a typical home, the sunlight transmitted through the windows accounts for 10-14% (ref. 1) of the total air conditioning cost. This can be equal to the savings accrued by installing storm windows or adding attic insulation in some regions of the United States. Furthermore, shielding windows by planting trees or using solar screens is usually much less expensive than adding insulation or storm windows (especially if you treat only the windows which need shading). The window analysis program described here will allow you to calculate how much is saved by shading windows in the summer and augmenting the winter heating by allowing sunlight into the home. Also, the program can be used for planning solar collector systems, designing greenhouses, evaluating the merit of adding skylights, or enclosing porches with glass.

As shown in Tables 1 and 2, the user inputs the latitude, the latitude, the size of the window, the tilt of the window from the horizontal, the azimuth (compass directions) that the window faces, and chooses either heating or cooling analysis to be performed. If cooling analysis is desired, the user inputs the capacity (tons) of the cooling system, the current it draws (amps), and the cost of the electricity. If the user chooses heating analysis, he must input the cost of natural gas. Both fuel savings, economic savings and the accrued energy in BTU/sq. ft. are printed by month and season. Because the window azimuth and elevation angle permit any angle window to be analyzed, a variety of applications is possible. In my residence, the east-facing windows cause almost $100 in excess cooling cost, whereas the winter gain is about a factor of three smaller. At the low latitude of my residence, south-facing windows do not contribute significantly to the heat load in the summer, but are important in reducing heating cost when the sun is lower in the southern sky.

The Calculations

The program uses eight basic equations, which describe the physical amount of sunlight and the angle at which it falls on the window's surface (refs. 2 and 3).

8

The day of the year (DOY) is calculated from the month (M) and the day of month (D). The solar declination (DE) is calculated from the day of year. The cosine of the zenith angle of the sun (A1) is calculated from the solar declination, the hour angle, and solar elevation angle (AL). The direct solar irradiance is calculated from the apparent solar irradiance at zero air mass (AO), the atmospheric extinction coefficient (BETA), and solar elevation angle (AL). The diffuse irradiance is calculated from the tilt of the window (TI) and the direct solar flux (GN). The cosine of the angle between the vector perpendicular to the window and the vector to the sun is calculated, based on the window tilt (TI), the window azimuth (BI), the sun's azimuth (AZ), and the sun's zenith angle (Z). Finally, the total flux transmitted through the window (GL) is calculated and summed by month (TT) and by season (SL).

The integration of transmitted energy during a day is accomplished in the FOR loop from lines 370 to 712. In this loop, calculations are made during a day for hour angles (HE) of minus 120 degrees (4 a.m. local solar time) to plus 120 degrees (8 p.m. local solar time). It is assumed that this calculation is valid for ten days. The integration by month is accomplished by calculating three ten-day intervals per month.

The conversion from energy to utility usage is made assuming that 1100 BTU are produced by each cu. ft. of natural gas and that air conditioner run time can be calculated from BTUs by the factor 12,000 BTU/(hr. ton). Kilowatt hours are calculated from volts times amps times time divided by 1000. The program is designed to be used at any latitude (except 0). However, if southern hemisphere calculations are desired, the seasons must be switched (the starting month M for heating = 11, and for cooling = 5). Similarly, the lengths of the heating and cooling seasons must be modified from 152 days and the printing routine should be modified for heating and cooling seasons appropriate to the long season regions. Special transmission functions for double glazed glass or solar film may be substituted as desired for the subroutine in lines 2000-2050.

References

1. *Houston Lighting and Power Residential Conservation Services.* Austin, Texas: Planenergy Inc., 1981.
2. Klen , David C. "Solar Specs." *Microcomputing,* March 1980, pp. 68-70.
3. Yellot, John I. *Solar Energy Utilization for Heating and Cooling.* NSF 74-41. Washington, D. C.: Government Printing Office, 1974.

Table 1. Heating Savings Due To Window Heating.

```
              WINDOW ANALYSIS - SOLAR TRANSMISSION


LATITUDE(DEG)?  30

ANALYSIS DESIRED:
    1) HEATING
    2) COOLING
?  1

# SQ FT OF WINDOWS FOR EVALUATION?  70

WINDOW TILT FROM HORZ, NORMAL = 90?  90
WINDOW AZIMUTH (N=0,S=180), DEG?  90

COST OF NATURAL GAS (CENTS/CU FT)?  .37

-----------------------------------------------------------
MONTH =  11           TOTAL =  19554.29  BTU/(SQ FT)
NATURAL GAS SAVED =  12.44  100 CU FT
DOLLAR SAVINGS = $ 4.6

-----------------------------------------------------------

MONTH =  12           TOTAL =  17299.96  BTU/(SQ FT)
NATURAL GAS SAVED =  11  100 CU FT
DOLLAR SAVINGS = $ 4.07

-----------------------------------------------------------

MONTH =  1            TOTAL =  17660.93  BTU/(SQ FT)
NATURAL GAS SAVED =  11.23  100 CU FT
DOLLAR SAVINGS = $ 4.15

-----------------------------------------------------------

MONTH =  2            TOTAL =  21405.49  BTU/(SQ FT)
NATURAL GAS SAVED =  13.62  100 CU FT
DOLLAR SAVINGS = $ 5.04

-----------------------------------------------------------

MONTH =  3            TOTAL =  25082.35  BTU/(SQ FT)
NATURAL GAS SAVED =  15.96  100 CU FT
DOLLAR SAVINGS = $ 5.9

-----------------------------------------------------------

MONTH =  4            TOTAL =  26858.1  BTU/(SQ FT)
NATURAL GAS SAVED =  17.09  100 CU FT
DOLLAR SAVINGS = $ 6.32

-----------------------------------------------------------

-----------------------------------------------------------
ANNUAL SAVINGS:

NATURAL GAS SAVED =  81.36  100 CU FT
DOLLAR SAVINGS = $ 30.1

-----------------------------------------------------------
```

Table 2. Extra Cooling Due To Window Heating.

```
              WINDOW ANALYSIS - SOLAR TRANSMISSION

LATITUDE(DEG)?  3Ø

ANALYSIS DESIRED:
    1) HEATING
    2) COOLING
?  2

# SQ FT OF WINDOWS FOR EVALUATION?  7Ø

WINDOW TILT FROM HORZ, NORMAL = 9Ø?  9Ø
WINDOW AZIMUTH (N=Ø,S=18Ø), DEG?  9Ø
AIR CONDITIONER TONS?  4
ENTER AMPS OF AIR CONDITIONER
     (IF NOT KNOWN HIT <RETURN>)?  3Ø
COST FOR ELECTRICITY, CENTS/KWH?  6.55

-----------------------------------------------------------
MONTH =  5            TOTAL =  27Ø86.46  BTU/(SQ FT)
POWER EXPENDED =  26Ø.7  KWH
COOLING COST DUE TO WINDOW = 17.Ø7  DOLLARS

-----------------------------------------------------------

MONTH =  6            TOTAL =  27118.47  BTU/(SQ FT)
POWER EXPENDED =  261.Ø1  KWH
COOLING COST DUE TO WINDOW = 17.Ø9  DOLLARS

-----------------------------------------------------------

MONTH =  7            TOTAL =  26652.Ø2  BTU/(SQ FT)
POWER EXPENDED =  256.52  KWH
COOLING COST DUE TO WINDOW = 16.8  DOLLARS

-----------------------------------------------------------

MONTH =  8            TOTAL =  26268.8  BTU/(SQ FT)
POWER EXPENDED =  252.83  KWH
COOLING COST DUE TO WINDOW = 16.56  DOLLARS

-----------------------------------------------------------

MONTH =  9            TOTAL =  25223.88  BTU/(SQ FT)
POWER EXPENDED =  242.77  KWH
COOLING COST DUE TO WINDOW = 15.9  DOLLARS

-----------------------------------------------------------

MONTH =  1Ø            TOTAL =  23689.78  BTU/(SQ FT)
POWER EXPENDED =  228.Ø1  KWH
COOLING COST DUE TO WINDOW = 14.93  DOLLARS

-----------------------------------------------------------

-----------------------------------------------------------
ANNUAL SAVINGS:

POWER EXPENDED =  15Ø1.87  KWH
COOLING COST DUE TO WINDOW = 98.37  DOLLARS

-----------------------------------------------------------
```

Program 1. OSI Version.

```
10 REM **********WINDOW HEATING ANALYSIS**************
30 REM PROGRAM CALCULATES SOLAR RADIATION TRANSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUDE, AZIMUTH AND ZENITH AND
32 REM ANGLE OF WINDOW
35 REM AL=SOLAR ALTITUDE,HE=HR ANGLE,DE=DECLINATION
36 REMTR=TRANSMISSION,SL=SEASONAL TOTAL BTU/SQ FT,TT = MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR IRRADIANCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION COEFFICIENT
44 FORI=1TO20:PRINT:NEXT
45 PRINTTAB(15);"WINDOW ANALYSIS - SOLAR TRANSMISSION"
46 PRINTTAB(25);"D. E. PITTS"
47 PRINT:PRINT
48 PI=3.14159:P2=PI/2:DIMBETA(12),AO(12)
50 DEFFNRAD(A)=A*PI/180
51 DEFFNASN(B)=ATN(B/(SQR(1-B^2)))
52 DEFFNACS(C)=ATN((SQR(1-C^2))/C)
53 DEFFNDEG(D)=INT((D*180)/PI)
54 DEFFNTRC(E)=INT(E*100)/100
55 DEFFNFUN(F)=F*180/PI
200 INPUT"LATITUDE(DEG)";LAT:L1=LAT:LAT=FNRAD(LAT)
223 PRINT"ANALYSIS DESIRED":PRINT" 1) HEATING":PRINT" 2) COOLING"
225 M=11:INPUTX:D=1:IFX=2THENM=5
226 IFM<3THENDOY=M*31-31+D:GOTO240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YEAR
```

```
240 FORI=1TO12:READAO(I),BETA(I):NEXT
250 INPUT" # SQ FT OF WINDOW FOR EVALUATION";FT:PRINT
260 PRINT:INPUT"WINDOW TILT FROM HORZ, NORMAL=90";TI:T1=TI
261 INPUT"WINDOW AZIMUTH(N=0,S=180), DEG";BI:B1=BI:TI=FNRAD(TI)
262 BI=FNRAD(BI):IFX=1THEN310
263 INPUT"AIRCONDITIONER TONS";T:T=T*12000
264 INPUT"ENTER AMPS OF AIRCONDITIONER, IF NOT KNOWN ENTER 0";SE
265 IFSE<1THENSE=25
267 INPUT"COST FOR ELECTRICITY, CENTS/KWH";C:GOTO335
310 PRINT:INPUT"COST OF NATURAL GAS (CENTS/CU FT)";C
335 PRINT:PRINT:PRINTTAB(5);"WINDOW HEATING ANALYSIS BY DIRECT
    SUNLIGHT"
340 PRINTTAB(17);"LATITUDE = ";L1;"DEG"
345 PRINT:PRINT"WINDOW ANGLE ";T1;"DEG";TAB(29);"WINDOW AZ=
    ";B1;" DEG"
348 PRINT:TT=0:FORJ=1TO3
350 X=FNRAD(DOY-82)*180/182.5:X=23.5*SIN(X):HE=-135
355 M=1:IFDOY>31THENM=INT((DOY+32.3)/30.6)
360 DE=FNRAD(X)
370 FORI=0TO16:AM=4+I:HE=HE+15:AN=FNRAD(HE)
372 IFPEEK(55104)<>95THENPOKE55104,95:GOTO410
373 IFPEEK(55104)=95THENPOKE55104,161:REMCURSOR
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*SIN(LAT)
420 X=FNACS(A1):AL=PZ-X
```

```
425 IFAL>P2THENAL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
441 REM IFA2<-1THENA2=-.9999
442 REM IFA2>1THENA2=.9999
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))/(COS(AN)*SIN(LAT))
450 AZ=FNASN(A2)+PI:Z=P2-AL:IFX<0THENAZ=PI-AZ
470 IFAL<FNRAD(1)THENGN=0:GOTO490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*COS(AZ)*COS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(BI)
575 IN=FNACS(A3):IFIN<0THENTR=0:GOTO600
590 GOSUB2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+GL
712 NEXT:DD=DD+10:DOY=DOY+10:IFDOY>365THENDOY=DOY-365
713 NEXT:PRINT"MONTH= ";TAB(9);M;TAB(29);"TOTAL = ";TAB(38);FNTRC(TT);
714 PRINTTAB(48);"BTU/(SQ FT)"
715 GOSUB719:IFDD<152THEN348
717 TT=SL:PRINT"-----------------------------------------------------------------------"
718 PRINT"ANNUAL SAVINGS!":PRINT:GOSUB719:FORI=1TO1000:NEXT:RUN48
719 IFM>4ANDM<11THEN800
720 P=TT*FT/110000:PRINT"NATURAL GAS SAVED ";FNTRC(P);"     100 CU FT"
730 PRINT"DOLLAR SAVINGS ";FNTRC(P*C)
740 PRINT:PRINT"-----------------------------------------------------------------------"
```

```
750 PRINT:RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 PRINT"POWER EXPENDED ";FNTRC(P);"KWH"
810 PRINT"COOLING COST DUE TO WINDOW";FNTRC(C*P/100);"DOLLARS"
820 PRINT:PRINT"-------------------------------------------------------------------------------"
830 PRINT
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GLAZED GLASS
2010 IFIN<.87266THENTR=.87:GOTO2100
2020 IFIN>1.2218THEN2050
2030 CI=(IN-.8726639)*4.5:TR=.16*COS(CI)+.68:GOTO2100
2050 TR=3.0599-1.948*IN:IFTR<0THENTR=0
2100 RETURN
4000 DATA390,.142,385,.144,376,.156,360,.18,350,.196,345,.205,344,.207
4002 DATA351,.201,365,.177,378,.16,387,.149,391,.142
5000 END
```

Program 2. VIC Version.

```
10 REMWINDOW HEATING      ANALYSIS VIC VERSION

30 REM PROGRAM CALCULATES SOLAR RADIATION TRA
   NSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUDE, AZIMU
   TH AND ZENITH AND
32 REM ANGLE OF WINDOW
35 REM AL=SOLAR ALTITUDE, HE=HR ANGLE, DE=DEC
   LINATION
36 REM TR=TRANSMISSION,SL=SEASONAL TOTAL BTU/
   SQ FT, TT=MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR IRRADIA
   NCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION COEFFICIEN
   T
44 PRINT"{CLEAR}   WINDOW ANALYSIS{DOWN}      ~
     SOLAR TRANSMISSION{DOWN}"
48 PI=3.14159:P2=PI/2:DIMBETA(12),AO(12)
50 DEFFNRAD(A)=A*PI/180
51 DEFFNASN(B)=ATN(B/(SQR(1-B↑2)))
52 DEFFNACS(C)=ATN((SQR(1-C↑2))/C)
53 DEFFNDEG(D)=INT((D*180)/PI)
54 DEFFNTRC(E)=INT(E*100)/100
55 DEFFNFUN(F)=F*180/PI
200 PRINT"LATITUDE(DEG)";:INPUTLAT:L1=LAT:LAT=
   FNRAD(LAT)
223 PRINT"{DOWN}ANALAYSIS DESIRED{DOWN}":PRINT
   "1)HEATING":PRINT"2)COOLING"
225 M=11:INPUTX:D=1:IFX=2THENM=5
226 IFM<3THENDOY=M*31-31+D:GOTO240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YEAR
240 FORI=1TO12:READAO(I),BETA(I):NEXT
250 PRINT"{DOWN}# SQ FT OFWINDOWS FOR EVALUATI
   ON":INPUTFT
260 PRINT"{DOWN}WINDOW TILT FROM HORZ, NORMAL ~
   = 90":INPUTTL:T1=TL
261 PRINT"{DOWN}WINDOW AZIMUTH (N=0,S=180), DE
   G":INPUTBI:B1=BI:TL=FNRAD(TL)
262 BI=FNRAD(BI):IFX=1THEN310
263 PRINT"AIRCONDITIONER TONS";:INPUTT:T=T*120
   00
```

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```
264 SE=25:PRINT"ENTER AMPS OF AIRCONDITIONER, ~
    IF NOT KNOWN HIT <CR>":INPUTSE
267 PRINT"COST FOR ELECTRICITY, CENTS/KWH":INP
    UTC:GOTO335
310 PRINT"{DOWN}COST OF NATURAL GAS (CENTS/CU ~
    FT)":INPUTC
335 PRINT"{CLEAR}   WINDOW ANALYSIS"
340 PRINT"LATITUDE = ";L1;"DEG"
345 PRINT"{DOWN}WINDOW ANGLE ";T1;"DEG":PRINT"
    WINDOW AZ= ";B1;" DEG"
346 PRINT"{DOWN}WAIT"
348 PRINT:TT=0:FORJ=1TO3
350 X=FNRAD(DOY-82)*180/182.5:X=23.5*SIN(X):HE
    =-135
355 M=1:IFDOY>31THENM=INT((DOY+32.3)/30.6)
360 DE=FNRAD(X)
370 FORI=0TO16:AM=4+I:HE=HE+15:AN=FNRAD(HE)
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*SIN(LA
    T)
420 X=FNACS(A1):AL=P2-X
425 IFAL>P2THENAL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))/(COS(
    AN)*SIN(LAT))
450 AZ=FNASN(A2)+PI:Z=P2-AL:IFX<0THENAZ=PI-AZ
470 IFAL<FNRAD(1)THENGN=0:GOTO490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TL))/12
560 A3=COS(Z)*COS(TL)+SIN(Z)*SIN(TL)*COS(AZ)*C
    OS(BI)+SIN(Z)*SIN(TL)*SIN(AZ)*SIN(BI)

575 IN=FNACS(A3):IFIN<0THENTR=0:GOTO600
590 GOSUB2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+GL
712 NEXT:DD=DD+10:DOY=DOY+10:IFDOY>365THENDOY=
    DOY-365
713 NEXT:PRINT"MONTH= ";M;"TOTAL=":PRINTFNTRC(
    TT);"BTU/(SQ FT)"
715 GOSUB719:IFDD<152THEN348
717 TT=SL:PRINT"--------------------"
718 PRINT"ANNUAL SAVINGS{DOWN}":GOSUB719:RUN48

719 IFM>4ANDM<11THEN800
720 P=TT*FT/110000:PRINT"NATURAL GAS SAVED=":P
    RINTFNTRC(P);" 100 CU FT"
```

```
730 PRINT"DOLLAR SAVINGS ";FNTRC(P*C)
740 PRINT"{DOWN}--------------------":PRINT:RE
    TURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 PRINT"POWER EXPENDED ";FNTRC(P);" KWH"
810 PRINT"COOLING COST DUE TO WINDOW=":PRINTFN
    TRC(C*P/100);"DOLLARS"
820 PRINT"{DOWN}--------------------{DOWN}"
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GLAZED GL
    ASS
2010 IFIN<.87266THENTR=.87:GOTO2100
2020 IFIN>1.2218THEN2050
2030 CI=(IN-.8726639)*4.5:TR=.16*COS(CI)+.68:GO
    TO2100
2050 TR=3.0599-1.948*IN:IFTR<0THENTR=0
2100 RETURN
4000 DATA390,.142,385,.144,376,.156,360,.18,350
    ,.196,345,.205,344,.207
4002 DATA351,.201,365,.177,378,.16,387,.149,391
    ,.142
5000 END
```

Program 3. Microsoft Version.

```
10 REM WINDOW HEATING ANALYSIS
30 REM PROGRAM CALCULATES SOLAR RADIATION TRA
    NSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUDE, AZIMU
    TH AND ZENITH AND
35 REM AL=SOLAR ALTITUDE, HE=HR ANGLE, DE=DEC
    LINATION
36 REM TR=TRANSMISSION,SL=SEASONAL TOTAL BTU/
    SQ FT, TT=MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR IRRADIA
    NCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION COEFFICIEN
    T
44 PRINT"{CLEAR}            WINDOW ANALYSIS{
    DOWN}                        SOLAR TRA
    NSMISSION{DOWN}"
48 PI=3.14159:P2=PI/2:DIMBETA(12),AO(12)
50 DEFFNRAD(A)=A*PI/180
```

8

```
51 DEFFNASN(B)=ATN(B/(SQR(1-B↑2)))
52 DEFFNACS(C)=ATN((SQR(1-C↑2))/C)
53 DEFFNDEG(D)=INT((D*180)/PI)
54 DEFFNTRC(E)=INT(E*100)/100
55 DEFFNFUN(F)=F*180/PI
200 PRINT"LATITUDE(DEG)";:INPUTLAT:L1=LAT:LAT=
    FNRAD(LAT)
223 PRINT"{DOWN}ANALAYSIS DESIRED{DOWN}":PRINT
    "1)HEATING":PRINT"2)COOLING"
225 M=11:INPUTX:D=1:IFX=2THENM=5
226 IFM<3THENDOY=M*31-31+D:GOTO240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YEAR
240 FORI=1TO12:READAO(I),BETA(I):NEXT
250 INPUT"{DOWN}# SQ FT OFWINDOWS FOR EVALUATI
    ON";FT
260 INPUT"{DOWN}WINDOW TILT FROM HORZ, NORMAL=
    90";TL:T1=TL
261 INPUT"{DOWN}WINDOW AZIMUTH (N=0,S=180), DE
    G";BI:B1=BI:TL=FNRAD(TL)
262 BI=FNRAD(BI):IFX=1THEN310
263 INPUT"AIRCONDITIONER TONS";T:T=T*12000
264 SE=25:PRINT"ENTER AMPS OF AIRCONDITIONER":
    INPUT"IF NOT KNOWN HIT <CR>";SE
267 INPUT"COST FOR ELECTRICITY, CENTS/KWH";C:G
    OTO335
310 INPUT"{DOWN}COST OF NATURAL GAS (CENTS/CU ~
    FT)";C
335 PRINT"{CLEAR}              WINDOW ANALYSIS"
340 PRINT"{DOWN}           LATITUDE = ";L1;"DEG
    "
344 PRINT"          WINDOW ANGLE ";T1;"DEG"
345 PRINT"          WINDOW AZ= ";B1;" DEG"
346 PRINTTAB(15);"{04 DOWN}WAIT{05 UP}"
348 PRINT:TT=0:FORJ=1TO3
350 X=FNRAD(DOY-82)*180/182.5:X=23.5*SIN(X):HE
    =-135
355 M=1:IFDOY>31THENM=INT((DOY+32.3)/30.6)
360 DE=FNRAD(X)
370 FORI=0TO16:AM=4+I:HE=HE+15:AN=FNRAD(HE)
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*SIN(LA
    T)
420 X=FNACS(A1):AL=P2-X
425 IFAL>P2THENAL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))/(COS(
    AN)*SIN(LAT))
```

```
450 AZ=FNASN(A2)+PI:Z=P2-AL:IFX<0THENAZ=PI-AZ
470 IFAL<FNRAD(1)THENGN=0:GOTO490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TL))/12
560 A3=COS(Z)*COS(TL)+SIN(Z)*SIN(TL)*COS(AZ)*C
    OS(BI)+SIN(Z)*SIN(TL)*SIN(AZ)*SIN(BI)

575 IN=FNACS(A3):IFIN<0THENTR=0:GOTO600
590 GOSUB2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+GL
712 NEXT:DD=DD+10:DOY=DOY+10:IFDOY>365THENDOY=
    DOY-365
713 NEXT:PRINT"MONTH= ";M;"TOTAL=";FNTRC(TT);"
    BTU/(SQ FT)"
715 GOSUB719:IFDD<152THEN348
717 TT=SL:PRINT"-----------------------------
    ---------"
718 PRINT"ANNUAL SAVINGS{DOWN}":GOSUB719:RUN48

719 IFM>4ANDM<11THEN800
720 P=TT*FT/110000:PRINT"NATURAL GAS SAVED=";F
    NTRC(P);" 100 CU FT"
730 PRINT"SAVINGS =$";FNTRC(P*C)
740 PRINT"-----------------------------------
    ---":RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 PRINT"POWER EXPENDED ";FNTRC(P);" KWH"
810 PRINT"COOLING COST DUE TO WINDOW= $";FNTRC
    (C*P/100)
820 PRINT"-----------------------------------
    ---"
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GLAZED GL
    ASS
2010 IFIN<.87266THENTR=.87:GOTO2100
2020 IFIN>1.2218THEN2050
2030 CI=(IN-.8726639)*4.5:TR=.16*COS(CI)+.68:GO
    TO2100
2050 TR=3.0599-1.948*IN:IFTR<0THENTR=0
2100 RETURN
4000 DATA390,.142,385,.144,376,.156,360,.18,350
    ,.196,345,.205,344,.207
4002 DATA351,.201,365,.177,378,.16,387,.149,391
    ,.142
5000 END
```

8

Program 4. Atari Version.

```
10 REM ***WINDOW HEATING ANALYSIS***
30 REM PROGRAM CALCULATES SOLAR
   {16 SPACES}RADIATION TRANSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUD
   E,{8 SPACES}AZIMUTH AND ZENITH.AND
32 REM ANGLE OF WINDOW-DAVID PITTS
   {8 SPACES}16011 STONEHAVEN DR HOUS
   TON TX 77059
35 REM AL=SOLAR ALTITUDE,HE=HR ANGLE,
   {10 SPACES}DE=DECLINATION
36 REM TR=TRANSMISSION, SL=SEASONAL
   {12 SPACES}TOTAL BTU/SQ FT, TT=MONT
   HLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR
   {10 SPACES}IRRADIANCE AT ZERO AIR M
   ASS
38 REM BETA=ATMOSPHERIC EXTINCTION
   {13 SPACES}COEFFICIENT
44 PRINT CHR$(125)
45 ? "WINDOW ANALYSIS - SOLAR TRANS
   MISSION"
46 POKE 85,14
47 ? :?
48 PI=3.14159:P2=PI/2:DIM BETA(12),AO
   (12):RAD
50 FRAD=100
51 FASN=110
52 FACS=120
53 FDEG=130
54 FTRC=140
55 FFUN=150
60 GOTO 200
100 V=V*PI/180:RETURN
110 V=ATN(V/(SQR(1-V*V))):RETURN
120 V=ATN((SQR(1-V*V))/V):RETURN
130 V=INT((V*180)/PI):RETURN
140 V=INT(V*100)/100:RETURN
150 V=V*180/PI:RETURN
200 PRINT "LATITUDE(DEG)";:INPUT LAT:
    L1=LAT:V=LAT:GOSUB FRAD:LAT=V
```

```
223 PRINT "ANALYSIS DESIRED":PRINT "1
    ) HEATING":PRINT "2) COOLING"
225 M=11:INPUT X:D=1:IF X=2 THEN M=5
226 IF M<3 THEN DOY=M*31-31+D:GOTO 24
    0
227 DOY=INT(M*30.6-32.3+D):REM DAY OF
     YEAR
240 FOR I=1 TO 12:READ A:AO(I)=A:READ
     B:BETA(I)=B:NEXT I
250 PRINT "#SQ FT OF WINDOW FOR EVALU
    ATION";:INPUT FT:?
260 ? :? "WINDOW TILT FROM HORIZ, NOR
    MAL=90":INPUT TI:T1=TI
261 ? "WINDOW AZIMUTH(N=0,S=180),DEG"
    ;:INPUT BI:B1=BI:V=TI:GOSUB FRAD:
    TI=V
262 V=BI:GOSUB FRAD:BI=V:IF X=1 THEN
    310
263 ? "AIR CONDITIONER TONS";:INPUT T
    :T=T*12000
264 ? "ENTER AMPS OF AIR CONDITIONER"
    :? "IF NOT KNOW ENTER 0";:INPUT S
    E
265 IF SE<1 THEN SE=25
267 ? "COST FOR ELECTRICITY, CENTS/KW
    H";:INPUT C:GOTO 335
310 ? :? "COST OF NATURAL GAS (CENTS/
    CU FT)";:INPUT C
335 ? :? :? :? "WINDOW ANALYSIS BY DI
    RECT SUNLIGHT"
340 ? "LATITUDE=";L1;" DEG"
345 ? :? "WINDOW ANGLE ";T1;" DEG
    {3 SPACES}WINDOW AZ=";B1;" DEG"
348 ? :TT=0:FOR J=1 TO 3
350 V=DOY-82:GOSUB FRAD:X=V*180/182.5
    :X=23.5*SIN(X):HE=-135
355 M=1:IF DOY>31 THEN M=INT((DOY+32.
    3)/30.6)
360 V=X:GOSUB FRAD:DE=V
370 FOR I=0 TO 16:AM=4+I:HE=HE+15:V=H
    E:GOSUB FRAD:AN=V
```

8

```
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(D
    E)*SIN(LAT)
420 V=A1:GOSUB FACS:X=V:AL=P2-X
425 IF AL>P2 THEN AL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
441 IF A2<-1 THEN A2=-0.9999
442 IF A2>1 THEN A2=0.9999
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LA
    T))/(COS(AN)*SIN(LAT))
450 V=A2:GOSUB FASN:AZ=V+PI:Z=P2-AL:I
    F X<0 THEN AZ=PI-AZ
470 IF AL<PI/180 THEN GN=0:GOTO 490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*0.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*
    COS(AZ)*COS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(
    BI)
575 V=A3:GOSUB FACS:IN=V:IF IN<0 THEN
     TR=0:GOTO 600
590 GOSUB 2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=S
    L+GL
712 NEXT I:DD=DD+10:DOY=DOY+10:IF DOY
    >365 THEN DOY=DOY-365
713 NEXT J:PRINT "MONTH=";M;"  TOTAL=
    ";:V=TT:GOSUB FTRC:PRINT V;" BTU/
    (SQ FT)"
715 GOSUB 719:IF DD<152 THEN 348
717 TT=SL:? "-------------------------
    --------------"
718 ? "ANNUAL SAVINGS!":? :GOSUB 719:
    FOR I=1 TO 1000:NEXT I:CLR :GOTO
    48
719 IF M>4 AND M<11 THEN 800
720 P=TT*FT/110000:? "NATURAL GAS SAV
    ED ";:V=P:GOSUB FTRC:PRINT V;" 10
    0 CU FT"
730 PRINT "DOLLAR SAVINGS ";:V=P*C:GO
    SUB FTRC:PRINT V
740 ? :? "-------------------------
    ----------"
```

```
750 ? :RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 ? "POWER EXPENDED ";:V=P:GOSUB FT
    RC:? V;" KWH"
810 ? "COOLING COST DUE TO WINDOW $";
    :V=C*P/100:GOSUB FTRC:? V
820 ? :? "-----------------------------
    ----------"
830 ?
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE
      GLAZED GLASS
2010 IF IN<0.87266 THEN TR=0.87:GOTO
     2100
2020 IF IN>1.2218 THEN 2050
2030 CI=(IN-0.8726639)*4.5:TR=0.16*CO
     S(CI)+0.68:GOTO 2100
2050 TR=3.0599-1.948*IN:IF TR<0 THEN
     TR=0
2100 RETURN
4000 DATA 390,.142,385,.144,376,.156,
     360,.18,350,.196,345,.205,344,.2
     07
4002 DATA 351,.201,365,.177,378,.16,3
     87,.149,391,.142
5000 END
```

Program 5. Color Computer Version.

```
10 REM*WINDOW HEATING ANALYSIS*
20 REM PROGRAM CALCULATES SOLAR RADIATION TRA
    NSMITTED THROUGH A WINDOW
30 REM GIVEN LATITUDE, AZIMUTH AND ZENITH AND
     ANGLE OF WINDOW
35 REM AL=SOLAR ALTITUDE,HE=HR ANGLE,DE=DECLI
    NATION
36 REM TR=TRANSMISSION,SL=SEASONAL TOTAL BTU/
    SQ FT,TT=MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR IRRADIA
    NCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION COEFFICIEN
    T
```

8

```
44 CLS
45 PRINTTAB(8)"WINDOW ANALYSIS":PRINTTAB(7)"S
    OLAR TRANSMISSION"
46 PRINTTAB(10)"D. E. PITTS"
47 PRINT:PRINT
48 PI=3.14159:P2=PI/2:DIMBETA(12),AO(12)
50 DEFFNRAD(A)=A*PI/180
51 DEFFNAZN(B)=ATN(B/SQR(1-B 2))
52 DEFFNACS(C)=ATN((SQR(1-C 2))/C)
53 DEFFNDEG(D)=INT((D*180)/PI)
54 DEFFNTRC(E)=INT(E*100)/100
55 DEFFNFUN(F)=F*180/PI
200 INPUT"LATITUDE(DEG)";LAT:L1=LAT:LAT=FNRAD(
    LAT)
223 PRINT"ANALYSIS DESIRED":PRINT" 1) HEATING"
    :PRINT" 2) COOLING"
225 M=11:INPUTX:D=1:IFX=2THENM=5
226 IFM<3THENDOY=M*31-31+D:GOTO240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YEAR
228 PRINT
240 FORI=1TO12:READAO(I),BETA(I):NEXT
250 INPUT"# SQ FT OF WINDOW FOR EVALUATION";FT
    :PRINT
260 INPUT"WINDOW TILT FROM HORZ, NORMAL=90";TI
    :T1=TI
261 INPUT"WINDOW AZIMUTH(N=0,S=180), DEG";BI:B
    1=BI:TI=FNRAD(TI)
262 BI=FNRAD(BI):IFX=1THEN310
263 INPUT"AIRCONDITIONER TONS";T:T=T*12000
264 INPUT"ENTER AMPS OR AIRCONDITIONER, IF NOT
     KNOWN ENTER 0";SE
265 IFSE<1THENSE=25
267 INPUT"COST FOR ELECTRICITY, CENTS/KWH";C:G
    OTO335
310 PRINT:INPUT"COST OF NATURAL GAS (CENTS/CU ~
    FT)";C
335 CLS:PRINTTAB(5)"WINDOW HEATING ANALYSIS":P
    RINTTAB(7)"BY DIRECT SUNLIGHT"
340 PRINTTAB(6)"LATITUDE = ";L1;"DEG"
345 PRINTTAB(6)"WINDOW ANGLE= ";T1;"DEG":PRINT
    TAB(6)"WINDOW AZ= ";B1;"DEG"
348 TT=0:FORJ=1TO3
350 X=FNRAD(DOY-82)*180/182.5:X=23.5*SIN(X):HE
    =-135
355 M=1:IFDOY>31THENM=INT((DOY+32.3)/30.6)
```

```
360 DE=FNRAD(X)
370 FORI=0TO16:AM=4+I:HE=HE+15:AN=FNRAD(HE)
372 IFPOINT(0,0)=-1 OR POINT(0,0)=0 THENSET(0,
    0,1):GOTO410
373 IFPOINT(0,0)=1THENRESET(0,0)
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*SIN(LA
    T)
420 X=FNACS(A1):AL=P2-X
425 IFAL>P2 THENAL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
441 REM IF A2<-1THENA2=.9999
442 REM IF A2>1THENA2=.9999
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))/(COS(
    AN)*SIN(LAT))
450 AZ=FNAZN(A2)+PI:Z=P2-AL:IFX<0THENAZ=PI-AZ
470 IFAL<FNRAD(1)THENGN=0:GOTO490
480 GN*AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*COS(AZ)*C
    OS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(BI)
575 IN=FNACS(A3):IFIN<0THENTR=0:GOTO600
590 GOSUB2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+GL
712 NEXT:DD=DD+10:DOY=DOY+10:IFDOY>365THENDOY=
    DOY-365
713 NEXT:SOUND200,3:PRINT"MONTH= ";M:PRINT"TOT
    AL= ";FNTRC(TT);"BUT/(SQ FT)"
715 GOSUB719:IFDD<152THEN348
716 FORZZ=1TO5:SOUND50,1:FORZY=1TO3:NEXT:NEXT
717 TT=SL:PRINT"-----------------------------
    -"
718 PRINT"ANNUAL SAVINGS!":PRINT:GOSUB719:FORI
    =1TO1000:NEXT:RUN48
719 IFM>4ANDM<11THEN800
720 P=TT*FT/110000:PRINT"NAT. GAS SAVED";FNTRC
    (P);"100 CU FT"
730 PRINT"DOLLAR SAVINGS ";FNTRC(P*C)
740 PRINT"-------------------------------"
750 RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 PRINT"POWER EXPENDED ";FNTRC(P);"KWH"
810 PRINT"COOLING COST DUE TO WINDOW":PRINTFNT
    RC(C*P/100);"DOLLARS"
820 PRINT"-------------------------------"
```

```
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GLAZED GL
     ASS
2010 IFIN<.87266THENTR=.87:GOTO2100
2020 IFIN>1.2218THEN2050
2030 CI=(IN-.8726639)*4.5:TR=.16*COS(CI)+.68:GO
     TO2100
2050 TR=3.0599-1.948*IN:IFTR<OTHENTR=0
2100 RETURN
4000 DATA390,.142,385,.144,376,.156,360,.18,350
     ,.196,345,.205,344,.207
4002 DATA351,.201,365,.177,378,.16,387,.149,391
     ,.142
5000 END
```

Program 6. TI-99 Version.

```
10 REM window heating analysis
   {3 SPACES}
30 REM program calculates solar radia
   tion transmitted through a window
   given latitude, azimuth and zenith
   and
32 REM angle of window
35 REM al=solar altitude, he=hr angle
   , de=declination
36 REM tr=transmission, sl=seasonal t
   otal btu/sq ft, tt=monthly
37 REM tm=time(hrs), a0=apparent sola
   r irradiance at zero air mass, bet
   a=atmospheric extinction coefficie
   nt
44 CALL CLEAR
45 PRINT "{7 SPACES}window analysis"
46 PRINT "{6 SPACES}solar transmissio
   n": : : : : :
47 DIM BETA(12),A0(12)
48 PI=3.14159
49 P2=PI/2
50 DEF RAD(A)=A*PI/180
51 DEF ASN(B)=ATN(B/(SQR(1-B*B)))
```

8

```
52 DEF ACS(C)=ATN((SQR(1-C*C))/C)
53 DEF DEG(D)=INT((D*180)/PI)
54 DEF TRC(E)=INT(E*100)/100
55 DEF FUN(F)=F*180/PI
60 PRINT "program requires 30 min to
    run": : : :
200 INPUT "latitude(deg)? ":LAT
201 PRINT
205 L1=LAT
210 LAT=RAD(LAT)
215 PRINT "analysis desired"
220 PRINT "1) heating"
221 PRINT "2) cooling"
223 M=11
224 INPUT X
225 IF X<>2 THEN 228
226 M=5
228 IF M>=3 THEN 232
229 DOY=M*31-31+D
230 GOTO 235
232 DOY=INT(M*30.6-32.3+D)
235 FOR I=1 TO 12
236 READ AO(I),BETA(I)
240 NEXT I
245 PRINT
250 INPUT " # sq ft of window for
    {6 SPACES}evaluation? ":FT
252 PRINT
255 INPUT "window tilt from horz,
    {6 SPACES}normal=90? ":TI
257 T1=TI
258 PRINT
259 INPUT "window azimuth(n=0,s=180),
      deg? ":BI
260 PRINT
261 B1=BI
263 TI=RAD(TI)
265 BI=RAD(BI)
267 IF X=1 THEN 310
269 INPUT "airconditioner tons? ":T
270 T=T*12000
271 PRINT
```

```
272 INPUT "enter amps of aircondition
    er, if not known enter 0? ":SE
273 PRINT
275 IF SE>0 THEN 280
277 SE=25
280 INPUT "cost for electricity, cent
    s/kwh? ":C
282 GOTO 335
310 INPUT "cost of natural gas (cents
    /cu ft)? ":C
335 PRINT : : : : :
336 CALL CLEAR
337 PRINT "window heating analysis by
    {8 SPACES}direct sunlight"
338 PRINT : :
340 PRINT "latitude = ";L1;" deg"
342 PRINT
345 PRINT "window angle= ";T1;"deg"
346 PRINT
347 PRINT "window az= ";B1;" deg"
348 TT=0
349 PRINT
350 FOR J=1 TO 3
352 X=RAD(DOY-82)*180/182.5
353 X=23.5*SIN(X)
354 HE=-135
355 M=1
356 IF DOY<=31 THEN 360
357 M=INT((DOY+32.3)/30.6)
360 DE=RAD(X)
370 FOR I=0 TO 16
372 AM=4+I
374 HE=HE+15
376 AN=RAD(HE)
378 CALL SCREEN(3+I/2)
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(D
    E)*SIN(LAT)
420 X=ACS(A1)
422 AL=P2-X
425 IF AL<=P2 THEN 440
427 AL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
```

```
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LA
    T))/(COS(AN)*SIN(LAT))
450 AZ=ASN(A2)+PI
452 Z=P2-AL
455 IF X>=0 THEN 470
456 AZ=PI-AZ
470 YY=RAD(1)
471 IF AL>=YY THEN 480
473 GN=0
475 GOTO 490
480 GN=A0(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*
    COS(AZ)*COS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(
    BI)
575 IN=ACS(A3)
580 IF IN>=0 THEN 590
582 TR=0
585 GOTO 600
590 GOSUB 2000
600 GL=(GN*A3*TR+GD)*10
605 TT=TT+GL
610 SL=SL+GL
700 NEXT I
702 DD=DD+10
704 DOY=DOY+10
706 IF DOY<366 THEN 708
707 DOY=DOY-365
708 NEXT J
710 YY=TRC(TT)
711 PRINT "month= ";M;"  total = ";YY
    ;" btu/sq ft"
712 CALL SOUND(100,1000,0)
713 GOSUB 725
714 IF DD<152 THEN 348
715 TT=SL
716 PRINT "-------------------------
    --"
718 PRINT "annual savings!": :
719 GOSUB 725
```

```
720 END
725 IF (M>4)*(M<11)THEN 800
726 P=TT*FT/110000
727 YY=TRC(P)
728 PRINT "natural gas saved= ";YY
729 YY=TRC(P*C)
730 PRINT "dollar savings = ";YY
740 PRINT "-------------------------
    --"
750 PRINT
751 RETURN
800 TM=TT*FT/T
802 P=220*SE*TM/1000
804 YY=TRC(P)
805 PRINT "power expended ";YY;" kwh"
809 YY=TRC(C*P/100)
810 PRINT "cooling cost due to window
     = ";YY;" dollars"
820 PRINT "-------------------------
    --"
830 PRINT
1000 RETURN
2000 REM get transmittance for single
      glazed glass
2010 IF IN>=.87266 THEN 2020
2012 TR=.87
2014 GOTO 2100
2020 IF IN>1.2218 THEN 2050
2030 CI=(IN-.8726639)*4.5
2035 TR=.16*COS(CI)+.68
2040 GOTO 2100
2050 TR=3.0599-1.948*IN
2055 IF TR>0 THEN 2100
2060 TR=0
2100 RETURN
4000 DATA 390,.142,385,.144,376,.156,
     360,.18,350,.196,345,.205,344,.2
     07
4002 DATA 351,.201,365,.177,378,.16,3
     87,.149,391,.142
5000 END
```

9

Window Shading Analysis

9

Window Shading Analysis

In "Window Heat Loss/Gain" (see Chapter 8), I discussed how to calculate the effect of solar heating on heating and cooling cost. If you have used that program, then you know that south-facing windows can augment winter heating to a substantial degree, while east- and west-facing windows can cause the homeowner substantial penalties in air conditioning cost.

In order to eliminate this unneeded burden on the summer budget, you should shade the affected windows. One of the most effective means is to plant a deciduous tree, and let mother nature install and remove the shade with the seasons. Your second best choice is to add a solar screen or put up an awning. Whether you are installing an awning, building a house, or remodeling, the decision of where to place the shading device is always a difficult one.

For south-facing windows at local solar noon, calculate the angle from the horizon to the sun by simply adding 90 degrees to the latitude and subtracting the solar declination from the sum. Add a little trigonometry, and you can design the depth of overhang necessary to shade the window in summer, yet permit sunlight in the window in winter. However, for early morning or late afternoon the geometry gets more complicated. It gets even more complex when the window faces any direction other than south.

The window shading program calculates the depth of an eave (distance out from the house) which is necessary to cast a shadow on the wall of a given dimension (SH). The program also calculates the shadow cast on the wall from an eave of a fixed size (EV). Both calculations are made simultaneously, and either factor (SH or EV) may be set to zero if that particular option is not needed. The calculations are done each hour of the day from 6 a.m. to 6 p.m. so that the varying conditions in the day can be examined.

At times, no eave of any size will shade the desired area; at other times, no shadowing may be necessary since the sun is on

the other side of the house. These instances are indicated in the output table, with zeros for the size of the eave or length of the shadow. At times the program will call for extraordinarily large eaves in order to perform the required shading. It is left up to you to choose dimensions which are architecturally sound and esthetically pleasing.

The inputs required for the program are latitude (LAT), month (M), day (D), the amount of shade required (SH), the size of the eave (EV), and the window azimuth (the direction the window faces). The outputs are the local solar time, the azimuth of the sun (AZ), the altitude of the sun above the horizon (AL), the zenith angle of the sun (Z), and the depth of the eave from the house necessary to produce the required shade, and the length of the shadow on the wall.

Thus, if you wanted a window shaded in the summer, the program would be run for June 20 (summer solstice), setting the amount of shade (SH) as the distance between the bottom of the window and the bottom of the eave (Table 1). In order to calculate the size of eave necessary to allow sunlight in the window, the program should be run for December 20 (winter solstice) using the distance between the top of the window and the bottom of the eave. Then you must compare the two results and how they vary during a day to decide on an optimum size overhang. Once you choose this optimum size overhang, then you should use the option of setting a constant overhang distance (EV) and running cases for all critical seasons to verify that the eave size was chosen correctly. An example of this type of run is given in Table 2.

The program is very simple. Lines 30 to 130 set up the functions, constants, and titles. Lines 140 to 180 calculate the day of year (DOY) and solar declination (DE) from the month and day. Lines 190 to 290 input the geometry of the eave, shadow, and latitude, and set up the table headings. Line 300 starts the FOR loop for time of day (AM) and converts it to hour angle (HE). Lines 310 to 350 calculate the altitude and azimuth of the sun (AL and AZ respectively), using standard formulas. Lines 360 and 370 calculate the projection of the eave on the wall and vice versa.

Reference

Klen, David C. "Solar Specs." *Microcomputing,* March 1980, pp. 68-70.

Table 1. Sample Run — Required Eave Size.

```
                    WINDOW SHADING

PROGRAM CALCULATES THE SIZE EAVE NECESSARY TO SHADE
A WINDOW FACING ANY DIRECTION FROM DIRECT SUNLIGHT

PROGRAM ALSO CALCULATES THE SIZE SHADOW ON THE WALL
PRODUCED BY AN EAVE OF A GIVEN SIZE


LATITUDE(DEG)?  30
MONTH?  6
DAY?  20
DISTANCE EAVE PROJECTS FROM WALL (ANY UNITS ARE OK)?  0
HEIGHT OF EAVE ABOVE DESIRED
LOC OF SHADE (ANY UNITS ARE OK)?  48
WINDOW AZIMUTH, 0=N, 90=E,180=S,270=W, DEG?  270


     WINDOW EAVE EVALUATION FOR  30 DEG LATITUDE
              WINDOW AZ= 270  , JUNE 20

 ---------------------------------------------------
 ! SUN TIME ! SUN POSITION ! SIZE OF ! SIZE OF !
 !   LOCAL  !AZI  ALT  ZEN !   EAVE  ! SHADOW  !
 ---------------------------------------------------
       6      69   11   78      0         0
       7      75   23   66      0         0
       8      81   36   53      0         0
       9      88   49   40      0         0
      10      96   62   27      0         0
      11     112   75   14      0         0
      12     179   83    6      0         0
      13     247   75   14     11         0
      14     263   62   27     24         0
      15     -89   49   40     40         0
      16     -82   36   53     63         0
      17     -76   23   66    105         0
      18     -70   11   78    220         0
```

Table 2. Sample Run — Shading By Eaves.

```
                    WINDOW SHADING

PROGRAM CALCULATES THE SIZE EAVE NECESSARY TO SHADE
A WINDOW FACING ANY DIRECTION FROM DIRECT SUNLIGHT

PROGRAM ALSO CALCULATES THE SIZE SHADOW ON THE WALL
PRODUCED BY AN EAVE OF A GIVEN SIZE


LATITUDE(DEG)?  30
MONTH?  6
DAY?  20
DISTANCE EAVE PROJECTS FROM WALL (ANY UNITS ARE OK)?  25
HEIGHT OF EAVE ABOVE DESIRED
LOC OF SHADE (ANY UNITS ARE OK)?  0
WINDOW AZIMUTH, 0=N, 90=E,180=S,270=W, DEG?  270


     WINDOW EAVE EVALUATION FOR  30 DEG LATITUDE
               WINDOW AZ= 270  , JUNE 20

-------------------------------------------------
 ! SUN TIME ! SUN POSITION ! SIZE OF ! SIZE OF !
 !   LOCAL  !AZI  ALT  ZEN !   EAVE  ! SHADOW  !
-------------------------------------------------
      6       69   11   78       0         0
      7       75   23   66       0         0
      8       81   36   53       0         0
      9       88   49   40       0         0
     10       96   62   27       0         0
     11      112   75   14       0         0
     12      179   83    6       0         0
     13      247   75   14       0        101
     14      263   62   27       0        48
     15      -89   49   40       0        29
     16      -82   36   53       0        18
     17      -76   23   66       0        11
     18      -70   11   78       0         5
```

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Program 1. OSI Version.

```
10 REM WINDOW SHADING ANALYSIS
30 DIM M$(12):PI=3.14159265:P2=PI/2:DEFFN
    RAD(A)=A*PI/180
40 DEFFNASN(B)=ATN(B/(SQR(1-B^2))):DEFFNA
    CS(C)=ATN((SQR(1-C^2)/C))
50 DEFFNDEG(D)=INT((D*180)/PI):DEFFNTRC(E
    )=INT(E*100)/100
60 FORI=1TO20:PRINT:NEXT:PRINTTAB(25);"WI
    NDOW SHADING"
70 FORI=1TO10:PRINT:NEXT
80 PRINTTAB(5);"PROGRAM CALCULATES THE SI
    ZE EAVE NECESSARY TO SHADE"
90 PRINTTAB(5);"A WINDOW FACING ANY DIREC
    TION FOR DIRECT SUNLIGHT"
100 PRINT:PRINT:PRINT
110 PRINTTAB(5);"PROGRAM ALSO CALCULATES T
    HE SIZE SHADOW ON THE WALL"
120 PRINTTAB(12);"PRODUCED FROM AN EAVE OF
     A GIVEN SIZE"
130 FORI=1TO5:PRINT:NEXT:INPUT"LATITUDE(DE
    G)";LAT
140 L1=LAT:LAT=FNRAD(LAT):INPUT"MONTH #";M
    :INPUT"DAY";D
150 IFM<3THENDOY=M*31-31+D:GOTO170
160 DOY=INT(M*30.6-32.3+D)
170 X=FNRAD((DOY-82)*180/182.5):X=23.5*SIN
    (X)
180 DE=FNRAD(X):FORI=1TO12:READM$(I):NEXT:
    RESTORE
190 INPUT"DISTANCE EAVE PROJECTS FROM WALL
    ,ANY UNITS ARE OK";EV
200 INPUT"HEIGHT OF EAVE ABOVE DESIRED LOC
     OF SHADE, ANY UNITS ARE OK";SH
210 INPUT"WINDOW AZIMUTH, 0=N, 90=E, 180=S
    , 270=W, DEG";BI:B1=BI
220 BI=BI+90:BI=FNRAD(BI):HE=-105:FORI=1TO
    8:PRINT:NEXT
230 PRINTTAB(5);"WINDOW EAVE EVALUATION FO
    R ";L1;"DEG LATITUDE"
```

9

```
240 PRINT:PRINTTAB(14);"WINDOW AZ= ";B1;",
    ";TAB(30);M$(M);TAB(35);D
250 Y=FNDEG(DE):PRINTTAB(15);"SIZE OF THE ~
    EAVE IS ";FNTRC(EV)
260 PRINT"DISTANCE FROM BOTTOM OF SHADE TO
     BOTTOM OF EAVE= ";SH
270 PRINT:GOSUB420
280 PRINT" ¦SUN TIME ¦ SUN POSITION ¦ SIZE
     OF ¦ SIZE OF¦":GOSUB 420
290 PRINT" ¦ LOCAL   ¦AZI  ALT  ZEN ¦  EAV
    E   ¦ SHADOW ¦"
300 GOSUB420:FORI=0TO12:AM=6+I:HE=HE+15:AN
    =FNRAD(HE)
310 OB=0:A1=COS(DE)*COS(AN)*COS(LAT)+SIN(D
    E)*SIN(LAT)
320 X=FNACS(A1):AL=P2-X:IFAL>P2THENAL=AL-P
    I
330 X=(COS(DE)*COS(AN)-SIN(AL)*COS(LAT))/(
    COS(AL)*SIN(LAT))
340 IFX<0THENOB=1
350 A2=COS(DE)*SIN(AN)/COS(AL):AZ=FNASN(A2
    )+PI:IFOB=1THENAZ=PI-AZ
360 Z=1.5708-AL:R=TAN(Z)*SIN(BI-AZ):IFZ>=P
    2THENR=0
370 Y=0:X=0:IFR>0THENX=SH*R:Y=EV/R
380 AZ=FNDEG(AZ):AL=FNDEG(AL):Z=FNDEG(Z)
390 PRINTTAB(2);AM;TAB(11);AZ;TAB(16);AL;T
    AB(21);Z;
400 PRINTTAB(28);FNTRC(X);TAB(39);FNTRC(Y)
    :NEXT:END
410 DATA JAN,FEB,MARCH,APRIL,MAY,JUNE,JULY
    ,AUG,SEPT,OCT,NOV,DEC
420 PRINT"-------------------------------
    ------------------":RETURN
```

Program 2. VIC Version.

```
10 REM WINDOW SHADING ANALYSIS   VIC VERSION
30 DIMM$(12):PI=3.14159265:P2=PI/2:DEF FNRAD(
   A)=A*PI/180
40 DEF FNASN(B)=ATN(B/(SQR(1-B↑2))):DEF FNACS
   (C)=ATN((SQR(1-C↑2)/C))
50 DEF FNDEG(D)=INT((D*180/PI)):DEF FNTRC(E)=
   INT(E*100)/100
60 PRINTTAB(4);"WINDOW SHADING":PRINT:PRINT:P
   RINT
80 PRINT"PROGRAM CALCULATES THESIZE EAVE NECE
   SSARY TO SHADE A WINDOW FACING"
90 PRINT"ANY DIRECTION FROM    DIRECT SUNLIGH
   T":PRINT:PRINT
110 PRINT"PROGRAM CALCULATES THESIZE SHADOW ON
    THE";
120 PRINT"    WALL PRODUCED FROM AN EAVE OF A ~
   GIVEN SIZE"
130 PRINT:PRINT:INPUT"LATITUDE(DEG)";LAT
140 L1=LAT:LAT=FNRAD(LAT):INPUT "MONTH";M:INPU
   T"DAY";D
150 IFM<3THENDOY=M*31-31+D:GOTO170
160 DOY=INT(M*30.6-32.3+D)
170 X=FNRAD((DOY-82)*180/182.5):X=23.5*SIN(X)
180 DE=FNRAD(X):FORI=1TO12:READM$(I):NEXT
190 PRINT:PRINT"DISTANCE EAVE PROJECTS FROM WA
   LL ANY UNITS":INPUT"ARE OK";EV
200 PRINT:PRINT"HEIGHT OF EAVE ABOVE   DESIRED
    LOC OF SHADE"
205 INPUT",ANY UNITS ARE OK";SH
210 PRINT:INPUT"WINDOW AZIMUTH, 0=N, 90=E,180=
   S,270=W, DEG";BI:B1=BI
220 BI=BI+90:BI=FNRAD(BI):HE=-105
230 PRINT"WINDOW EAVE EVALUATION FOR ";L1;"DEG
    LATITUDE"
240 PRINT"WINDOW AZ=";B1;M$(M);D
280 PRINT"SUN    SUN  SIZE SIZE"
290 PRINT"TIME   POS    OF   OF":PRINT"     AZ
     ALT EAVE SHADE":GOSUB420
300 FORI=0TO12:AM=6+I:HE=HE+15:AN=FNRAD(HE)
310 OB=0:A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*S
   IN(LAT)
320 X=FNACS(A1):AL=P2-X
325 IFAL>P2THENAL=AL-PI
```

```
330 X=(COS(DE)*COS(AN)-SIN(AL)*COS(LAT))/(COS(
    AL)*SIN(LAT))
340 IFX<ØTHENOB=1
350 A2=COS(DE)*SIN(AN)/COS(AL):AZ=FNASN(A2)+PI
    :IFOB=1THENAZ=PI-AZ
360 Z=1.5708-AL:R=TAN(Z)*SIN(BI-AZ):IFZ>=P2THE
    NR=Ø
370 X=Ø:Y=Ø:IFR>ØTHENX=SH*R:Y=EV/R
375 IFR<.ØØØ1THENY=Ø
380 AZ=INT(FNDEG(AZ)):AL=INT(FNDEG(AL)):Y=INT(
    Y):X=INT(X)
390 PRINTAM;TAB(4);AZ;TAB(9);AL;TAB(13);X;TAB(
    17);Y:NEXT
400 GOTO400
410 DATA"JAN","FEB","MAR","APRIL","MAY","JUNE"
    ,"JULY","AUG","SEPT","OCT","NOV","DEC
    "
420 PRINT"--------------------":RETURN
```

Program 3. Microsoft Version.

```
10 REM WINDOW SHADING
30 DIMM$(12):PI=3.14159265:P2=PI/2:DEF FNRAD(
   A)=A*PI/180
40 DEF FNASN(B)=ATN(B/(SQR(1-B↑2))):DEF FNACS
   (C)=ATN((SQR(1-C↑2)/C))
50 DEF FNDEG(D)=INT((D*180/PI)):DEF FNTRC(E)=
   INT(E*100)/100
60 PRINT"{CLEAR}";TAB(10);"WINDOW SHADING{03
   DOWN}"
80 PRINT"PROGRAM CALCULATES THESIZE EAVE NECE
   SSARYTO SHADE A WINDOW FACING";
90 PRINT" ANY DIRECTION  FROM DIRECT SUNLIGHT
   ":PRINT:PRINT
110 PRINT"PROGRAM CALCULATES THESIZE SHADOW ON
    THE";
120 PRINT"WALL PRODUCED FROM AN EAVE OF A GIVE
   N    SIZE"
130 PRINT:PRINT:INPUT"LATITUDE(DEG)";LAT
140 L1=LAT:LAT=FNRAD(LAT):INPUT "MONTH";M:INPU
   T"DAY";D
150 IFM<3THENDOY=M*31-31+D:GOTO170
```

```
160 DOY=INT(M*30.6-32.3+D)
170 X=FNRAD((DOY-82)*180/182.5):X=23.5*SIN(X)
180 DE=FNRAD(X):FORI=1TO12:READM$(I):NEXT
190 PRINT:PRINT"DISTANCE EAVE PROJECTS FROM WA
    LL ANY":INPUT"UNITS ARE OK";EV
200 PRINT:PRINT"HEIGHT OF EAVE ABOVE DESIRED L
    OC OF SHADE"
205 INPUT",ANY UNITS ARE OK";SH
210 PRINT"{DOWN}WINDOW AZIMUTH, 0=N, 90=E,180=
    S,270=W,":INPUT"DEG";BI:B1=BI
220 BI=BI+90:BI=FNRAD(BI):HE=-105
230 PRINT"{CLEAR}";"WINDOW EAVE EVALUATION FOR
     ";L1;"DEG LAT":GOSUB420
240 PRINT"WINDOW AZ=";B1;M$(M);D:GOSUB420
280 PRINT"SUN        SUN      SIZE     SIZE"
290 PRINT"TIME       POS        OF       OF"
295 PRINT"          AZ   ALT     EAVE   SHADE":GOSU
    B420
300 FORI=0TO12:AM=6+I:HE=HE+15:AN=FNRAD(HE)
310 OB=0:A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*S
    IN(LAT)
320 X=FNACS(A1):AL=P2-X
325 IFAL>P2THENAL=AL-PI
330 X=(COS(DE)*COS(AN)-SIN(AL)*COS(LAT))/(COS(
    AL)*SIN(LAT))
340 IFX<0THENOB=1
350 A2=COS(DE)*SIN(AN)/COS(AL):AZ=FNASN(A2)+PI
    :IFOB=1THENAZ=PI-AZ
360 Z=1.5708-AL:R=TAN(Z)*SIN(BI-AZ):IFZ>=P2THE
    NR=0
370 X=0:Y=0:IFR>0THENX=SH*R:Y=EV/R
375 IFR<.0001THENY=0
380 AZ=INT(FNDEG(AZ)):AL=INT(FNDEG(AL)):Y=INT(
    Y):X=INT(X)
390 PRINTAM;TAB(6);AZ;TAB(12);AL;TAB(19);X;TAB
    (26);Y:NEXT
400 GOTO400
410 DATA"JAN","FEB","MAR","APRIL","MAY","JUNE"
    ,"JULY","AUG","SEPT","OCT","NOV","DEC
    "
420 PRINT"-----------------------------------
    ---":RETURN
```

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Program 4. Atari Version.

```
10 REM WINDOW SHADING ANALYSIS ATARI
   VERSION
20 DIM M$(12*3):PI=3.14159265:P2=PI/2
30 FNRAD=35:FNASN=40:FNACS=45:FNDEG=5
   0:GOTO 60
35 V=V*PI/180:RETURN
40 V=ATN(V/(SQR(1-V^2))):RETURN
45 V=ATN((SQR(1-V^2)/V)):RETURN
50 V=INT((V*180/PI)):RETURN
60 PRINT "{CLEAR}WINDOW SHADING":PRIN
   T :PRINT :PRINT
80 ? :PRINT "PROGRAM CALCULATES THE":
   ? "SIZE EAVE NECESSARY TO":? "SHAD
   E A WINDOW FACING"
90 PRINT "ANY DIRECTION FROM DIRECT S
   UNLIGHT":PRINT :PRINT
110 PRINT "PROGRAM CALCULATES THE SIZ
    E SHADOW ON"
120 PRINT "THE WALL PRODUCED FROM":?
    "AN EAVE OF A GIVEN SIZE"
130 PRINT :PRINT :PRINT "LATITUDE(DEG
    )";:INPUT LAT
140 L1=LAT:V=LAT:GOSUB FNRAD:LAT=V:?
    "MONTH";:INPUT M:PRINT "DAY";:INP
    UT D
150 IF M<3 THEN DOY=M*31-31+D:GOTO 17
    0
160 DOY=INT(M*30.6-32.3+D)
170 V=((DOY-82)*180/182.5):GOSUB FNRA
    D:X=V:X=23.5*SIN(X)
180 V=X:GOSUB FNRAD:DE=V:M$="JANFEBMA
    RAPRMAYJUNJULAUGSEPOCTNOVDEC"
190 PRINT :PRINT "DISTANCE EAVE PROJE
    CTS FROM":? "WALL (ANY UNITS ARE
    OK)";:INPUT EV
200 PRINT :PRINT "HEIGHT OF EAVE ABOV
    E{3 SPACES}DESIRED LOC"
205 PRINT "OF SHADE, ANY UNITS ARE OK
    ";:INPUT SH
210 PRINT :PRINT "WINDOW AZIMUTH, O=N
    , 90=E,180=S,270=W, DEG";:INPUT B
    I:B1=BI
```

```
220 BI=BI+90:V=BI:GOSUB FNRAD:BI=V:HE
    =-105
230 PRINT "{CLEAR}Window Eave Evaluat
    ion":? "for ";L1;" DEG Latitude"
240 PRINT "Window Azimuth=";B1;",";M$
    (M*3-2,M*3);" ";D
250 ? "{Q}{5 R}{W}{8 R}{W}{4 R}{W}
    {5 R}{E}"
280 ? "¦ SUN ¦  SUN{3 SPACES}¦SIZE¦SI
    ZE ¦"
290 ? "¦TIME ¦POSITION¦ OF ¦ OF  ¦"
295 ? "¦LOCAL¦AZI  ALT¦EAVE¦SHADE¦"
297 ? "{A}{5 R}{S}{8 R}{S}{4 R}{S}
    {5 R}{D}"
300 FOR I=0 TO 12:AM=6+I:HE=HE+15:V=H
    E:GOSUB FNRAD:AN=V
310 OB=0:A1=COS(DE)*COS(AN)*COS(LAT)+
    SIN(DE)*SIN(LAT)
320 V=A1:GOSUB FNACS:X=V:AL=P2-X
325 IF AL>P2 THEN AL=AL-PI
330 X=(COS(DE)*COS(AN)-SIN(AL)*COS(LA
    T))/(COS(AL)*SIN(LAT))
340 IF X<0 THEN OB=1
350 A2=COS(DE)*SIN(AN)/COS(AL):V=A2:G
    OSUB FNASN:AZ=V+PI:IF OB=1 THEN A
    Z=PI-AZ
360 Z=1.5708-AL:R=(SIN(Z)/COS(Z))*SIN
    (BI-AZ):IF Z>=P2 THEN R=0
370 X=0:Y=0:IF R>0 THEN X=SH*R:Y=EV/R
375 IF R<1E-04 THEN Y=0
380 V=AZ:GOSUB FNDEG:AZ=INT(V):V=AL:G
    OSUB FNDEG:AL=INT(V):Y=INT(Y*100+
    0.5)/100:X=INT(X*100+0.5)/100
390 PRINT "¦ ";AM;:POKE 85,8:? ;"¦";A
    Z;:POKE 85,14:? AL;:POKE 85,17:?
    "¦";X;:POKE 85,22:? "¦";Y;:POKE 8
    5,28:? "¦":NEXT I
395 ? "{Z}{5 R}{X}{8 R}{X}{4 R}{X}
    {5 R}{C}"
400 ? "When finished, press RETURN:";
410 IF PEEK(764)<>12 THEN 410
420 POKE 764,255:GRAPHICS 0:END
```

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Program 5. Color Computer Version.

```
5 COLOR COMPUTER VERSION
10 REM WINDOW SHADING
30 DIM M$(12):PI=3.14159265:P2=PI/2:DEFFNRAD(
   A)=A*PI/180
40 DEFFNSAN(B)=ATN(B/(SQR(1-B 2))):DEFFNACS(C
   )=ATN((SQR(1-C 2)/C))
50 DEFFNDEG(D)=INT((D*180)/PI):DEFFNTRC(E)=IN
   T(E)
60 CLS:PRINTTAB(9);"WINDOW SHADING"
70 PRINT:PRINT
80 PRINT"PROGRAM CALCULATES THE SIZE EAVE NEC
   ESSARY TO SHADE A WINDOW FACING"
90 PRINT"ANY DIRECTION FROM DIRECTSUNLIGHT"
100 PRINT:PRINT
110 PRINT"PROGRAM ALSO CALCULATES THE SIZESHAD
   OW ON THE WALL"
120 PRINT"PRODUCED FROM AN EAVE OF ANY GIVEN S
   IZE"
130 PRINT:PRINT:PRINT:INPUT"LATITUDE (DEG)";LA
   T
140 L1=LAT:LAT=FNRAD(LAT):INPUT"MONTH #";M:INP
   UT"DAY";D
150 IFM<3THENDOY=M*31-31+D:GOTO170
160 DOY=INT(M*30.6-32.3+D)
170 X=FNRAD((DOY-82)*180/182.5):X=23.5*SIN(X)
180 DE=FNRAD(X):FORI=1TO12:READM$(I):NEXT:REST
   ORE
190 PRINT:INPUT"DISTANCE EAVE PROJECTS FROM WA
   LL ANY UNITS ARE OK";EV
200 PRINT:INPUT"HEIGHT OF EAVE ABOVE DESIRED L
   OC OF SHADE, ANY UNITS ARE OK";SH
210 PRINT:INPUT"WINDOW AZIMUTH, 0=N, 90=E, 180
   =S, 270=W, DEG";BI:B1=BI
220 BI=BI+90:BI=FNRAD(BI):HE=-105:FORI=1TO8:PR
   INT:NEXT
230 PRINT"    WINDOW EAVE EVALUATION ":PRINTTA
   B(5);L1;"DEG LATITUDE"
240 PRINT"   WINDOW AZ= ";B1;",";M$(M);D
250 Y=FNDEG(DE):PRINT"    SIZE OF THE EAVE IS ~
   ";FNTRC(EV)
260 PRINT"  DISTANCE FROM BOTTOM OF SHADE     ~
    TO BOTTOM OF EAVE= ";SH
270 GOSUB420
```

```
280 PRINT"!SUN !SUN POSITION!SIZE!SIZE !"
290 PRINT"!    !             ! OF ! OF  !"
295 PRINT"!TIME! AZI  ALT    !EAVE !SHADE!"
300 GOSUB420:FORI=0TO12:AM=6+I:HE=HE+15: AN=FN
    RAD(HE)
310 OB=0:A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*S
    IN(LAT)
320 X=FNACS(A1):AL=P2-X:IFAL>P2 THENAL=AL-PI
330 X=(COS(DE)*COS(AN)-SIN(AL)COS(LAT))/(COS(A
    L)*SIN(LAT))
340 IFX<0THENOB=1
350 A2=COS(DE)*SIN(AN)/COS(AL):AZ=FNSAN(A2)+PI
    :IFOB=1THENAZ=PI-AZ
360 Z=1.5708-AL:R=TAN(Z)*SIN(BI-AZ):IFZ>=P2 TH
    ENR=0
370 Y=0:X=0:IFR>0THENX=SH*R:Y=EV/R
375 IFR<.0001THENY=0
380 AZ=FNDEG(AZ):AL=FNDEG(AL)
390 PRINTAM;TAB(5);AZ;TAB(12);AL;TAB(18);FNTRC
    (X);TAB(25);FNTRC(Y):NEXT
400 GOTO400
410 DATA JAN,FEB,MARCH,APRIL,MAY,JUNE,JULY,AUG
    ,SEPT,OCT,NOV,DEC
420 PRINT"------------------------------":RET
    URN
```

Program 6. TI-99 Version.

```
10 REM WINDOW SHADING ANALYSIS, TI VE
   RSION
20 DIM M$(12)
25 PI=3.14159265
28 P2=PI/2
30 DEF RAD(A)=A*PI/180
35 DEF ASN(B)=ATN(B/(SQR(1-B*B)))
40 DEF ACS(C)=ATN((SQR(1-C*C)/C))
45 DEF DEG(D)=INT((D*180)/PI)
50 DEF TRC(E)=INT(E*10)/10
55 CALL CLEAR
60 PRINT "{7 SPACES}window shading":
   : : : :
```

9

```
80 PRINT "program calculates the size
    eave necessary to shade a"
90 PRINT "window facing any direction
    from direct sunlight": : : :
110 PRINT "program also caculates the
      size shadow on the wall
    {5 SPACES}produced from an eave of
    a{3 SPACES}given size": : : : :
130 INPUT "latitude (deg) = ?":LAT
132 L1=LAT
134 LAT=RAD(LAT)
136 INPUT "month # ?":M
140 INPUT "day ?":D
150 IF M>=3 THEN 160
155 DOY=M*31-31+D
158 GOTO 170
160 DOY=INT(M*30.6-32.3+D)
170 X=RAD((DOY-82)*180/182.5)
175 X=23.5*SIN(X)
180 DE=RAD(X)
182 FOR I=1 TO 12
184 READ M$(I)
186 NEXT I
188 RESTORE
189 PRINT : :
190 INPUT "distance eave projects fro
    m wall, any units are ok ?":EV
195 PRINT : :
200 INPUT "height of eave above desir
    ed loc of shade, any units are ok
     ?":SH
205 PRINT : :
210 INPUT "window azimuth, 0=n, 180=s
    , 270=w, deg ?":BI
215 B1=BI
220 BI=BI+90
222 BI=RAD(BI)
```

```
224 HE=-105
226 CALL CLEAR
230 PRINT "window eave evaluation for
    "
235 PRINT TAB(5);L1;"deg latitude": :
240 PRINT TAB(2);"window az = ";B1;TA
    B(21);M$(M);TAB(25);D
250 Y=DEG(DE)
252 YY=TRC(EV)
255 PRINT TAB(4);"size of the eave is
     ";YY
260 GOSUB 420
280 PRINT "!sun  !sun{5 SPACES}!size!
    size"
285 PRINT "!time !position! of ! of"
290 PRINT "!local!azi alt !eve !shado
    w"
300 GOSUB 420
302 FOR I=0 TO 12
304 AM=6+I
306 HE=HE+15
308 AN=RAD(HE)
310 OB=0
312 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(D
    E)*SIN(LAT)
320 X=ACS(A1)
322 AL=P2-X
324 IF AL<=P2 THEN 330
326 AL=AL-PI
330 X=(COS(DE)*COS(AN)-SIN(AL)*COS(LA
    T))/(COS(AL)*SIN(LAT))
340 IF X>=0 THEN 350
345 OB=1
350 A2=COS(DE)*SIN(AN)/COS(AL)
352 AZ=ASN(A2)+PI
354 IF OB<>1 THEN 360
356 AZ=PI-AZ
360 Z=1.5708-AL
362 R=TAN(Z)*SIN(BI-AZ)
364 IF Z<P2 THEN 370
```

```
366 R=0
370 Y=0
372 X=0
374 IF R<=0 THEN 380
376 X=SH*R
378 Y=EV/R
380 AZ=DEG(AZ)
382 AL=DEG(AL)
390 PRINT AM;TAB(7);AZ;TAB(12);AL;
394 YY=TRC(X)
396 ZZ=TRC(Y)
400 PRINT TAB(17);YY;TAB(23);ZZ
402 NEXT I
404 END
410 DATA jan,feb,march,april,may,june
    ,july,aug,sept,oct,nov,dec
420 PRINT "-------------------------
    --"
430 RETURN
```

10

Ceiling Fan Analysis

10

Ceiling Fan Analysis

As the cost of electricity increases at an alarming rate, people are looking for methods to reduce the cost of keeping cool. They add insulation, shade windows, reduce kitchen heating, turn up thermostats, and sometimes, out of desperation, turn air conditioners completely off. However, since most people prefer not to sacrifice their comfort to an undue degree, ceiling fans have become a popular supplement to air conditioning in much of the Sunbelt. They may even serve as an inexpensive alternative to air conditioning in more moderate summer climates.

Ceiling fans cool by the same wind chill processes that we experience with the passage of a "blue norther." However, at the higher summer temperatures, the effect is not nearly as pronounced. Basically, the wind chill effect occurs because the convective heat transfer from our bodies increases dramatically as the wind speed increases. Thus, with the addition of a ceiling fan, we can reduce the air conditioning thermostat and still experience the same comfort level at a decreased energy cost.

Should you invest in a ceiling fan? Three factors need to be considered: 1) the cost of the fan, 2) the potential savings, and 3) the cost of operation. This program will estimate the last two of these, leaving it up to you to minimize the cost of the fan. The program will enable you, the user, to evaluate the effective decrease in temperature, the savings due to increasing the air conditioner thermostat, and the cost of operating the ceiling fan. With this, you will have a tool with which you can evaluate buying a ceiling fan, based on the pay-out period of the investment.

Customizing For Wind Chill

The wind chill factor (see ref. 2.) used in line 300 (line 280 in the Atari and Color Computer versions) is a function of temperature (T, degrees centigrade) and the wind speed (V, m/sec). Several modifications were necessary in order to use the wind chill index for this application. First, the base wind speed was increased to 4 mi/hr (1.788 m/sec), since the index is set for a person at normal walking speed. Second, the index is calibrated for anemometer measured winds, so the ceiling fan speed had to be increased to

account for the height of a standard anemometer (divided by 0.57). (See ref. 4.) Once this is done, the cooling index matches Fanger's comfort equation (see ref. 1).

I measured the wind speed of several ceiling fans with a commercial hot wire anemometer and found the speed to be about 1 m/sec. If you know the wind speed of your prospective fan, then you should alter line 70 (line 40 in the Atari version, line 50 in the Color Computer version, or line 75 in the TI version) accordingly. The effect of increasing the air conditioning thermostat by DF degrees is calculated in line 240 (line 230 in the Atari version, line 220 in the Color Computer version, or line 243 in the TI version). This formula is based on the Federal Energy Administration algorithm (see ref. 3) which uses the utility cost rather than the fuel amount. Because of this, the program will accept any cooling fuel (e.g., electricity, natural gas, etc.).

The cost of operating a ceiling fan is usually about the same as the cost of operating a moderately sized light bulb. However, for the purpose of completeness, I have allowed for these calculations in the program. The user can input the current used by the fan, the number of hours the fan is used per day, and the number of days used in a calendar year. The default values used are 0.5 amps, 6 hrs/day, and 100 days.

References

1. *ASHRAE Handbook of Fundamentals.* New York: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1972.
2. Dare, P.M. "A Study of the Severity of the Midwestern Winters of 1977 and 1978 Using Heating Degree Days Determined from Both Measured and Wind Chill Temperatures." *Bulletin of the American Meteorological Society,* vol. 62, July 1981.
3. *Home Energy Saver's Workbook.* FEA/D-77/117. Washington, D. C.: Government Printing Office, 1977.
4. Steadman, R. G. "Indices of Windchill of Clothed Persons." *Journal of Applied Meteorology,* vol. 10, 1971, pp. 674-683.

Sample Run.

```
                    CEILING FAN ANALYSIS

              SAVINGS IN AIR CONDITIONING
          AND COST OF OPERATING FAN WILL BE CALCULATED

------------------------------------------------------------

ANY COOLING FUEL (E.G., ELECTRICITY, NAT. GAS) IS OK.

IS COOLING FUEL USED FOR OTHER PURPOSES (E.G., LIGHTING)? Y

ANNUAL COOLING FUEL COST (DOLLARS)? 528

TEMP (DEG F) CURRENTLY SET FOR AIR CONDITIONER? 76

COST FOR ELECTRICITY, CENTS/KWH? 6.55
------------------------------------------------------------

HIT <RETURN> IF REQUESTED QUANTITY IS UNKNOWN

AMPS DRAWN BY CEILING FAN? 0.5

# DAYS PER YEAR FAN IS IN OPERATION? 100

# HOURS PER DAY FAN IS IN OPERATION? 6

------------------------------------------------------------
ANNUAL COST OF OPERATING FAN = $2.35
------------------------------------------------------------
YOU MAY INCREASE YOUR THERMOSTAT TO 79 DEGREES F
ANNUAL A/C SAVINGS = $24.57
------------------------------------------------------------
```

Program 1. OSI Version.

```
10 REM CEILING FAN ANALYSIS
30 DEFFNTRC(E)=INT(E*100)/100
40 DEFFNRDD(F)=INT(F+.99)
50 POKE2888,0:POKE8722,0:REM SET CR FOR N
   ULL INPUT =0
60 FORI=1TO20:PRINT:NEXT:PRINTTAB(25);"CE
   ILING FAN ANALYSIS"
70 PRINT:PRINT:PRINT:PRINT:X=.6:V=1
80 PRINTTAB(22);"SAVINGS IN AIR CONDITION
   ING"
90 PRINTTAB(15);"AND COST OF OPERATING FA
   N WILL BE CALCULATED"
```

10

```
100 PRINT:PRINT:GOSUB280:PRINT:PRINT
110 PRINT"ANY COOLING FUEL (E.G. ELECTRICI
    TY, NAT GAS) IS OK"
120 PRINT:PRINT"IS COOLING FUEL USED FOR O
    THER PURPOSES (E.G. LIGHTING)";
130 INPUTB$:IFASC(B$)=78THENX=1
140 PRINT:INPUT"ANNUAL COOLING FUEL COST (
    DOLLARS)";CS:CS=CS*X
150 PRINT:INPUT"TEMP (DEG F) CURRENTLY SET
     FOR A/C";TF
160 T=(TF+40)*5/9-40:PRINT
170 INPUT"COST FOR ELECTRICITY, CENTS/KWH"
    ;C:C=C/100:GOSUB280:PRINT
180 PRINT:PRINT:PRINT"HIT <CR> IF REQUESTE
    D QUANTITY IS UNKNOWN"
190 PRINT:INPUT"AMPS DRAWN BY CEILING FAN"
    ;A:IFA=0THENA=.5
200 PRINT:INPUT"# DAYS PER YEAR FAN IS IN ~
    OPERATION";D:IFD=0THEND=100
210 PRINT:INPUT"# HOURS PER DAY FAN IS IN ~
    OPERATION";H:IFH=0THENH=6
220 PRINT:PRINT:GOSUB280:PRINT"ANNUAL ";
230 CO=C*D*H*A*120/1000:PRINT"COST OF RUNN
    ING FAN = $";FNTRC(CO)
240 V=1.788+V/.57:GOSUB280:GOSUB300:DF=DT*
    9/5:TF=FNRDD(TF+DF)
250 PRINT"YOU MAY INCREASE YOUR THERMOSTAT
     TO";TF;"DEG F"
260 PRINT"ANNUAL A/C SAVINGS = $";FNTRC(CS
    *DF*.03):GOSUB280
270 END
280 PRINT"-----------------------------
    -------------------------";
290 PRINT"------":RETURN
300 DT=T-33-(10*SQR(V)+10.45-V)*(T-33)/22.
    03:IFDT<0THENDT=0
310 RETURN:REM DT=EFFECTIVE DECREASE IN TE
    MP(C) DUE TO WIND (V=M/SEC)
320 REM T=DEG CENTIGRADE, TF=DEG FAHRENHEI
    T
```

```
330 REM A=AMPS, D=# DAYS, H=# HOURS/DAY
340 REM X=REDUCTION IN UTILITY COST TO ACC
    OUNT FOR USES OTHER
350 REM THAN COOLING.
360 REM DF=EFFECTIVE DECREASE IN TEMP (DEG
     F) DUE TO WIND.
```

Program 2. VIC Version.

```
10 REM CEILING FAN ANALYSIS VIC VERSION
30 DEF FNTRC(E)=INT(E*100)/100
40 DEF FNRDD(F)=INT(F+.99)
60 PRINT"{CLEAR} CEILING FAN ANALYSIS"
70 PRINT"{02 DOWN}":X=.6:V=1
80 PRINT"     SAVINGS IN        AIRCONDITIONI
    NG AND  COST OF OPERATING FAN"
90 PRINT"  WILL BE CALCULATED"
100 PRINT:GOSUB280:PRINT
110 PRINT"ANY COOLING FUEL      (E.G. ELECTRIC
    ITY,    NAT GAS) IS OK"
120 PRINT:PRINT"IS COOLING FUEL USED  FOR OTHE
    R PURPOSES":INPUT"(E.G. LIGHTING)";B$

130 IFASC(B$)=78THENX=1
140 CS=0:PRINT:PRINT"ANNUAL COOLING FUEL":INPU
    T"COST (DOLLARS)";CS:CS=CS*X
150 TF=0:PRINT:PRINT"TEMP(DEG F) CURRENTLY":IN
    PUT"SET FOR A/C";TF
160 T=(TF+40)*5/9-40:PRINT
170 C=0:PRINT"COST FOR ELECTRICITY,":INPUT"CEN
    TS/KWH";C:C=C/100:PRINT"{CLEAR}"
180 PRINT"HIT <CR> IF REQUESTED QUANTITY IS UN
    KNOWN":GOSUB280:PRINT
190 A=.5:PRINT"AMPS DRAWN BY CEILING":INPUT"FA
    N";A
200 D=100:PRINT:PRINT"# DAYS PER YEAR FAN":INP
    UT"IS IN OPERATION";D
210 H=6:PRINT:PRINT"# OF HRS PER DAY FAN":INPU
    T"IS IN OPERATION";H
220 PRINT"{CLEAR}":PRINT"ANNUAL ";
230 CO=C*D*H*A*120/1000:PRINT"COST OF RUNNING ~
    FAN = $";FNTRC(CO)
```

```
240 V=1.788+V/.57:GOSUB280:GOSUB300:DF=DT*9/5:
    TF=FNRDD(TF+DF)
250 PRINT"YOU MAY INCREASE YOUR THERMOSTAT TO"
    ;TF;"DEG F"
260 PRINT"ANNUAL A/C SAVINGS =  $";FNTRC(CS*DF
    *.03):GOSUB280
270 END
280 PRINT"----------------------":RETURN
300 DT=T-33-(10*SQR(V)+10.45-V)*(T-33)/22.03:I
    FDT<0THENDT=0
310 RETURN
```

Program 3. Microsoft Version.

```
10 REM CEILING FAN ANALYSIS
30 DEF FNTRC(E)=INT(E*100)/100
40 DEF FNRDD(F)=INT(F+.99)
60 PRINT"{CLEAR}          CEILING FAN ANALYSI
    S"
70 PRINT"{02 DOWN}":X=.6:V=1
80 PRINT"SAVINGS IN AIR CONDITIONING AND COST
     OF  OPERATING FAN";
90 PRINT" WILL BE CALCULATED"
100 PRINT:GOSUB280:PRINT
110 PRINT"ANY COOLING FUEL (E.G. ELECTRICITY, ~
       NAT GAS) IS OK"
120 PRINT:PRINT"IS COOLING FUEL USED FOR OTHER
     PURPOSES":INPUT"(E.G. LIGHTING)";B$
130 IFASC(B$)=78THENX=1
140 CS=0:PRINT:INPUT"ANNUAL COOLING FUEL COST ~
    (DOLLARS)";CS:CS=CS*X
150 TF=0:PRINT:INPUT"TEMP(DEG F) CURRENTLY SET
     FOR A/C";TF
160 T=(TF+40)*5/9-40:PRINT
170 C=0:INPUT"COST FOR ELECTRICITY, CENTS/KWH"
    ;C:C=C/100:PRINT"{CLEAR}"
180 PRINT"PRESS <CR> IF REQUESTED QUANTITY":PR
    INT"IS UNKNOWN":GOSUB280:PRINT
190 A=.5:INPUT"AMPS DRAWN BY CEILING FAN";A
200 D=100:PRINT:INPUT"# DAYS PER YEAR FAN IS I
    N OPERATION";D
210 H=6:PRINT:INPUT"# OF HRS PER DAY FAN IS IN
     OPERATION";H
```

```
220 PRINT"{CLEAR}":PRINT"ANNUAL ";
230 CO=C*D*H*A*120/1000:PRINT"COST OF RUNNING ~
    FAN = $";FNTRC(CO)
240 V=1.788+V/.57:GOSUB280:GOSUB300:DF=DT*9/5:
    TF=FNRDD(TF+DF)
250 PRINT"YOU MAY INCREASE YOUR THERMOSTAT TO"
    :PRINTTF;"DEG F"
260 PRINT"ANNUAL A/C SAVINGS =  $";FNTRC(CS*DF
    *.03):GOSUB280
270 END
280 PRINT"-----------------------------------
    ---":RETURN
300 DT=T-33-(10*SQR(V)+10.45-V)*(T-33)/22.03:I
    FDT<0THENDT=0
310 RETURN
```

Program 4. Atari Version.

```
10 REM *** CEILING FAN ANALYSIS ***
20 REM *** ATARI VERSION ***
30 POKE 82,2:POKE 752,1:? CHR$(125):P
   OKE 85,9:? "[graphics]"
40 ? :? :X=0.6:V=1:DIM B$(1)
50 POKE 85,5:? "SAVINGS IN AIR-CONDIT
   IONING,"
60 POKE 85,8:? "AND COST OF OPERATING
   "
70 POKE 85,8:? "FAN WILL BE CALCULATE
   D":? :? :GOSUB 270
80 ? :? :? "ANY COOLING FUEL IS OK":?
    "(E.G., ELECTRICITY, NATURAL GAS)
   "
90 ? :? "IS COOLING FUEL USED FOR OTH
   ER":? "PURPOSES (E.G., LIGHTING),
   Y OR N";
100 INPUT B$:IF B$="N" THEN X=1
110 ? :POKE 85,1:? "ANNUAL COOLING FU
    EL COST (DOLLARS)";:INPUT CS:CS=C
    S*X
120 ? :? "TEMP (DEG F) CURRENTLY SET
    ON":? "AIR CONDITIONER";:INPUT TF
```

10

```
130 T=(TF+40)*5/9-40:?
140 ? "COST FOR ELECTRICITY, CENTS/KW
    H";:INPUT C:C=C/100:GOSUB 270
150 ? :? :? "ENTER 0 (ZERO) IF REQUES
    TED":? "QUANTITY IS UNKNOWN"
160 ? :? "AMPS DRAWN BY CEILING FAN";
    :INPUT A:IF A=0 THEN A=0.5
170 ? :? "# DAYS PER YEAR FAN IS IN":
    ? "OPERATION";:INPUT D:IF D=0 THE
    N D=100
180 ? :? "# HOURS PER DAY FAN IS IN":
    ? "OPERATION";:INPUT H:IF H=0 THE
    N H=6
190 ? :? :GOSUB 270
200 CO=C*D*H*A*120/1000:? "ANNUAL COS
    T OF OPERATING":? "FAN = $";INT(C
    O*100)/100
210 V=1.788+V/0.57:GOSUB 270
220 GOSUB 280
230 DF=DT*9/5:TF=INT((TF+DF)+0.99)
240 ? "YOU MAY INCREASE YOUR THERMOST
    AT TO":? TF;" DEG F"
250 ? "ANNUAL A/C SAVINGS = $";INT((C
    S*DF*0.03)*100)/100:GOSUB 270:GOS
    UB 270
260 END
270 POKE 85,0:FOR I=1 TO 40:? "-";:NE
    XT I:RETURN
280 DT=T-33-(10*SQR(V)+10.45-V)*(T-33
    )/22.03:IF DT<0 THEN DT=0
290 RETURN
300 REM ********************************
310 REM DT=EFFECTIVE DECREASE IN TEMP
    (C) DUE TO WIND (V=M/SEC)
320 REM T=DEG CENTIGRADE, TF=DEG FARE
    NHEIT, A=AMPS, D=# DAYS,H=# HOURS
    /DAY
330 REM X=REDUCTION IN UTILITY COST T
    O ACCOUNT FOR USES OTHER THAN COO
    LING
340 REM DF=EFFECTIVE DECREASE IN TEMP
     (DEG F) DUE TO WIND.
```

10

Program 5. Color Computer Version.

```
10 REM CEILING FAN ANALYSIS - COLOR COMPUTER ~
    VERSION
30 DEFFNTRC(E)=INT(E*100)/100
35 DEFFNRDD(F)=INT(F+.99)
40 CLS:PRINTTAB(5);"CEILING FAN ANALYSIS"
50 PRINT:PRINT:X=.6:V=1
60 PRINT "SAVINGS IN AIR CONDITIONING,"
70 PRINT"AND COST OF OPERATING"
80 PRINT"FAN WILL BE CALCULATED":PRINT:GOSUB2
    60:PRINT
90 PRINT"ANY COOLING FUEL IS OK":PRINT"(E.G. ~
    ELECTRICITY, NATURAL GAS)"
100 PRINT:PRINT"IS COOLING FUEL USED FOR OTHER
    ":PRINT"PURPOSES (E.G. LIGHTING";
110 INPUTB$:IFASC(B$)=78THENX=1
120 PRINT:PRINT"ANNUAL COOLING FUEL COST":INPU
    T"(DOLLARS)";CS:CS=CS*X
130 PRINT:PRINT"TEMP (DEG F) CURRENTLY SET FOR
    ":INPUT"AIRCONDITIONER";TF
140 T=(TF+40)*5/9-40:PRINT
150 PRINT"COST FOR ELECTRICITY,":INPUT"CENTS/K
    WH";C:C=C/100:GOSUB260:PRINT
160 PRINT:PRINT:PRINT"HIT <ENTER> IF REQUESTED
    ":PRINT"QUANTITY IS UNKNOWN"
170 PRINT:INPUT"AMPS DRAWN BY CEILING FAN";A:I
    FA=0THENA=.5
180 PRINT:PRINT"# DAYS PER YEAR FAN IS IN":INP
    UT"OPERATION";D:IFD=0THEND=100
190 PRINT:PRINT"# HOURS PER DAY FAN IS IN":INP
    UT"OPERATION";H:IFH=0THENH=6
200 PRINT:PRINT:GOSUB260:PRINT"ANNUAL ";
210 CO=C*D*H*A*120/1000:PRINT"COST OF OPERATIN
    G":PRINT"FAN = $";INT(CO*100)/100
220 V=1.788+V/.57:GOSUB260:GOSUB280:DF=DT*9/5:
    TF=FNRDD(TF+DF)
230 PRINT"YOU MAY INCREASE YOUR THERMOSTAT TO"
    ;TF;"DEG F"
240 PRINT"ANNUAL A/C SAVINGS = $";FNTRC(CS*DF*
    .03):GOSUB260
250 END
260 PRINT"--------------------------------"
270 RETURN
```

```
280 DT=T-33-(10*SQR(V)+10.45-V)*(T-33)/22.03:I
    FDT<0THENDT=0
290 RETURN:REM EFFECTIVE DECREASE IN TEMP(C) D
    UE TO WIND (V=M/SEC)
300 T=DEG C, TF=DEG F, DF=EFFECTIVE DECREASE I
    N TEMP (DEG F) DUE TO WIND
310 REM X=REDUCTION IN UTILITY COST TO ACCOUNT
     FOR USES OTHER THAN COOLING
```

Program 6. TI-99 Version.

```
10 REM ceiling fan analysis
30 DEF TRC(E)=INT(E*100)/100
40 DEF RDD(F)=INT(F+.99)
60 CALL CLEAR
63 PRINT "{4 SPACES}ceiling fan analy
   sis": : : : : :
74 X=.6
75 V=1
80 PRINT "savings in airconditioning"
90 PRINT "and cost of operating fan
   {3 SPACES}will be calculated": : :
102 GOSUB 280
103 PRINT : :
110 PRINT "any cooling fuel
    {12 SPACES}(e.g. electricity, nat
    gas) is ok": :
121 PRINT "is cooling fuel used for
    {4 SPACES}other purposes (e.g.
    {8 SPACES}lighting) ";
130 INPUT B$
131 IF ASC(B$)=121 THEN 140
132 IF ASC(B$)=89 THEN 140
135 X=1
140 PRINT
141 INPUT "annual cooling fuel cost
    {4 SPACES}(dollars)? ":CS
142 CS=CS*X
150 PRINT
151 INPUT "temp (deg f) currently set
      for a/c ?":TF
```

```
160 T=(TF+40)*5/9-40
161 PRINT
170 INPUT "cost for electricity,
    {7 SPACES}cents/kwh ?":C
171 C=C/100
172 GOSUB 280
173 PRINT : : :
182 PRINT "enter <0> if requested  qu
    antity is unknown": :
191 INPUT "amps drawn by ceiling fan
    ?":A
192 IF A<>0 THEN 200
195 A=.5
200 PRINT
201 INPUT "#days per year fan is in
    {4 SPACES}operation ?":D
202 IF D<>0 THEN 210
205 D=100
210 PRINT
211 INPUT "# hours per day fan is in
    {3 SPACES}operation ?":H
212 IF H<>0 THEN 220
215 H=6
220 PRINT : :
222 GOSUB 280
223 PRINT "annual";
225 CO=C*D*H*A*120/1000
230 YY=TRC(CO)
231 CO=C*D*H*A*120/1000
232 PRINT "cost of running fan = $";Y
    Y
240 V=1.788+V/.57
241 GOSUB 280
242 GOSUB 300
243 DF=DT*9/5
244 TF=RDD(TF+DF)
250 PRINT "you may increase your
    {7 SPACES}thermostat to ";TF;" de
    g f"
259 YY=TRC(CS*DF*.03)
260 PRINT "annual a/c savings = $";YY
```

10

```
261 GOSUB 280
270 END
280 PRINT "-------------------------
    --"
291 RETURN
300 DT=T-33-(10*SQR(V)+10.45-V)*(T-33
    )/22.03
301 IF DT>0 THEN 310
305 DT=0
310 RETURN
311 REM dt=effective decrease in temp
    (c) due to wind (v=m/sec)
320 REM  t=deg centigrade,  tf=deg fa
    renheit
330 REM  a=amps, d=# days,  h=# hours
    /day
340 REM  x=reduction in{5 SPACES}util
    ity cost to account for uses othe
    r than cooling.

360 REM df=effective decrease in temp
     (deg f) due to wind.{3 SPACES}
```

Appendix

Many of the programs which are listed in this book contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, {人}.

When you see	Type	See
{CLEAR}	ESC SHIFT <	Clear Screen
{UP}	ESC CTRL -	Cursor Up
{DOWN}	ESC CTRL =	Cursor Down
{LEFT}	ESC CTRL +	Cursor Left
{RIGHT}	ESC CTRL *	Cursor Right
{BACK S}	ESC DELETE	Backspace
{DELETE}	ESC CTRL DELETE	Delete Character
{INSERT}	ESC CTRL INSERT	Insert Character
{DEL LINE}	ESC SHIFT DELETE	Delete Line
{INS LINE}	ESC SHIFT INSERT	Insert Line
{TAB}	ESC TAB	TAB key
{CLR TAB}	ESC CTRL TAB	Clear TAB
{SET TAB}	ESC SHIFT TAB	Set TAB stop
{BELL}	ESC CTRL 2	Ring Buzzer
{ESC}	ESC ESC	ESCape key

Graphics characters, such as CTRL-T, the ball character • will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, {■} means to enter a reverse-field heart with CTRL-comma, {5 ■} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC/64

Unless there are separate program listings, use the program titled "Microsoft Version" for all PET/CBM models and the Commodore 64.

Generally, any PET/CBM/VIC/64 program listings will contain bracketed words which spell out any special characters: {DOWN} would mean to press the cursor-down key; {3DOWN} would mean to press the cursor-down key three times.

To indicate that a key should be *shifted* (hold down the SHIFT KEY while pressing the other key), the key would be underlined in our listing. For example, S would mean to type the S key while holding the shift key. This would result in the "heart" graphics symbol appearing on your screen. Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

Sometimes in a program listing, especially within quoted text when a line runs over into the next line, it is difficult to tell where the first line ends. How many times should you type the SPACE bar? In our convention, when a line breaks in this way, the ~ symbol shows exactly where it broke. For example:

```
100 PRINT "TO START THE GAME  ~
    YOU MAY HIT ANY OF THE KEYS
    YOUR KEYBOARD.
```

shows that the program's author intended for you to type two spaces after the word *GAME*.

Clear Screen	{CLEAR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

Apple II/Apple II Plus

Except in those cases where a special Apple version is provided, use the Microsoft version. The only required modifications are to the cursor control commands.

PET/CBM command	Apple equivalent
{CLEAR}	HOME
{DOWN}	PRINT (Apple II+: CALL -922)
{RIGHT}	PRINT CHR$(21)
{LEFT}	PRINT CHR$(8)

For example,

```
PET/CBM:    10 PRINT"{CLEAR} message"
Apple:      10 HOME:PRINT" message"

PET/CBM:    20 PRINT"{ 02 DOWN} message"
Apple:      20 PRINT:PRINT:PRINT" message"
```

TRS-80 Color Computer

No special characters are used.

Texas Instruments 99/4

The only special control characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY { 10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Enter all programs with the ALPHA lock on (in the down position). Release the ALPHA lock to enter lowercase text.

Notes

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