BCS Task 61
(210761)

(EC-77-C-03-1697)
DE-AC03-77CS20205

ENERGY AND ENVIRONMENTAL ANALYSIS, INC.

1111 North 19th Street
Arlington, Virginia 22209
(703) 528-1900

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DOE/CS/20205--T10

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

REVISED BCS
RESOURCE-ALLOCATION METHODOLOGY

FINAL REPORT

MASTER

AC03-77CS20205

Prepared for:

DIVISION OF BUILDINGS AND COMMUNITY SYSTEMS
OFFICE OF CONSERVATION AND SOLAR APPLICATIONS
U.S. DEPARTMENT OF ENERGY
20 Massachusetts Avenue, NW
Washington, DC 20545

Prepared by:

ENERGY AND ENVIRONMENTAL ANALYSIS, INC.
1111 North 19th Street
Arlington, Virginia 22209

September 19, 1979

Contract No. EC-77-C-03-1697
Task 61

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MGW

TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION	1
2. BACKGROUND	3
2.1 Description of RAM	4
2.1.1 Methodology Overview	4
2.1.2 Developing RAM Inputs.	7
2.1.3 Evaluating a Single Portfolio.	8
2.1.4 Comparing Portfolios	9
2.1.5 Interpreting RAM Outputs	10
2.2 Rationale for Modifications to RAM	11
2.2.1 Need to Clarify Market Group Classification Scheme	11
2.2.2 Need for Better Market Penetration Estimates	11
2.2.3 Need for an Automatic Link to TES Data	12
3. MODIFICATIONS.	14
3.1 Market Group Definition.	14
3.2 Use of BECOM for Market Penetration Estimates.	20
3.2.1 Design of Interface.	21
3.2.2 Required Modifications to BECOM.	22
3.3 Integration with TES Data Base	23
3.4 Development of Technology Cost Curves and Other Data	23
4. RESULTS.	28
5. LIMITATIONS AND CONCLUSIONS.	47
5.1 Technologies Affecting more than one End-Use Category	47
5.2 Space Conditioning Projects.	47
5.3 A Retrofit Market for New Buildings.	48
5.4 Competition for Energy Savings Between Technology Development and Motivational Projects.	48
5.5 Combining Market Groups.	49
5.6 Linking RAM and BECOM for all Market Groups.	49
5.7 Uncertainty Associated with BCS Projects	49

APPENDICES

A - RAM User's Manual

B - Runs for Other Projects

LIST OF FIGURES

	<u>Page</u>
Figure 2-1 Energy Savings Curve	5
Figure 2-2 Technology Cost Curve.	6
Figure 3-1 Definition of Market Groups in End-Use Category 1	15
Figure 3-2 Market Classification of BCS Projects.	17
Figure 3-3 Conventional Systems for End-Use Category 1.	19
Figure 3-4 Sample Technology Cost Curve	26
Figure 3-5 Standard Risk Curves	27

1. INTRODUCTION

The Resource Allocation Model (RAM) was developed by EEA to assist the Division of Buildings and Community Systems (BCS) in developing an efficient RD&D program for energy conserving technologies in the residential and commercial sectors. Since the resources available for this program are limited, and the range of technologies it covers large, there is competition between projects for funding. In order to effectively allocate its budget among these projects, BCS must have some method to assess the value of alternative research portfolios. RAM was designed to perform this function.

The model is useful in evaluating technology development projects which address related markets. This evaluation begins by classifying the technologies according to the markets in which they will compete once they are commercialized. Within each market group, the probable costs of the new technologies are compared to the cost of the competitive conventional product. This information, in conjunction with estimates of the per unit energy savings and market penetration that will be achieved, is used to calculate the expected energy savings of each portfolio of projects. Portfolios are then ranked in order of increasing energy savings, and estimates made of the value of various levels of funded research in each functional use area. Finally, successful portfolios in different market groups are compared in a similar manner in order to identify the most efficient comprehensive portfolio at each research funding level.

The following section describes the original methodology in more detail. It also presents some of the modifications that were made during this task, and explains why they were necessary. Section 3 discusses the

specific changes that were made, including improvements to the model as well as the development of more reliable data. The revised methodology is then applied to one market group to demonstrate its capabilities and limitations.

Section 4 includes a summary of the results of this effort, along with an updated set of RAM runs. The final section discusses the limitations of the modified methodology and describes the aspects of RAM that need further development.

A set of instructions for running the computer models associated with the RAM methodology is contained in Appendix A. Appendix B includes runs for those BCS projects not in the market group to which the revised methodology has been applied. These runs are based on data that has been collected during previous tasks.

2. BACKGROUND

RAM is an analytical tool for the evaluation, ranking and selection of research portfolios. The model was originally designed to work exclusively off of data collected for the Threshold Evaluation System (TES), a project evaluation methodology developed and used by EEA for BCS. This data consists of the capital costs, unit energy savings, and market penetration associated with each new technology. These estimates are developed exogenously from various sources. The methods used are adequate for the TES's screening function, but a greater degree of consistency is necessary for RAM runs where interproject comparisons are made.

The requirement for internally consistent market penetration data has been satisfied by using output generated by BNL's BECOM model as input to RAM. BECOM is a large scale optimization model used to simulate energy use in the residential and commercial sectors. The integration of these two models is one of the problems addressed in this report.

A second activity described in this report is the development of an automatic link between TES data and RAM inputs. RAM continues to use TES estimates of the capital costs and energy savings of each new technology. In order to insure that RAM runs are always based on the most current TES data, a system was developed to integrate the two sets of data files.

The third major area of effort in this task was the collection of information necessary to derive probabilistic cost curves for use in RAM. New, more realistic estimates of the uncertainty associated with the production of the new technologies was elicited from experts at DOE and the national laboratories.

A discussion of these activities, and the resulting modifications to the RAM methodology will be described in Section 3. The remainder of this section is a description of the theory on which the model is based. A more in-depth discussion of RAM may be found in the previous EEA report, "Final Report: The RAM2 Resource Allocation Methodology" (November 1, 1978).

2.1 DESCRIPTION OF RAM

One of the basic assumptions upon which RAM is based is that the total energy savings attributable to an RD&D program is dependent upon the presence (or absence) of other programs addressing the same market. That is, if a technology is being developed to increase the efficiency of gas-fired heating equipment in new homes, it's success in the market place, and thus the amount of energy it saves, will be limited if another technology is developed and commercialized which addresses this same functional end use. Before RAM can be executed, it is important to classify the BCS projects being considered into appropriate "market groups". The market groups used during this task are described in Section 3.1.

A second assumption which is closely related to the first is that, if two programs within the same market group are funded, the likelihood that at least one of the technologies produced will enter the market at or below a certain cost is higher than the probability that either one, funded singly, would achieve that cost. The method of determining the magnitude of this effect is discussed later in this section.

2.1.1 Methodology Overview

The analytical structure of RAM can be divided into two parts: the evaluation of a single portfolio of RD&D projects, and the comparison of different portfolios. Both calculations are based on two basic inputs. The first is a curve which relates the dollar value of the total resource savings achieved by a technology or group of technologies to some measure of the cost of the technology. A typical energy savings curve is shown in Figure 2-1.

FIGURE 2-1
ENERGY SAVINGS CURVE

The curve's negative slope reflects the fact that, as the cost of a technology increases its penetration into the market decreases, resulting in a lower level of resource savings to the nation. The values on the vertical axis are determined by multiplying the energy savings achieved by each unit of the technology by the number of units reaching the market. The values on the horizontal axis may be specified as either the capital cost or life-cycle cost of the new technology. One such curve is developed for each market group being evaluated.

The second type of input to RAM is the technology cost curves. The uncertainty associated with the outcome of an RD&D program is represented by a frequency distribution of the technology cost.

Figure 2-2 is an example of a cumulative probability distribution of cost showing the likelihood that a technology will enter the market at or below each of the prices appearing on the x-axis. These prices are the same as those used for the energy savings curve, described previously.

FIGURE 2-2
TECHNOLOGY COST CURVE

Together the energy savings and technology cost curves define the frequency distribution of the energy savings resulting from the development of the new technology. From this curve, the expected value of the energy savings may be calculated.

The procedure for applying this concept to portfolios of projects within a market group involves combining the separate technology cost curves for all funded projects into one curve for the entire portfolio. This curve can then be multiplied by the energy savings curve for the entire market group to yield the frequency distribution and expected value of the energy savings which will result from the portfolio of projects. When a portfolio spans several market groups, the energy savings in each group, as determined by the procedure described above, are added together.

RAM is capable of evaluating large numbers of portfolios, eliminating poor choices and outputting a list which shows which project selections should be made at each funding level to maximize the impact of the program. A more detailed description of the methodology follows.

2.1.2 Developing RAM Inputs

The preparation of the two classes of inputs mentioned earlier in this paper, the technology cost curves and the energy savings curves, involves four steps. The first step is the collection of cost and performance data for each technology. The required information includes: the expected capital cost of the technology when it reaches the market; the annual energy use of the new technology as compared to the conventional product against which it will compete; the lifetime of the product; its non-fuel operating and maintenance costs; and a precise description of its applicability in different market areas.

The second step in the process of data preparation is the generation of the cost probability curves, based on the information gathered during step one and estimates from experts about the risk involved in the production of the technology. A description of how these curves were developed during this task is given in Section 3.3.

The third and fourth steps of the process are necessary to develop the energy savings curve, which relates the dollar value of the resources conserved as a result of a product entering the market to the cost of that product. The third step is an estimation of the number of units of each new technology in use by a given year. Market penetration estimates must be made at a number of different costs, covering the range between the highest and lowest probable costs of all projects within a market group.

Next, each level of market penetration is multiplied by the savings per unit attributable to the new technology. The result of this calculation is the energy savings curve.

As presented in this report, the units for the input curves are those which were shown in Figures 2-1 and 2-2. The costs used (on the

horizontal axes of the two curves) for this task were the annualized life cycle costs of the new technologies. In each market group, the savings shown on the vertical axis of the energy savings curve are the net dollars saved as the result of the new technology entering the market at each of a number of costs. The net savings is calculated as the total resource savings attributable to the portfolio minus the capital investment in the new units sold.

2.1.3 Evaluating A Single Portfolio

A portfolio is defined as a group of one or more projects, all addressing the same end-use market. The procedure for evaluating a portfolio of one project will be described first, followed by a brief discussion of the technique used to evaluate portfolios containing more than one project.

For the case where there is only one project addressing a market:

- A frequency distribution of cost is developed for the candidate project,
- Market penetration estimates are made for selected values of cost spanning the range of the technology's cost frequency distribution,
- The market penetration estimates are used to develop a function relating the savings to technology cost,
- The frequency distribution and expected value of savings is determined by multiplying the savings function by the cost frequency distribution.

If there are several projects addressing the same market, the procedure is altered to account for two factors. The first is the competition that will occur between projects and the second is the fact that the success of one project in being produced at or below a given cost will probably enhance the success of others. In this case:

- A frequency distribution of cost is developed for each project in the portfolio.
- These distributions are combined to determine the probability that the least expensive of the projects will reach the market at or below each cost. The total portfolio cost curve is defined by the relationship.

$$f_p(x) = \frac{d}{dx} \left(1 - \prod_{i=1}^{n_p} \left\{ 1 - \int_0^x f_i(x) dx \right\} \right)$$

where

x = each cost value

$f_p(x)$ = cost frequency distribution of the entire portfolio

n_p = number of projects in the portfolio

$f_i(x)$ = cost frequency distribution of project i .

- One market penetration curve is prepared for selected values of cost spanning the range of the cost distributions of all projects in the portfolio
- The market penetration estimates are used to derive a function relating savings to technology cost. This function expresses the savings which will result if any of the projects achieve each cost level.
- The frequency distribution and expected value of savings for each portfolio is determined by multiplying the savings function times the cost frequency distribution of the portfolio.

2.1.4 Comparing Portfolios

The above procedures are carried out for all candidate portfolios within a market group. Since the total number of portfolios is large, the results must be processed to screen out useless information about poor portfolios and to summarize the remainder in a comprehensible form.

RAM accomplishes this by ranking all of the portfolios in order of increasing research cost. The total research cost of a portfolio is simply the sum of the research costs of all of the projects it includes. As each portfolio is inserted at the proper rank in the list, its expected energy savings is compared to the portfolio it follows. If the portfolio being considered does not save more energy than the one it follows (which costs less), it is eliminated from the listing.

2.1.5 Interpreting RAM Outputs

There are two primary outputs of RAM. The first is the market group portfolio sheet which indicates the number and name of the market group represented and the projects it includes. Also, the following information is given for each successful portfolio within the market group: the portfolio number (in order of increasing research cost), the funded projects in that portfolio, its expected net resource savings, the total research cost, the total private capital investment, and the ratio of the resources saved per dollar spent on RD&D. Also included is one extra portfolio which represents the case where the last portfolio in the list is enlarged by one extra project, whose characteristics resemble the average of all of the projects in the group. The savings achieved by this extra portfolio are listed at the bottom of the sheet, and give some idea of the marginal value of an additional project in the market group.

The second output of RAM is a graph with each portfolio plotted according to its research cost (on the X-axis) and net resource savings (Y-axis). The resulting curve can be used to determine the best portfolio of projects at any funding level. This can be done by drawing a line (on the list or graph) at the funding level being considered. The portfolio closest to that line would contain the projects which should be funded to optimize the use of the research funds.

2.2 RATIONALE FOR MODIFICATIONS TO RAM

In applying RAM to BCS programs, it became clear that there were many aspects of the methodology that needed clarification and further development. The rest of this section will be spent discussing some of the implementation problems which were encountered. Section 3 presents the modifications made to the methodology to remedy these problems.

2.2.1 Need To Clarify Market Group Classification Scheme

RAM is designed to compete projects within market groups. In the original documentation, a market group was defined as those projects that will directly compete with each other in the market place. This implies that each different combination of markets will constitute a different market group. For example, if one heat pump project applies to both single family and multi-family homes, and another applies to single family homes only, they would each have been placed in different market groups. It became apparent that by defining every possible combination of groups as a potential market it would be unlikely that more than one project would fit into each.

In addition to overcoming this difficulty with the original market group design of RAM, several new considerations had to be made. Markets of some projects needed to be limited to fuel-specific systems; the distinction had to be made between technologies with new buildings applications and those intended for retrofit; and market groups needed to be set up so that each project can be compared to an appropriate conventional system.

2.2.2 Need for Better Market Penetration Estimates

RAM was originally designed to acquire all of its data from the Threshold Evaluation System. After examining this data, and the various sources and assumptions used to develop it, it was decided that some of the

information, especially the market penetration data, needed to be derived in a more consistent manner. TES estimates of market penetration for each project were often based on the personal opinions of knowledgeable persons at DOE and elsewhere. This method is adequate for the calculations done in TES, but creates problems when inter-project comparisons are made.

2.2.3 Need For An Automatic Link to TES Data

As was discussed in Section 2.1, RAM develops most of its inputs from the data used in the Threshold Evaluation System (TES) model. This information, including the capital cost, energy use, lifetime, and performance characteristics of each project is essential to RAM. However, the Threshold system was designed to evaluate a project based upon the average performance of a technology across all of its applications. In RAM, information must be more market-specific. In many cases, it was not clear from the TES data for each project exactly which markets were appropriate, which fuels could be used, nor whether or not the project was favorable to new or retrofit applications. It is necessary to the proper use of RAM to be able to specify all information in a manner which clearly defines the application(s) of the project under study, because pertinent project data may vary with each application. Once the TES data is adjusted to fit RAM's needs, there arises the need for one further modification. That is the development of an automatic link between TES and RAM so that all the new data in TES can be quickly transferred to RAM to update its files. Threshold's data is modified quite often due to changing energy prices, capital costs, and performance estimates. In order to be most efficient, the file containing all of this updated information should be easily accessed by both systems. This would save time and computer costs and would assure that both systems were continually up to date.

In addition, RAM requires capital cost estimates which are in the form of probability distributions, rather than single points. Since this information is not available from TES data it must be developed as part of RAM's data collection activities.

3. MODIFICATIONS

In order to address the inconsistencies described in the previous section, and improve the clarity and efficiency of both TES and RAM, several modifications were made to the methodology. During this task, the revised methodology was applied to the projects in the Residential space heating end-use category. The rest of this section will discuss each of the modifications, and their implementation for analyzing BCS projects addressing markets within this functional end-use area.

3.1 MARKET GROUP DEFINITION

The revised approach to market group classification used in this task views a project in terms of each application it may have, and designates each application as a separate market group. The major end-use categories used in the original runs remain as a broad classification, defined by sector (residential or commercial), and end-use demand (space heating, air conditioning, water heating and appliances). One other distinction made within this level of categorization is whether or not the technology is a conversion device or a shell improvement. Groups are then defined more specifically by building type, new versus retrofit applications, and fuel types. This breakdown in detail provides both specifics about the technology, and information about the usefulness of the product in the market place. Each project is entered into all of the groups to which it applies and competed against the others in each of those groups. The energy savings attributable to each project, then, is the sum of the savings the project achieves in each of its applications.

The major end-use category addressed during this task and the definition of its market groups is shown below in Figure 3-1. Groups 1A and 1B include new equipment purchased for use in new buildings. All of the

FIGURE 3-1
DEFINITION OF MARKET GROUPS
IN END-USE CATEGORY 1: RESIDENTIAL
SPACE HEATING - CONVERSION DEVICES

	<u>Single Family</u>	<u>Multi-Family</u>
New buildings	1A	1B
Existing buildings		
New equipment at turnover		
Gas	1C	1F
Oil	1D	1G
Electric	1E	1H
Retrofit		
Gas	1I	1L
Oil	1J	1M
Electric	1K	1N

remaining groups apply to existing buildings, but the distinction is made between two categories of devices. The first (1C-1H) includes new equipment that is purchased when the conventional system in an existing building is retired. The penetration of the devices in groups 1C-1H, therefore, is dependent upon the average turnover rate of heating equipment (based on a lifetime of 15 years). The devices included in market groups 1I-1N are those that would be purchased to be added to an existing conventional system, even though that system is still functional. These groups are defined to include the early retirement of entire systems, the replacement of a component of a system, or an operational adjustment.

Consider, for example, a technology that may be used in all single family homes. It would be entered in groups 1A, 1C, 1D, 1E, 1I, 1J, and 1K, according to its performance in each of these applications. Another project might only affect new, single-family homes, and therefore only be entered into group 1A. This second technology would then compete with the first for this application.

BCS projects had to be examined closely for detailed descriptions and market applicability in order to accurately classify them into these market groups. Research into new studies, and interviews with those persons involved in the development of each technology (as mentioned in Section 3.3), aided in the final classification process. A chart of those BCS projects classified under End-Use Category 1 is given in Figure 3-2.

In order to compete these new technologies within a market group, and accurately assess their energy benefits, all of the projects in each group were compared to the same conventional system. The conventional system was defined as either the system presently in use in an existing home, or the product that is currently available on the market for new

**FIGURE 3-2 - MARKET CLASSIFICATION OF BCS PROJECTS
RESIDENTIAL SPACE HEATING - CONVERSION DEVICES**

New Buildings

Existing Buildings

At Equipment Turnover

Retrofit Existing Equipment

PROJECTS

18 - MED II
25 - ACES - Single Family
48 - Microprocessor Controlled Thermostat
51-Zone Controls for Hydronic Systems
52 - Var. Low Firing Rate Oil Burner
53 - High Efficiency Gas Furnace
55 - Integrated Appl. Sp.ht./wtr.ht.
56 - Oil Retrofit
57 - High Eff. Elec. Heat Pump
58 - Gas Heat Pumps
63-Demo. Stir./Rank. Gas Heat Pump
105 - Air-to-Air Heat Exchanger

	New Buildings			Existing Buildings			Existing Buildings		
	SF	MF	MH	SF	MF	MH	SF	MF	MH
	Gas	Oil	Electric	Gas	Oil	Electric	Gas	Oil	Electric
18 - MED II	x	x	x						
25 - ACES - Single Family			x						
48 - Microprocessor Controlled Thermostat	x	x	x	x	x	x	x	x	x
51-Zone Controls for Hydronic Systems	x	x	x	x	x	x	x	x	x
52 - Var. Low Firing Rate Oil Burner		x			x			x	
53 - High Efficiency Gas Furnace	x			x			x		
55 - Integrated Appl. Sp.ht./wtr.ht.	x			x			x		
56 - Oil Retrofit					x			x	
57 - High Eff. Elec. Heat Pump			x			x			
58 - Gas Heat Pumps	x			x					
63-Demo. Stir./Rank. Gas Heat Pump	x			x					
105 - Air-to-Air Heat Exchanger	x	x	x						

homes. This system would satisfy the same end-use function as any of the new technologies it was compared to, but in a less energy efficient manner.

Figure 3-3 gives a description of each conventional system, and its cost and energy use. It was assumed that a person purchasing a new home would have the choice of using any fuel in his home, so that the market groups for new homes did not distinguish between fuel types. However, in an existing home, it was assumed that the homeowner would not change fuel types. Therefore, the technologies used in existing homes were compared to the conventional system of the appropriate fuel type. The conventional systems used for market groups 1I - 1N were assumed to have no capital cost, since the consumer has the option of doing nothing, which would cost nothing. The energy use for these systems is the same as that given for groups 1C - 1H.

The energy use figures used to define the conventional systems were derived from Brookhaven National Laboratories data. The fuel demand for space heating in an existing single family home was determined to be 155 million Btu's per year. This number is the weighted average of the energy used for heating by systems run with different fuels. The weights used to represent the percentage of homes using each fuel were: 62 percent gas, 25 percent oil, and 13 percent electric for existing single family homes. This average energy use was then applied across all fuel types. It should be noted that Brookhaven did provide fuel-specific energy use figures, but they did not appear very accurate when compared to other data previously collected.

The fuel demand for space heating in an existing multi-family unit was also calculated by using weighted averages of BNL data. However, our definition of multi-family includes two of BNL's building types, namely low density and multi-family buildings. To deal with this inconsistency, we first calculated the weighted averages (by fuel) for each building type, which totalled 72×10^6 Btu's/yr for multi-family units

FIGURE 3-3
CONVENTIONAL SYSTEMS FOR END-USE CATEGORY 1 -
RESIDENTIAL SPACE HEATING CONVERSION DEVICES

<u>Market Group</u>	<u>Description</u>	<u>Cost</u>	<u>Energy Use</u> (10 ⁶ Btu's/yr)	<u>Lifetime</u> (yrs)	<u>O&M</u> (\$/yr)
1A	A new heating system in new single-family homes.	\$1718.00*	130	15	\$71.00
1B	A new heating system in new multi-family homes	\$1394.00*	74	15	\$57.00
1C	A new heating system for an existing single family gas-fueled home.	\$ 429.00**	155	15	\$68.00
1D	A new heating system for an existing multi-family gas-fueled home.	\$ 432.00**	91	15	\$86.00
1E	A new heating system for an existing single family oil-fueled home.	\$ 474.00**	155	15	\$70.00
1F	A new heating system for an existing multi-family oil-fueled home.	\$ 331.00**	91	15	\$52.00
1G	A new heating system for an existing single family electrically heated home.		155		
1H	A new heating system for an existing multi-family electrically heated home.	\$ 331.00**	91	15	\$59.00

* = Cost of ductwork included

** = Cost of ductwork not included (ductwork already in place).

and 108×10^6 Btu's yr for low density units. These two figures were then averaged according to the percentage of the stock they constituted (53 percent low density and 47 percent multi-family), to provide one average figure of 91×10^6 Btu's per year. This was the final figure used to represent the fuel demand for space heating in existing multi-family units.

Since new buildings, in general, consume less energy than existing ones, it is also necessary to determine the average fuel demand of new single family and multi-family homes. The calculations done were the same as those just described, except that the fuel distribution used reflected the fractions of new (rather than existing) homes built with heating systems of each fuel type. The values so derived equalled 130×10^6 Btu's per year for new, single family homes and 74×10^6 Btu's per year for new, multi-family homes.

3.2 USE OF BECOM FOR MARKET PENETRATION ESTIMATES

A major concern in selecting a source for market penetration estimates for RAM was that its representation of energy end-use devices and their markets be sufficiently disaggregated. Also, the source had to include a model that could evaluate new technologies by allocating energy demand between them on the basis of cost and performance considerations. Once these criteria were met, BCS projects, or groups of competing projects, could be evaluated by adding them to the devices available within each market. A prediction of how much of the market they could capture could then be made.

The BECOM model (Buildings Energy Conservation Optimization Model) of residential and commercial energy demand, in use at Brookhaven National Laboratories, was chosen for this purpose. It is a linear programming model that determines the optimal configuration of technology use, and resulting fuel use, by minimizing total energy system cost, subject to

certain demand and supply oriented constraints. The penetration of various conversion devices and building shell technologies is specified at a high level of detail, including new and retrofit markets for nine building types. Each market within the space heating end-use area may choose from several conversion devices and four levels of new and four of retrofit structural improvement.

In this configuration, new technologies may be added to the options available, and will compete with the conventional systems for shares of the appropriate markets. In order to use BECOM to predict the market penetration of a technology developed as the result of one or more BCS programs, the technology must be characterized in a manner consistent with all of the other technologies already in BECOM. This presented some difficulty during this task because the numbers available from TES data had to be modified so that the assumptions on which they are based and the system components they include are the same as those in BECOM.

3.2.1 Design of Interface

Specifically, technologies in BECOM are characterized by an operating efficiency, capital cost, useful lifetime, and annual operating and maintenance costs. Those BCS projects that apply to equipment in existing buildings can be described this way, based on information collected from DOE experts and persons involved in related research. For each market group in RAM affecting existing buildings, then, a range of cost and performance data spanning the highest and lowest values for the projects included in the group can be entered to BECOM and run to determine the penetration expected at each level of cost. The characteristics of an individual project in the group may be compared to this range, and evaluated according to the penetration occurring at each of its probable costs.

The characterization of BCS technologies that affect new buildings presents a problem because one of the assumptions made about these

markets is that the fuel used for heating in new homes is not predetermined. That is, since we do not restrict the choice of fuel in new construction, we cannot specify an operating efficiency for these heating systems. Instead, each market group is represented as a range of annualized life cycle costs. This value is calculated for each project by first adding the present value of all operating expenses incurred over the lifetime of the technology to its initial cost. The total life cycle cost (LCC) is then annualized. This calculation is repeated at each of the technology's probable costs. At this stage, the annualized LCC's for all projects within the market group may be examined to determine the range of costs to be run in BECOM. The resulting market penetration is applied to individual projects in the same manner as in existing buildings.

3.2.2 Required Modifications to BECOM

The addition of new technologies to BECOM is a common change, and therefore straightforward to implement. Since RAM's market groups are defined so as to be independent, at least within functional end-use areas, it is possible to enter and run them all simultaneously. That is, the market penetration achieved by the technology representing one market group will not affect that achieved by a technology representing a second group.

It is necessary, then, to run BECOM, including this new set of technologies, for each of a number of costs spanning the range in each market group. For this task, four runs were made to determine the penetration of the devices in the space heating area by 1985. Runs can be made for other years to determine the changes that will occur as more units enter the market.

A second necessary change to BECOM is the addition of a "turnover" market. This market includes those existing buildings that must replace

their heating equipment when it fails. Normally, BECOM does not consider these units in its allocation, but there are instances when there are more of them than there are new buildings. For this reason, a constraint was added to BECOM's formulation to assure that 4.5 percent of all existing homes (based on an equipment lifetime of 15 years) acquire new heating equipment each year. New and conventional replacement systems are allowed to compete for this market.

3.3 INTEGRATION WITH TES DATA BASE

In the initial steps of this task, the data for each project was updated. This resulted in new, more precise definitions of projects on TES, and more accurate cost and energy use estimates. This modification greatly improved the information in Threshold, and therefore provided improved input for RAM. The increased detail and more current figures aided in classifying each project into the newly organized market groups.

In order to store this new information in the format required for RAM input, a new file (PV) was appended to the Threshold system. Through this arrangement, updated TES information is input to the PV file, from which RAM can be run. Since TES data is updated and changed quite often, this automatic link is necessary to assure consistency between the two models. The interaction between the PV file and the rest of the RAM computer system is illustrated in Figure A-1 in Appendix A (User's Manual).

3.4 DEVELOPMENT OF TECHNOLOGY COST CURVES AND OTHER DATA

An integral part of this task was to develop new data to be used by both the Threshold System and RAM. More accurate descriptions, energy use specifications and cost figures for many technologies were obtained to update our files. The task required that the cost information we

gathered be in the form of a range of costs rather than a single estimate. The range of costs was used to develop a cost probability curve. In developing such a curve, each cost was associated with a probability which reflected the chance of the technology entering the market at that price.

In assessing the market costs of future energy conservation technologies, some degree of technical uncertainty is to be expected. In order to best reflect this uncertainty, we chose to develop cost probability curves. Information regarding the risks associated with each technology was obtained through interviews with those persons having technical expertise, or having worked closely with the development of the technology. DOE officials who have worked in the research and development of energy efficient technologies, and managers at national laboratories who have aided in the technical development of these devices were contacted and interviewed.

Interview techniques were patterned after probability encoding in decision analysis studies developed by Stanford Research Institute (SRI). Interviews were conducted as a means to gather data and to reveal true levels of technical uncertainty. A general discussion was necessary as a preview to update descriptive information, determine applicable markets, and assess the energy savings potential of each project. The maximum and minimum cost possibilities had to be determined first, in order to prevent the interviewee from stating an initial cost and feeling compelled to base all other answers around that one cost so as not to appear unsure of himself. Other biases were avoided by phrasing questions carefully and maintaining the awareness that each person may tend to underestimate costs to make the project appear economic. With cooperation from each of the persons interviewed, ranges of costs, better descriptive information, and some personal insights from experienced persons about the future of each project were recorded.

The costs for each project were plotted and probability distributions drawn. Figure 3-4 is an example of one of the distributions so derived. It soon became apparent that many of these curves resembled log-normal distributions. Since the margin of error associated with most of the curves we plotted was fairly large it was decided that the quality of our data would not suffer if log-normal functions were used to predict the actual points to be used as input to RAM, given an indication of the relative level of risk associated with each project.

Four standard curves were defined to represent the levels of risk which may be associated with a technology's development. The curves are indicated in Figure 3-5. A section of code has been added to the program to generate cost probability curves for each project, given a mean cost and a risk level.

SAMPLE TECHNOLOGY COST CURVE

FIGURE 3-5
STANDARD RISK CURVES

4. RESULTS

The revised Resource Allocation Methodology has been applied to all BCS projects involving residential space heating devices. The output for each of the market groups described in this report is included in the rest of this section.

02/12/77

BARKLEY GROUP 1A 1 RES. SPACE HEATING CONVERSION DEVICES SF NEW

YEAR 1 1985

	RES. COST	NET RESOURCE	SAVING/1	PRIVATE	PORTFOLIOS (FUNDING LEVELS)									
	(1X10445)	SAVING (1X10446)		INVESTMENT (1X10448)	10	25	52	83	85	57	58	63	105	
1	0.239E100	0.745E103	0.312E104	0.207E102	0	0	1	0	0	0	0	0	0	
2	0.472E100	0.103E104	0.207E104	0.103E104	1	0	0	0	0	0	0	0	0	
3	0.731E100	0.143E104	0.195E104	0.549E103	1	0	1	0	0	0	0	0	0	
4	0.107E101	0.155E104	0.144E104	0.531E103	1	0	1	0	0	0	0	0	1	
5	0.240E101	0.156E104	0.450E103	0.910E103	1	0	1	0	0	1	0	0	1	
6	0.323E101	0.147E104	0.517E103	0.566E103	1	0	1	1	0	0	0	0	0	
7	0.752E101	0.175E104	0.409E103	0.540E103	1	0	1	1	0	0	0	0	1	
8	0.302E101	0.177E104	0.444E103	0.909E103	1	0	1	0	0	0	1	0	0	
9	0.412E101	0.186E104	0.446E103	0.806E103	1	0	1	0	0	0	1	0	1	
10	0.549E101	0.186E104	0.346E103	0.106E104	1	0	1	0	0	1	1	0	1	
11	0.632E101	0.195E104	0.308E103	0.031E103	1	0	1	1	0	0	1	0	0	
12	0.667E101	0.201E104	0.301E103	0.764E104	1	0	1	1	0	0	1	0	1	
13	0.779E101	0.201E104	0.252E103	0.903E103	1	0	1	1	0	1	1	0	1	
14	0.853E101	0.206E104	0.239E103	0.132E104	1	1	1	0	0	0	1	0	1	
15	0.925E101	0.206E104	0.207E103	0.142E104	1	1	1	0	0	1	1	0	1	
16	0.168E102	0.215E104	0.198E103	0.132E104	1	1	1	1	0	0	1	0	0	
17	0.111E102	0.210E104	0.196E103	0.124E104	1	1	1	1	0	0	1	0	1	
18	0.125E102	0.210E104	0.175E103	0.136E104	1	1	1	1	0	1	1	0	1	
19	0.140E102	0.219E104	0.140E103	0.130E104	1	1	1	1	0	0	1	1	1	
20	0.155E102	0.220E104	0.141E103	0.126E104	1	1	0	1	1	0	1	0	1	
21	0.158E102	0.222E104	0.141E103	0.102E104	1	1	1	1	1	0	1	0	1	
22	0.171E102	0.222E104	0.130E103	0.122E104	1	1	1	1	1	1	1	0	1	
23	0.195E102	0.223E104	0.114E103	0.117E104	1	1	1	1	1	0	1	1	1	
24	0.208E102	0.223E104	0.107E103	0.127E104	1	1	1	1	1	1	1	1	1	
	0.231E102	0.230E104	0.998E102											
	----- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT													

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

[illegible]

09/12/79

BASEE1 GROUP 10 : RES1 SPACE HEATING CONVERSION DEVICES IN NEW
YEAR : 1985

	RES. COST ($\times 10^4$ \$)	NET RESOURCE SAVING ($\times 10^4$ \$)	SAVING ($\times 10^4$ \$)	PRIVATE INVESTMENT ($\times 10^4$ \$)	PORTFOLIOS (CHOICING LEVELS)		
					53	55	57
1	0.132E101	0.103E102	0.776E101	0.401E103	0	0	1
2	0.250E101	0.127E103	0.506E102	0.125E101	1	0	0
3	0.382E101	0.132E103	0.345E102	0.303E103	1	0	1
4	0.454E101	0.158E103	0.340E102	0.395E102	0	1	0
5	0.594E101	0.160E103	0.268E102	0.260E103	0	1	1
6	0.714E101	0.214E103	0.300E102	0.024E102	1	1	0
7	0.845E101	0.215E103	0.259E102	0.215E103	1	1	1
	0.413E102	0.238E103	0.211E102	VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

07/12/79

MARKET GROUP 10 : REST SP HI : CONV DEVICES : EXISTG BLDGS, NEW LOOTH : SP GAS

YEAR : 1985

	RES. COST (X10445)	NET RESOURCE SAVING (X10446)	SAVING/4	PRIVATE INVESTMENT (X10346)	PORTFOLIOS (FUNDING LEVELS)			
					53	55	50	63
1	0.250E101	0.242E103	0.966E102	0.144E103	1	0	0	0
2	0.458E101	0.341E103	0.735E102	0.455E102	0	1	0	0
3	0.559E101	0.347E103	0.620E102	0.264E103	1	0	1	0
4	0.714E101	0.392E103	0.549E102	0.748E102	1	1	0	0
5	0.773E101	0.409E103	0.530E102	0.214E103	0	1	1	0
6	0.192E102	0.450E103	0.439E102	0.191E103	1	1	1	0
7	0.119E102	0.451E103	0.324E102	0.244E103	1	1	1	1
	0.474E102	0.476E103	0.273E102	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

02-12-77

MARKET GROUP 11 : RES1 SE 111 CORP DEVICES - EXISTG BLDGS - NEW LINDY - HE GAS

YEAR : 1985

	FES. COST (\$X10TT6)	NET RESOURCE SAVING (\$X10TT6)	SAVING/1	PRIVATE INVESTMENT (\$X10TT6)	PORTFOLIOS (FUNDING LEVELS)	
					53	55
1	0.250E101	0.111E102	0.413E101	0.221E102	1	0
2	0.454E101	0.276E102	0.594E101	0.705E101	0	1
3	0.714E101	0.311E102	0.435E101	0.147E102	1	1
	0.107E102	0.355E102	0.331E101	<-- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

FORT ONTO COST 104664

09/12/79

MARKET GROUP II : RESI SP HT - CONV DEVICES - EXISTG BLDGS, RETROFIT - SF GAS

YEAR : 1905

	RES. COST	NET RESOURCE	SAVING%	PRIVATE	PORTFOLIOS (FUNDING LEVELS)			
	($\times 10^{+6}$)	($\times 10^{+6}$)		INVESTMENT				
				($\times 10^{+6}$)	48	51	53	55
1	0.233E+00	0.463E+04	0.198E+05	0.880E+03	1	0	0	0
2	0.567E+00	0.469E+04	0.828E+04	0.704E+03	0	1	0	0
3	0.000E+00	0.778E+04	0.973E+04	0.792E+03	1	1	0	0
4	0.330E+01	0.866E+04	0.263E+04	0.205E+04	1	1	1	0
5	0.794E+01	0.915E+04	0.115E+04	0.216E+04	1	1	1	1
	0.993E+01	0.101E+05	0.102E+04		<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

PORTFOLIO COST 10**64

09/12/79

MARKET GROUP 1.1 : REST SUPPLY - CONV DEVICES - EXISTING BLDGS, RETROFIT - SF OIL

YEAR : 1985

	RES. COST	NET RESOURCE	SAVING/%	PRIVATE	PORTFOLIOS (FUNDING LEVELS)			
	(\$X10**6)	SAVING (\$X10**6)		INVESTMENT (\$X10**6)				
					48	51	52	54
1	0.233E+00	0.220E+04	0.970E+04	0.311E+03	1	0	0	0
2	0.472E+00	0.326E+04	0.690E+04	0.374E+03	1	0	1	0
3	0.800E+00	0.373E+04	0.466E+04	0.200E+03	1	1	0	0
4	0.104E+01	0.423E+04	0.407E+04	0.332E+03	1	1	1	0
5	0.503E+01	0.445E+04	0.885E+03	0.358E+03	1	1	1	1
	0.629E+01	0.483E+04	0.767E+03	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT				

MARKET GROUP 13 : REST OF HT - COMM DEVICES - EXISTG BLDGS, RETROFIT - SF OIL

YEAR : 1985

09/12/79

MARKET GROUP 1K : REST SP HT - CONV DEVICES - EXISTG BLDGS, RETROFIT - SF ELEC

YEAR : 1985

	RES. COST	NET RESOURCE	SAVING/4	PRIVATE	PORTFOLIOS (FUNDING LEVELS)	
	(\$X10**6)	SAVING (\$X10**6)		INVESTMENT (\$X10**6)		
					48	51
1	0.233E100	0.121E104	0.520E104	0.187E103	1	0
2	0.567E100	0.123E104	0.217E104	0.149E103	0	1
3	0.800E100	0.200E104	0.250E104	0.168E103	1	1
	0.120E101	0.253E104	0.210E104	--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT		

MARKET GROUP 18 : REST SF HT - CONV DEVICES - EXISTG BLDGS, RETROFIT - SF ELEC

YEAR : 1985

PORTFOLIO COST 10**6

02/12/79

MARKET GROUP 1L : REST OF HI - CONV DEVICES - EXISTG BLDGS. RETROFIT - ME TAG

YEAR : 1905

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/%	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					40	53	55
1	0.233E100	0.509E103	0.252E104	0.137E103	1	0	0
2	0.273E101	0.747E103	0.273E103	0.427E103	1	1	0
3	0.737E101	0.022E103	0.111E103	0.414E103	1	1	1
	0.983E101	0.969E103	0.985E102	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

PORTFOLIO COST 103455

08/21/79

HAFFECT GROUP 1X : ROL-COMPETITIVE RESIDENTIAL SPACE HEATING - CONVERSION DEVIC

YEAR : 1935

	RES. COST (\$X10**6)	HIT RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					48	52	57
1	0.233E+00	0.749E+02	0.321E+03	0.321E+02	1	0	0
2	0.472E+00	0.132E+03	0.279E+03	0.379E+02	1	1	0
3	0.179E+01	0.132E+03	0.734E+02	0.105E+03	1	1	1
	0.239E+01	0.175E+03	0.734E+02	<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

5. LIMITATIONS OF THE REVISED METHODOLOGY

At the completion of this task, RAM was reviewed to determine the limits of its applicability. Some of the areas that need to be addressed before RAM may be further improved are summarized below.

5.1 TECHNOLOGIES AFFECTING MORE THAN ONE END-USE CATEGORY

Some BCS projects involve technologies that reduce demand in more than one end-use category. For example, a heat pump influences both space heating and air conditioning demand. In order to represent these products fairly, it was necessary to implement a method which would allocate portions of these technologies costs and savings to each end-use that was affected. This was accomplished by using the same fractions which represent the distribution of energy consumption over the end-uses. In other words, if a building's space conditioning demand (heating and cooling) is broken down as 70 percent heating and 30 percent cooling, these percentages were applied to the cost and savings attributable to a technology which influenced both.

5.2 SPACE CONDITIONING PROJECTS - SHELL IMPROVEMENTS VERSUS CONVERSION DEVICES

Another area of concern is with the definition of conversion devices and shell improvements. RAM was modified to distinguish between these because of the categories used in BECOM, but the relationship between the two lacks clarity. There is likely to be some type of trade off between conversion devices and shell improvements that affect a given end-use demand. Specifically, a more efficient conversion device may have a larger impact on a home without an improved shell, than it would if coupled with an improved shell. The RAM model does not provide a way

to deal with these interdependencies. One possible solution would be to include a check in the model for any projects in a portfolio that are related in this manner. After creating a list of all of the relationships of this type, the savings attributable to the portfolio could then be adjusted by some predetermined amount. Any savings which appeared to fall at the "intersection" of the two projects could be subtracted from the total.

5.3 A RETROFIT MARKET FOR NEW BUILDINGS

This study does not examine the retrofit market in new homes. RAM does compete new technologies in the retrofit market in existing homes. However, the fact that new buildings employing conventional systems may voluntarily choose to replace their conventional systems with new technologies is not considered. One possible method that would account for this additional penetration of new technologies would be to apply the percentage of existing buildings that have retrofitted with the new technology to the number of new buildings with conventional systems. However, this method is not very accurate, because it assumes that the percentage retrofitted is the same in new buildings as in existing buildings. This is not necessarily true.

5.4 COMPETITION FOR ENERGY SAVINGS BETWEEN TECHNOLOGY DEVELOPMENT AND MOTIVATIONAL PROJECTS

RAM assumes that the energy savings (per unit) attributed to each project is independent of all other projects. However, competition for savings does exist between technology development motivational projects. For example, a residential space heating conversion device project may claim the same savings as a consumer motivation project such as the "Energy Cost of Ownership" (ECO). This relationship between hardware and software projects needs to be examined in order to more accurately allocate the total potential energy savings of each project and to avoid double counting.

5.5 COMBINING MARKET GROUPS

The number of market groups defined and the number of projects contained in each is so large as to prohibit combining portfolios across market groups. The task of combining these groups, so that a comprehensive list of the best portfolios across all market groups may be developed, may require an integer program formulation.

When various market groups are combined, there are likely to be interactions between them. The nature of these interactions must be determined, and some method of representing them devised.

5.6 LINKING RAM AND BECOM FOR ALL MARKET GROUPS

The link between RAM and BECOM has been completed for only one market group. Market group 1(A-N) contained a set of projects with enough descriptive information to successfully complete the link between the two models. There are, however, fifteen other market groups which could utilize this link. A major research effort would be necessary to provide adequate data to complete the RAM-BECOM link for all market groups.

5.7 UNCERTAINTY ASSOCIATED WITH BCS PROJECTS

There are several types of uncertainty that BCS projects face during their development, demonstration, and commercialization phases. The first is the technical uncertainty associated with the project's ability to perform as expected at a reasonable cost when it reaches the market. RAM is designed to represent this uncertainty in the form of the technology cost curves developed for each project.

The second type of uncertainty is related to the consumer's perception of the risk associated with the new product. Since no model can account for irrational decisions and perceptions, RAM assumes that the customer's perception of risk is correlated with the actual risk involved.

The final type of uncertainty faced by BCS projects is the fact that the success of a product in a market is dependent on a number of circumstances that cannot be controlled. These include fuel prices, material availability in different regions, and the usefulness of the product in specific situations. It appears, from information obtained during this task, that this is often the prevailing factor in the success or failure of BCS technologies. There are many different markets for residential and commercial energy conserving devices, and it is often very difficult to determine which of these will be affected by the introduction of any given product.

Since RAM is not designed to model market uncertainty, it will not necessarily select the optimal portfolio of projects for BCS to fund. If it is determined that this is the most important factor in the successful commercialization of new conservation technologies, future efforts should be in the direction of a more market-oriented approach.

APPENDIX A - RAM USER'S MANUAL

A.1 Purpose

A.2 System Overview

A.3 Terminal Operating Procedures

A.3.1 Method for Signing On

A.3.2 Correcting Errors

A.4 Program Execution

A.4.1 Data Requirements

A.4.2 Writing and Editing the 'PV' Data File

A.4.3 RAM Outputs

A.5 Sample Runs

A.6 Program Flow Charts

A.7 List of Variables and Subroutines

A.8 Program Listings

A.9 File Specifications

A.1 PURPOSE

The Resource Allocation Methodology (RAM) is an analytical tool developed by EEA for the Division of Buildings and Community Systems (BCS) at DOE. Its purpose is to aid BCS in the evaluation and ranking of portfolios of RD&D projects.

The system used to run RAM is designed to operate in conjunction with the Threshold Evaluation System (TES), also in use at EEA. Information about the technologies resulting from each RD&D program, stored in TES data files, is used to determine the expected energy savings and cost of each project. These projects are then combined into portfolios, using the technique described in the report accompanying this manual, the "Revised Resource Allocation Methodology", and in a previous EEA report, entitled "The RAM2 Methodology". This manual contains directions for operating both the RAM model, ACOMP1, and the interface between it and the TES, called CREATE. These two programs are used when the projects being considered are competing for the same applications, or market group.

Another version of the model, including the programs CREATENO and ANON is also described. This version is used when there is no competition between the projects in a particular group. The purpose of this second version is to rank portfolios of independent projects, which may be related in various ways.

A.2 SYSTEM OVERVIEW

RAM consists of several programs, files and subroutines that interact to complete the comparison, competition and ranking of portfolios of energy conservation technologies. A description of each of these is given below.

Programs

ACOMP1	is the program that competes the portfolios, producing a list of the least costly portfolios within each market group. This program also generates a table and graph of the results.
CREATE	uses both BIGFILEB and the PV file to compute the annualized net present value and the research cost for each project and create the ESC, PC and BENCST files.
WRITEPV	is the program used to create new records for the PV data file.
ERRORPV	is a program used to make changes in the data of the PV file.
READPV	provides a listing of the records contained in the PV data file.
CREATENO	uses data in BIGFILEB to compute the annualized net present value and research cost for each project. This information is entered to the ESC file.
ANON	ranks portfolios of non-competitive projects according to their expected energy savings and research cost.

Files

BIGFILEB	is the data file for the Threshold program.
ESC	is the file containing the net energy savings curve, calculated in the program CREATE, for each market group.
MG	is a file of descriptions for each of the market groups.
PC	is the file containing the possible costs of each project, and the probabilities associated with each cost.
BENCST	is the file which stores the total private capital investment required for each project.

PRICES is the file of energy (fuel) prices for each year, through the year 2000.

PV is the file containing data for each project as it applies to different market groups.

PVINDE_X index for the PV data file.

RISK contains the level of risk associated with each project.

Subroutines used in ACOMP1 (all subroutines are contained in COMPSUB)

ENSAV This subroutine calculates the probability density function and expected value of energy savings for each portfolio.

COMBIN This subroutine combines the cumulative probability curves of all of the projects in each portfolio and calculates the total research costs of the portfolio.

YPAND This subroutine expands each curve (energy savings and technology cost) from 11 points to 50 points, by linear interpolation between the original 11 points.

RANK This subroutine sorts the portfolios in order of increasing research cost and retains the 50 least costly portfolios.

EXTRA This subroutine calculates the research cost and expected energy savings of a portfolio containing one additional project, using the average of costs and energy savings for all other projects in that market group to characterize the extra project.

SYMPLT This subroutine plots the portfolios generated by RANK.

AXES Determines labels for the X and Y axes of the graph produced by SYMPLT.

A system flow chart which shows the relationships between the programs, and files described above is given in Figure A-1. It should be noted that this diagram represents the version of RAM that deals with competitive projects. The organization of the system for non-competitive projects is basically the same (CREATENO replaces CREATE, and ANON replaces ACOMP1) except that the PV data file is not used. Individual

FIGURE A-1
SYSTEM FLOW CHART

program flow charts, a variable list, complete program listings, and file specifications can be found in Sections A.6, A.7, A.8, and A.9 respectively.

A.3 TERMINAL OPERATING PROCEDURES

The RAM program is currently run on an Amdahl 470 using IBM's CMS (VM/370) operating system. Execution is controlled by CMS EXECs which allocate files and run programs in the proper order. Computer time is purchased from CallData Time Sharing Systems.

A.3.1 Method For Signing On

To sign on to this system, you must:

- Turn on the terminal.
- Dial 841-1640 on telephone.
- When you hear a high pitched tone, place the telephone receiver securely into the coupler next to the terminal.
- When the carriage light on the coupler goes on, hit the carriage return on the terminal.
- The terminal will print out "Enter L".
- Enter "L" and return.
- The terminal will reply "VM/370 ONLINE".
- Enter "L EEA3 EEAIBM3" and return
- Terminal will say "Enter subtask number"
- Enter "009" and return
- The terminal will say "LOGON EEA3....." Wait until the terminal has completely stopped answering you before entering anything else.
- You are now on EEA3.

A.3.2 Correcting Errors

If you realize you have incorrectly typed something before you enter it, you may delete characters by typing @ for each improper character and then continue with the proper character(s). To delete an entire line of typing, enter '] '.

A.4 PROGRAM EXECUTION

RAM may be executed for any projects that are currently stored in the Threshold system. If the Threshold data is inappropriate for a particular RAM application, revised information may be entered to the 'PV' data file (using 'WRITEPV'). During the execution of the RAM programs, the data read from 'BIGFILEB' in Threshold, is then replaced by what is in the 'PV' file for a given project in a given market group. If there is no entry in 'PV', the data will remain as it was read from 'BIGFILEB'.

Before running 'ACOMPl' (or 'ANON'), which are the main programs associated with the RAM methodology, four data files, 'ESC', 'PC', 'RISK', and 'BENCST' must be filled. 'ESC', 'PC', and 'BENCST' can be established by running 'CREATE' (or 'CREATENO'), or by entering data points manually at the terminal. 'RISK' must be created manually, by entering the risk level (1 = very low, 2 = low, 3 = medium, 4 = high) associated with each project.

The specific information necessary to run each of the programs mentioned above is indicated in the sample runs provided in Section A.5. More general instructions for the use of this system are given below.

A.4.1 Data Requirements

The quantity of data required as input to RAM varies according to the degree to which the user wishes to modify the information that exists in the Threshold system. If the data which is stored in 'BIGFILEB' can be used as is, the user only needs to know the number of the market group being considered, the projects it includes, and the risk level associated with each of those projects.

In other cases, it may be necessary to enter new market penetration estimates, or a different characterization of the conventional system to which all projects in the group are compared. The sources for this information will vary, and may include the output of large-scale energy system models.

A.4.2 Writing and Editing the 'PV' Data File

Market-specific data not found in 'BIGFILEB' is stored in the 'PV' data file. This file is created by the program 'WRITEPV' and may be printed out using 'READPV', and modified using 'ERRORPV'. The information stored in 'PV' includes: the number and market group of the project, the annual energy use, the non-energy operating expenses, the capital costs and lifetimes of the new and conventional systems involved, and the market penetration that the new technology is expected to achieve.

A.4.3 RAM Outputs

The execution of either of the main programs, 'ACOMPl' or 'ANON', produces a table and graph which summarize their results. Basically, the output for each market group is a list of the optimal portfolios, in order of increasing research cost. The graph merely plots the points which appear on the list.

Figures A-2 and A-3 are sample outputs of the RAM system. In Figure A-2, the headings at the top of the page indicate the date of the run, the market group involved and the year of the analysis. For each portfolio, the first five columns present the portfolio number, its total research cost, the net present value of its savings, the ratio of the dollars saved to dollars invested in research, and the total private capital investment, respectively. The right-hand portion of the table is a matrix that shows which projects are included in each portfolio. The numbers across the top of the matrix represent projects, and the zeros and ones below indicate whether or not a project is included in a given portfolio (a one indicating that it is, a zero, that it is not). The bottom line of the table shows the characteristics, i.e., savings and costs, of a hypothetical portfolio containing all of the projects in the market group, plus one additional "average" project.

The graph shown in Figure A-3 is simply a plot of the net resource savings versus the research cost for each portfolio included in the

FIGURE A-2

08/14/79

MARKET GROUP 14 : NEA PROJECTS (NC)

YEAR : 1985

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/£	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)					
					42	43	44	95	101	102
1	0.673E+01	0.446E+03	0.662E+02	0.461E+02	0	0	0	0	1	0
2	0.673E+01	0.512E+03	0.761E+02	0.230E+03	0	0	0	0	0	1
3	0.135E+02	0.958E+03	0.712E+02	0.276E+03	0	0	0	0	1	1
4	0.230E+02	0.250E+04	0.109E+03	0.162E+03	0	1	0	0	0	0
5	0.297E+02	0.295E+04	0.992E+02	0.208E+03	0	1	0	0	1	0
6	0.297E+02	0.302E+04	0.101E+03	0.391E+03	0	1	0	0	0	1
7	0.345E+02	0.346E+04	0.949E+02	0.437E+03	0	1	0	0	1	1
8	0.460E+02	0.456E+04	0.990E+02	0.567E+03	1	1	0	0	0	0
9	0.528E+02	0.500E+04	0.948E+02	0.613E+03	1	1	0	0	1	0
10	0.528E+02	0.507E+04	0.961E+02	0.796E+03	1	1	0	0	0	1
11	0.595E+02	0.552E+04	0.927E+02	0.842E+03	1	1	0	0	1	1
12	0.721E+02	0.593E+04	0.823E+02	0.835E+03	1	1	1	0	0	0
13	0.788E+02	0.637E+04	0.809E+02	0.881E+03	1	1	1	0	1	0
14	0.788E+02	0.644E+04	0.817E+02	0.106E+04	1	1	1	0	0	1
15	0.855E+02	0.689E+04	0.805E+02	0.111E+04	1	1	1	0	1	1
16	0.100E+03	0.726E+04	0.725E+02	0.126E+04	1	1	1	1	1	1
0.117E+03 0.847E+04 0.725E+02					<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT					

A-9

FIGURE A-3

MARKET GROUP 14 : NEA PROJECTS (NC)

YEAR : 1985

A-10

summary table. Each portfolio is represented by its number in the table, and when two (or more) numbers fall very close together, the second (and others) is placed above the first.

A.5 SAMPLE RUNS

This section contains copies of actual runs made on the RAM system. The user's responses to questions printed by the program are underlined.

Sample runs for 'CREATE', 'ACOMPl', 'WRITEPV', 'READPV', 'ERRORPV', 'CREATENO', and 'ANON' are included.

CREATE
DMSLI0740I EXECUTION BEGINS...

1=THRESHB 2=TERMINAL

?

.1

ENTER MARKET GROUP

.04

ENTER MARKET PENETRATION FOR FOUR COSTS:

?

.350000.350000.350000.350000

ENTER NO OF PROJECTS TO BE RUN, FOLLOWED BY THEIR NUMBERS

?

.5.55.68.69.70.74

DO YOU WANT TO CHANGE CONV. COST ? YES=1 NO=2

?

.1

ENTER CAPITAL COST, ENERGY USE(GAS, OIL, COAL,ELEC,OTHER),NON-FUEL O&M

?

.150.11.1E6.1.8E6.0.17.4E6.0.0

THE TOTAL CONV IS : .1119899E+04

THE ANNUALIZED CONV IS : .1822585E+03

.3500E+060.3500E+060.3500E+060.3500E+06

R; T=0.51 IO=381 ISRU=0.09 09:02:26

ACOMP1
DMSLI0740I EXECUTION BEGINS...

ENTER MARKET GROUP

.04

ENTER MARKET PENETRATION YEAR

?

.1985

SCROLL TO HEAD OF FORM

IHQ001A PAUSE 0

WRITERU
DMSL107401 EXECUTION BEGINS...

ENTER MARKET GROUP

.04

ENTER PROJECT NUMBER AND RISK DATA

1=VERY LOW RISK 2=LOW RISK 3=MEDIUM RISK 4=HIGH RISK

?

.74.2

ENTER USEFUL LIFE TIMES OF CONV. SYS. AND SUBST. SYS.

?

.10.10

ENTER 5 ENERGY USE AND NON FUEL OPER & MAINT.
OF CONVENTIONAL SYSTEM

?

.30E6.0.0.0.0.0

ENTER 5 ENERGY USE AND NON FUEL OPER & MAINT.
OF SUBSTITUTE SYSTEM

?

.23E6.0.0.0.0.0

ENTER CAPITAL COST, CC(1) AND CC(2)

?

.150.200

ENTER NUMBER OF UNITS IN USE FOR 1985, 1990, 2000

?

.50000.220000.1000000

1=SAME MARKET GROUP 2=DIFF. MARKET GROUP 3=STOP

?

.3

R# T=0.19 IO=261 ISRU=0.05 16:15:13

READRU
 DMSL10/401 EXECUTION BEGINS...
 ENTER MARKET GROUP
 :04
 ENTER PROJECT NUMBER
 ?
 :74

MARKET GROUP 04 74 2 10 10
 0.3000E+080.0 0.0 0.0
 0.0 0.2300E+080.0 0.0
 0.0 0.0 0.1500E+030.2000E+03
 0.0 0.0 0.5000E+050.2200E+06
 0.1000E+07
 R: T=0.30 ID=318 ISRU=0.06 16:16:32

READRU
 DMSL10/401 EXECUTION BEGINS...

ENTER MARKET GROUP
 :04
 ENTER PROJECT NUMBER
 ?
 :74
 ENTER ITEM NUMBER(1-22)
 ?
 :5
 OLD = 10

ENTER CORRECT DATA

:15

CONTINUE ? 1=DIFF MG 2= SAME MG
 3=SAME PROJECT ? 4=STOP
 ?
 :4
 R: T=0.22 ID=267 ISRU=0.05 16:17:13

CREATEND
DMSL107401 EXECUTION BEGINS...

ENTER YEAR: 1=1981 2=1985 3=1990 4=2000

?

2
ENTER NO OF PROJECTS TO BE RUN, FOLLOWED BY THEIR NUMBERS

?

7,1,3,4,5,7,9,12
R: T=0.59 ID=489 ISRU=0.11 14:09:47

ANON
DMSL107401 EXECUTION BEGINS...

ENTER MARKET GROUP

13

ENTER YEAR

?

1985

SCROLL TO HEAD OF FORM

INH0001A PAUSE 0

A.6 PROGRAM FLOW CHARTS

This section provides flow diagrams outlining the relationships between the various programs and data files used in RAM. Following a definition of the symbols used, both 'CREATE' and 'ACOMP1' are included. The logic used in 'CREATENO' and 'ANON' (for non-competing projects) is basically the same.

The variables used in the flow diagrams are defined in Section A.7.

SYMBOL KEY

= Input, Output

= Fortran Program, Calculation,
or Operation

= Decision

= Disk Data File

= Start, Stop

A.7 LIST OF VARIABLES AND SUBROUTINES

In this section, all of the variables used in RAM's main program, 'ACOMPl' are identified, described, and located according to the sub-routines in which they appear.

VARIABLES

PROGRAM: ACOMP1

<u>Variable</u>	<u>Description</u>	<u>Subroutines used in</u>
AMG	Market group (entered from terminal)	MAIN
AMG1	Market group (from MG file)	MAIN
AUG(1)	Energy savings/\$ of extra portfolio	EXTRA, MAIN
AUG(2)	Research cost of extra portfolio	EXTRA, MAIN
AUG(3)	Energy saving of extra portfolio	EXTRA, MAIN
AUX(1)	Temporary storage (savings/\$ of each portfolio)	RANK
AUX(2)	Temporary Storage (research cost of each portfolio)	RANK
AUX(3)	Temporary storage (energy savings of each portfolio)	RANK
BAR	"_"	SYMPLT
BLANK	" "	SYMPLT
CDFC(50)	Combined cumulative probability distribution of cost of all funded projects	COMBIN, MAIN
CDCOST(15,50)	Cumulative prob. distribution of cost	MAIN, COMBIN, EXTRA
CINT	Interval	MAIN, YPAND
COST(50)	Cost (read from ESC file)	MAIN, YPAND
COST1(50)	Probability of cost (read from PC file)	MAIN, YPAND
CRC	Total research cost of all funded portfolios	COMBIN, MAIN, RANK
DASH	"_"	SYMPLT
DFLAG	Logical flag	RANK
EES(50)	Net energy savings (ES(I) expanded to 50 points)	MAIN, YPAND ENSAV, RANK, EXTRA

EPCOST(50)	Probability distribution of costs (may or may not be cumulative)	YPAND, MAIN
ES(50)	Net energy savings (read from ESC file)	MAIN, YPAND
EVES	Expected value of energy savings	ENSAV, MAIN, RANK
IJ	Pointer	RANK
IONE	First of two digits	SYMPLT
IP	Pointer	RANK
IPLLOT(101,51)	Whole symbol table	SYMPLT
IPORT(15)	Combination of funded projects of each portfolio	MAIN, COMBIN RANK, EXTRA
IPROJ(15)	Project number	MAIN
ISYM(10)	Integers from 0 to 9	SYMPLT
ITEN	Second of two digits	SYMPLT
IX	No. of intervals away from Y axis	SYMPLT
IY	No. of intervals away from X axis	SYMPLT
JXH	Highest X value	AXES
JYH	Highest Y value	AXES
K	Pointer	MAIN
KTOT	Number of possible combinations	MAIN
LABEL(15)	Description of market group	MAIN
MT	Pointer for extra project	EXTRA
NCO	Pointer	RANK
NC01	Pointer	RANK
NFLAG	Data entered as cumulative (= 0) or not cumulative (= 1) curve	MAIN
NPORT(50),15)	Table containing all funded projects of all portfolios	MAIN, RANK
NREM	Pointer	MAIN
NRES	Pointer	MAIN
NPTS	Number of points	MAIN
NT	Pointer	MAIN, COMBIN
NT1	Pointer	MAIN, COMBIN
NUM	No. of portfolios	MAIN, RANK

NUM1	Pointer	RANK
NZ	Pointer	YPAND
PCOST1(50)	Probability (read from PC file)	MAIN, YPAND
PDFES(50)	Prob. distribution of energy savings	ENSAV, EXTRA, MAIN
RC(15)	Research Cost	MAIN, COMBIN, EXTRA
STAR	***	SYMPLT
STORE(50),3)	Table containing savings/\$, research costs, and energy savings	RANK, MAIN
SUM	Total of cumulative probabilities of projects	EXTRA
SUM1	Total probability of original curve	YPAND
SUM2	Total probability of new curve	YPAND
SUM3	Cumulative probability of new expanded curve	YPAND
TODAY	Date (month/day/year)	MAIN
X(200,2)	Table containing research costs and energy savings of all portfolios	AXES
XDEL	Each interval of X axes	SYMPLT
XHIGH	Highest X-value	SYMPLT
XLAB(51)	Literal	SYMPLT
XNUM(200,2)	Table containing research costs and energy savings of all portfolios	SYMPLT
XNT	Number of projects	EXTRA
XPLO(200,2)	Table containing research costs and energy savings of all portfolios	MAIN
XTEST	X test value	SYMPLT
YDEL	Each interval of Y axis	SYMPLT
YHIGH	Highest Y value	AXES
YLAB	Literal	SYMPLT
YTEST	Y test value	AXES

A.8 PROGRAM LISTINGS

This section contains a listing of the code of the major RAM programs. 'CREATE' is used to establish the data files for the main program 'ACOMPl' (and 'COMPSUB', which contains its associated subroutines). Both of these programs are to be run when there is competition between projects in a market group. When there is no competition, 'CREATENO' and 'ANON', which are basically shortened versions of the above, may be used to rank and list the portfolios according to their expected energy savings and funding requirements.

Also included are listings of the three programs used to edit the PV data file. 'WRITEPV' enters data, 'ERRORPV' is used to make changes to the data after it is entered, and 'READPV' prints out the contents of the file so that the data may be examined.

FILE: CREATE FORTRAN A

CALL DATA MONITOR SYS

```

      DEFINE FILE 10(200,830,E,10UM),7(8,504,E,10UM),13(300,4,E,10UM) CRE00010
      DIMENSION CC(2),CMA(2),COP(65,2),SCP(2),IYST(2),PMKT(4) CRE00020
      DIMENSION CE(2,6),TYRL(2),CF(25),RNFUM(2),FED(10),UMAR(25) CRE00030
      DIMENSION PRIN(15),TEVDM(6),EPR(5) CRE00040
      DIMENSION CMKT(25),IFED(11),MMS(400) CRE00050
      DIMENSION UNIT(25),TMKT(6),CFED(25),NFED(25) CRE00060
      DIMENSION PRIV(25),TCE(6),TEV(6),TEVD(6),EMP(25,5) CRE00070
      DIMENSION COST(11),PCOST(11),LOGRAT(4,11),LCOST(50),HCOST(50) CRE00080
      DIMENSION XT(50),YT(50) CRE00090
      DIMENSION TCOST(11),LTCOST(50),HTCOST(50) CRE00100
      REAL LOGRAT,LCOST,ETCOST,LOW,LOWT CRE00110
      REAL*4 AMG,AMG1,BMG CRE00120
      DATA PCOST/.05,.1,.2,.3,.4,.5,.6,.7,.8,.9,.95/ CRE00130
      DATA LOGRAT/ CRE00140
      80,88,0.69,0.41,0.17, CRE00150
      80,90,0.75,0.50,0.25, CRE00160
      80,94,0.83,0.64,0.40, CRE00170
      80,96,0.90,0.76,0.57, CRE00180
      80,98,0.95,0.88,0.76, CRE00190
      81,00,1.00,1.00,1.00, CRE00200
      81,02,1.07,1.15,1.30, CRE00210
      81,04,1.13,1.33,1.75, CRE00220
      81,07,1.22,1.57,2.45, CRE00230
      81,10,1.35,2.00,3.95, CRE00240
      81,13,1.47,2.45,5.80/ CRE00250
C CRE00260
C ENTER INFORMATION FROM TERMINAL CRE00270
C CRE00280
      WRITE(6,1234) CRE00290
1234 FORMAT(//,'1=THRESH 2=TERMINAL') CRE00300
      READ(5,*)INPUT CRE00310
      IF(INPUT.EQ.1)GO TO 3000 CRE00320
      CALL 81 CRE00330
      CALL 89 CRE00340
      GO TO 7000 CRE00350
3000 JJJ=0 CRE00360
      WRITE(6,2111) CRE00370
2111 FORMAT(//,'ENTER MARKET GROUP') CRE00380
      READ(5,590)AMG CRE00390
590 FORMAT(A4) CRE00400
      WRITE(6,888) CRE00410
888 FORMAT(//,'ENTER MARKET PENETRATION FOR FOUR CUSTS.') CRE00420
      READ(5,*)(PMKT(LL),LL=1,4) CRE00430
      TMKT(2)=0.0 CRE00440
3 IENX=8 CRE00480
      READ(7,1ENX,2996).((EMP(KYR,XFUEL),KYR=1,25),XFUEL=1,4) CRE00490
2996 FORMAT(100F5,2) CRE00500
      ICALC=1 CRE00510
      WRITE(6,4146) CRE00520
4146 FORMAT(1X,'ENTER NO OF PROJECTS TO BE RUN, FOLLOWED BY THEIR', CRE00530
      &' NUMBERS') CRE00540
      READ(5,*)MPROJ,(MMS(MP),MP=1,MPROJ) CRE00550
336 DO 370 I RANGE=1,MPROJ CRE00560
      IPROJ=MMS(I RANGE) CRE00570
C CRE00600

```


FILE: CREATE FORTRAN A

CALL DATA MONITOR SYS

```

C      READ DETAIL RECORD FROM RIGFILEB                                CRE00061
C      READ(10,'(PROJ,2000)RIB,RIS,AC,CC(1), CMA(1),YST1,(CE(1,J),J=1,5),  CRE00062
&RNFOM(1),RPROJ,                                CRE00063
&      YRL1,SCP(1),CC(2),CMA(2),YST2,(CE(2,J),J=1,5),RNFOM(2),  CRE00064
&      YRL2,SCP(2),RIP,EYR,CM,CD,CY,RIFYR,  CRE00065
&      (FED(J),J=1,10),RIPYR,(PRIN(L),L=1,10),  CRE00066
&      (CMKT(J),J=1,17),(TMKT(I),I=1,5),(EPR(K),K=1,5)  CRE00067
2000  FORMAT(80E10,4)  CRE00068
C      READ RISK DATA  CRE00069
C      LIVERY LOW RISK 2:LOW 3:MEDIUM 4:HIGH  CRE00070
C      READ(13,'(PROJ,5008)IRISK  CRE00071
5008  FORMAT(11I)  CRE00072
REWIND 16  CRE00073
C      LOCATE MARKET GROUP AND PROJECT NO IN PV FILE  CRE00074
C      CONTINUE  CRE00075
1600  READ(16,1550,END=1610)AMG1,KPROJ  CRE00076
1550  FORMAT(A4,14)  CRE00077
IF(AMG1.EQ.AMG.AND.KPROJ.EQ.(PROJ))GO TO 1900  CRE00078
GO TO 1600  CRE00079
C      READ PV FILE  CRE00080
C      BACKSPACE 16  CRE00081
1900  READ(16,1588)AMG1,KPROJ,IRISK,MYRL1,MYRL2,(CE(1,J),J=1,5),  CRE00082
&(CE(2,J),J=1,5),(CC(J),J=1,2),(RNFOM(J),J=1,2),CMKT(10),CMKT(15),  CRE00083
&CMKT(17)  CRE00084
YRL1=MYRL1  CRE00085
YRL2=MYRL2  CRE00086
1588  FORMAT(A4,4(4,17E10,4)  CRE00087
1610  CONTINUE  CRE00088
IF(IRANGE.NE.1)GO TO 1611  CRE00089
C      ENTER DIFFERENT CONVENTIONAL SYSTEM DATA ? 00960
C      WRITE(6,511) 00961
511  FORMAT(7,'DO YOU WANT TO CHANGE CONV. COST ? YES=1 NO=2')  CRE00970
READ(5,'1111  CRE00980
IF(IRANGE.EQ.1.AND.111.EQ.2)GO TO 1611  CRE00990
WRITE(6,566)  CRE01000
566  FORMAT(7,'ENTER CAPITAL COST, ENERGY USE(GAS, OIL, 01020
&1 COAL,ELEC,OTHER),NON-FUEL (B/M') 01021
READ(5,'1CC(1),(CE(1,J),J=1,5),RNFOM(1)  CRE01030
1611  CONTINUE  CRE01040
SHIFT AND STURE RORO INVESTMENT 01041
MEYR=EYR 01042
I1=MEYR-1975 01043
Q0-1905 I=1,25 01044
EMP(I,5)=EPR(5)*EXP(.025*(I-1)) 01045

```

FILE: CREATE FORTRAN A

CALL DATA MONITOR SYS

1905	CONTINUE	CRE0109
	IFY=RIFYR=1976.	CRE0110
	IPY=RIPYR=1976.	CRE0111
	DO 1904 I=1,25	CRE0112
	CFED(I)=0	CRE0113
	PRIV(I)=0	CRE0114
1904	CONTINUE	CRE0115
	DO 1901 I=1,10	CRE0116
	CFED(IPY+1)=FED(I)	CRE0117
	PRIV(IPY+1)=PRIN(I)	CRE0118
1901	CONTINUE	CRE0119
C		CRE0125
C	CHANGE REAL VARIABLES TO INTEGER VALUES	CRE0126
C		CRE0127
	IB=RIB	CRE0128
	IS=RIS	CRE0129
	IAC=AC	CRE0130
	IF(IAC.GT.25) IAC=25	CRE0131
	IYST(1)=YST1	CRE0132
	IF(IYST(1).EQ.0.AND.IB.EQ.2) YST1=1	CRE0133
	IF(IB.EQ.2.AND.IYST(1).EQ.0) IYST(1)=1	CRE0134
	IYST(2)=YST2	CRE0135
	IF(IYST(2).EQ.0) YST2=1	CRE0136
	IF(IYST(2).EQ.0) IYST(2)=1	CRE0137
	IYRL(1)=YRL1	CRE0138
	IYRL(2)=YRL2	CRE0139
	IR=RIP	CRE0140
C		CRE0141
C	CALCULATE TOTAL OPERATING COSTS FOR NEW AND	0142
C	CONVENTIONAL SYSTEMS	0142
C		CRE0143
	DO 119 KI=1,65	CRE0144
	COP(KI,1)=0	CRE0145
	COP(KI,2)=0	CRE0146
119	CONTINUE	CRE0147
	DO 2559 J=1,2	CRE0148
	IYRST=MEYR-1975	CRE0149
	IYREND=IYRL(J)+MEYR-1975-1	CRE0150
	IF(IYREND.GT.50) IYREND=50	CRE0151
	DO 1193 KY=IYRST, IYREND	CRE0152
	OPER=0.0	CRE0153
	OPCUST=0.0	CRE0154
	DO 2558 L=1,5	CRE0155
	IF(KY.GT.25) GO TO 94	CRE0156
	FUEL=EMP(KY,L)	CRE0157
	GO TO 195	CRE0158
94	FUEL=EMP(25,L)	CRE0159
195	CONTINUE	CRE0160
	OPCOST=OPCUST+CE(J,L)*FUEL/1.E6	CRE0161
2558	CONTINUE	CRE0162
	COP(KY,J)=OPCUST+RNFORM(J)	CRE0163
1193	CONTINUE	CRE0164
2559	CONTINUE	CRE0165
	TCOP=0.0	CRE0166
	TCOP1=0.0	CRE0167

```

      DO 8112 MM=1,65
      TCUP=TCOP+COP(MM,2)
8112- CONTINUE
      JJJ=JJJ+1
      IF(JJJ.NE.MBRUJ)GO TO 655
      DO 333 MM=1,65
      TCOP1=TCUP1+COP(MM,1)
655- DO 6 K=1,25
      CF(K)=0
      UMAR(K)=0
      UNIT(K)=0
6- CONTINUE
2- CONTINUE
C- CALCULATE UNITS BETWEEN 1990,1995,2000.
C- DO 60 I=1,25
      CF(I)=CFED(I)*1.0E+6
60- CONTINUE
      LIM=25
      UNIT(20)=CMKI(16)
      UNIT(25)=CMKI(17)
      DO 82 I=1,15
      UNIT(I)=CMKI(I)
82- CONTINUE
      DO 1902 I=1,2
      J1=16.5*(I-1)
      J2=J1+3
      A=ALOG(CMKI(15+I)/CMKI(14+I))/5
      R=EXP(A)=1
      DO 1903 J=J1,J2
      UNIT(J)=UNIT(J-1)*(1+R)+.5
1903- CONTINUE
1902- CONTINUE
      IF (IP.EQ.11)GO TO 90
      DO 85 I=2,LIM
      UNIT(I)=UNIT(I)+UNIT(I-1)
85- CONTINUE
90- CONTINUE
C- DETERMINE NUMBER OF MARGINAL UNITS
C- JAC=IAC+1
      DO 91 I=JAC,LIM
      UMAR(I)=UNIT(I)-UNIT(I-IAC)
91- CONTINUE
      DO 93 I=1,IAC
      UMAR(I)=UNIT(I)
93- CONTINUE
8229 CONTINUE
      GO TO 300
C- COMPUTE TOTAL AND DISCOUNTED INVESTMENTS
C- 300 CONTINUE

```

CRE0168
 CRE0169
 CRE0170
 CRE0171
 CRE0172
 CRE0173
 CRE0174
 CRE0175
 CRE0176
 CRE0177
 CRE0178
 CRE0179
 CRE0180
 0180
 CRE0181
 0181
 CRE0182
 CRE0183
 CRE0184
 CRE0185
 CRE0186
 CRE0187
 CRE0188
 CRE0189
 CRE0190
 CRE0191
 CRE0192
 CRE0193
 CRE0194
 CRE0195
 CRE0196
 CRE0197
 CRE0198
 CRE0199
 CRE0200
 CRE0201
 CRE0202
 CRE0203
 CRE0204
 0204
 0204
 0204
 CRE0205
 CRE0206
 CRE0207
 CRE0208
 CRE0209
 CRE0210
 CRE0211
 CRE0212
 CRE0213
 CRE0214
 CRE0215
 CRE0216
 CRE0217

FILE: CREATE FORTRAN A

A-30
CALL DATA MONITOR SYST

```

      TFI=0.0
      PIV=0.
      TFPID=0.
      PIVD=0.
      OC=CC(2)-CC(1)
      TPID=UNIT(1)*OC
      TFI=0.
      DO 310 I=1,LIM
      TFI=TFI+CF(I)
      PIV=PIV+PRIV(I)
      I=I+1
      TFI=TFI+CF(I)/1.1**J
      TFPID=TFPID+(PRIV(I)+CF(I))/1.1**J
      PIVD=PIVD+PRIV(I)/1.1**J
      IF (I.EQ.1) GO TO 310
      TPID=TPID+(UNIT(I)-UNIT(I-1))*OC/1.1**J
310  CONTINUE
C
C   CALCULATE TOTAL PRIVATE CAPITAL INVESTMENT
C
      BENCST=(CC(2)-CC(1))*1/(1.-1.1**(-IYRL(2)))
      BENCST=BENCST*ARMKT(1)
      WRITE(9,456)BENCST
456  FORMAT(E10.4)
C
C   CALCULATE NET PRESENT VALUE OF NEW SYSTEM
C
      PV=TCUR+CC(2)
      PV=PV*1/(1.-1.1**(-IYRL(2)))
C
C   APPLY LOG-NORMAL DISTRIBUTION TO ANNUALIZED AND
C   NON-ANNUALIZED TOTAL LIFE CYCLE COST (LCC)
C
      DO 4000 I=1,11
      COST(I)=PV*LOGRAT(IRISK,I)
4000  CONTINUE
C
C   ENTER VALUE TO PC FILE
C
      WRITE(2,5100)IPROJ,I,(COST(J),J=1,11)
      WRITE(2,5220)TFID,(PCOST(J),J=1,11)
5100  FORMAT(2I5,/, (5F10.1))
5220  FORMAT(E11.5,/, (5F10.3))
C
C   STORE LOWEST AND HIGHEST COSTS FOR EACH PROJECT
C
      LCOST(IRANGE)=COST(1)
      HCOST(IRANGE)=COST(11)
370  CONTINUE
C
C   DETERMINE HIGHEST AND LOWEST TOTAL LCC AND ANNUALIZED
C   LCC COSTS FOR MARKET GROUP
C
      LOW=LCOST(1)
      HIGH=HCOST(1)

```

CRE02180
 CRE02190
 CRE02200
 CRE02210
 CRE02220
 CRE02230
 CRE02240
 CRE02250
 CRE02260
 CRE02270
 CRE02280
 CRE02290
 CRE02300
 CRE02310
 CRE02320
 CRE02330
 CRE02340
 CRE02350
 02360
 CRE02400
 CRE02420
 CRE02430
 CRE02440
 CRE02450
 CRE02460
 02470
 CRE02480
 02480
 CRE02490
 CRE02500
 CRE02510
 CRE02520
 CRE02530
 CRE02540
 CRE02550
 CRE02560
 CRE02570
 CRE02580
 CRE02590
 CRE02600
 CRE02610
 CRE02620
 CRE02630
 CRE02640
 CRE02650
 CRE02660
 CRE02670
 CRE02680
 CRE02690
 CRE02700
 CRE02710
 CRE02720
 CRE02730
 CRE02740
 CRE02750

```

      LOWT=LTCOST(I)
      HIGHT=HTCOST(I)
      DO 8888 I=2,NPROJ
      IF(LCOST(I).LT.LOW)LOW=LCOST(I)
      IF(HCOST(I).GT.HIGH)HIGH=HCOST(I)
      IF(LTCOST(I).LT.LOWT)LOWT=LTCOST(I)
      IF(HTCOST(I).GT.HIGHT)HIGHT=HTCOST(I)
8888  CONTINUE
C
C PRINT THE LOWEST TOTAL LCC AND HIGHEST
C TOTAL LCC FOR MARKET GROUP
C
C CALCULATE CONVENTIONAL COST FOR THE DESIRED
C MARKET GROUP
C CCC11 IS READ FROM PV DATA
C
      CONV=(CCC(1)+ICUP1)
      WRITE(6,7775)CONV
7775  FORMAT(/,' THE TOTAL CONV IS : ',E12,7)
      CONV=CONV*(1/(1.-1.1**(-LYRL(1))))
      WRITE(6,4444)CONV
4444  FORMAT(/,' THE ANNUALIZED CONV IS : ',E12,7)
C
C BUILD ENERGY SAVINGS CURVE, USING MARKET
C PENETRATION AT DIFFERENT COSTS
C
      75 FROM=LOW
      TO=HIGH
      NPTS=35
97    DELTA=(TO-FROM)/NPTS
      WRITE(6,5555)(PMKT(JJJ),JJJ=1,4)
5555  FORMAT(4E10,4)
      NPTS=NPTS+1
      DO 100 I=1,NPTS
      XMKT=PMKT(4)
      IF(I.LE.9)XMKT=PMKT(1)
      IF(I.LE.18)XMKT=PMKT(2)
      IF(I.LE.27)XMKT=PMKT(3)
      X1(I)=FROM
      Y1(I)=(CONV-FROM)*XMKT
      IF(Y1(I).LT.0.)Y1(I)=0.
      FROM=FROM+DELTA
100   CONTINUE
C
C ENTER VALUES TO ESC FILE
C
      WRITE(1,11)NPTS,(Y1(I),I=1,NPTS)
      WRITE(1,11)NPTS,(X1(I),I=1,NPTS)
      1 FORMAT(12,/, (5E10,3))
7000  STOP
      END
C *****
C THIS SUBROUTINE IS USED WHEN YOU ENTER DATA
C FROM TERMINAL - TO BUILD ENERGY SAVINGS CURVE

```

CRE0276

CRE0277

CRE0278

CRE0279

CRE0280

CRE0281

CRE0282

CRE0283

CRE0284

CRE0285

CRE0286

CRE0287

CRE0288

CRE0289

CRE0290

CRE0291

CRE0292

CRE0293

CRE0294

CRE0295

CRE0296

CRE0297

0297

0297

0297

0297

CRE0298

CRE0299

CRE0300

CRE0301

CRE0302

CRE0303

CRE0304

CRE0305

CRE0306

CRE0307

CRE0308

CRE0309

CRE0310

CRE0311

CRE0312

CRE0313

CRE0314

CRE0315

CRE0316

CRE0317

CRE0318

CRE0319

CRE0320

CRE0321

CRE0322

CRE0323

CRE0324

0324

0324

FILE: CREATE FORTRAN A

CALL DATA MONITOR SYS T

```

SUBROUTINE 81
  DIMENSION X(50), Y(50)
  WRITE(6,5)
  5 FORMAT(' 0 FOR SHORT', //, ' 1 FOR LONG ')
  READ(5,*) IFLAG
  IF (IFLAG.EQ.1) GO TO 25
  READ(5,*)(X(I), I=1,5)
  GO TO 75
25 WRITE(6,2)
  2 FORMAT(' 1 READY TO BUILD ENERGY SAVINGS CURVE ', //,
    ' 1 INPUT THE FOLLOWING PIECES OF INFORMATION ', //
    ' 2 1. LOWEST COST VALUE ', //
    ' 3 2. HIGHEST COST VALUE ', //
    ' 4 3. NUMBER OF INCREMENTS (<40) ', //
    ' 5 4. COST OF THE CONVENTIONAL TECHNOLOGY ', //
    ' 6 5. NUMBER OF UNITS IN PLACE BY OPTIMIZING YEAR ', //)
  DO 50 I=1,5
    WRITE(6,3) I
  3 FORMAT(I5)
  READ(5,*) X(I)
  50 CONTINUE
  75 FROM=X(1)
  TO=X(2)
  NPTS=X(3)
  CONV=X(4)
  XMKT=X(5)
  WRITE(6,4)
  4 FORMAT(' // // // ')
  DELTA=(TO-FROM)/X(3)
  NPTS=NPTS+1
  DO 100 I=1,NPTS
    X(I)=FROM
    Y(I)=(CONV-FROM)*XMKT
    IF (Y(I).LT.0) Y(I)=0
    FROM=FROM+DELTA
  100 CONTINUE
  WRITE(11,1) NPTS, (Y(I), I=1, NPTS)
  WRITE(11,1) NPTS, (X(I), I=1, NPTS)
  1 FORMAT(I2, //, (SE10, 3))
  RETURN
END
*****
THIS SUBROUTINE IS USED WHEN YOU ENTER DATA FROM
TERMINAL - TO BUILD COST CURVES FOR EACH PROJECT

SUBROUTINE 89
  DIMENSION COST(30), PCOST(30)
  DATA COST/30*0.0/
  DATA PCOST/30*0.0/
  100 CONTINUE
  WRITE(6,1)

```

CRE03250
 CRE03260
 CRE03270
 CRE03280
 CRE03290
 CRE03300
 CRE03310
 CRE03320
 CRE03330
 CRE03340
 CRE03350
 CRE03360
 CRE03370
 CRE03380
 CRE03390
 CRE03400
 CRE03410
 CRE03420
 CRE03430
 CRE03440
 CRE03450
 CRE03460
 CRE03470
 CRE03480
 CRE03490
 CRE03500
 CRE03510
 CRE03520
 CRE03530
 CRE03540
 CRE03550
 CRE03560
 CRE03570
 CRE03580
 CRE03590
 CRE03600
 CRE03610
 CRE03620
 CRE03630
 CRE03640
 CRE03650
 CRE03660
 CRE03670
 CRE03680
 CRE03690
 03693
 03695
 CRE03700
 CRE03710
 CRE03720
 CRE03730
 CRE03740
 CRE03750
 CRE03760
 CRE03770

FILE: CREATE FORTRAN A

A-33
CALCULATA MONITOR SYST

```

1 FORMAT(' INPUT PROJECT NUMBER '
      & ' ENTER 0 TO TERMINATE INPUT')
      READ(5,*)IPROJ
      IF(IPROJ.EQ.0)RETURN
      WRITE(5,70)
70  FORMAT(' ENTER RESEARCH COST.')
      READ(5,*)RC
      WRITE(6,10)
10  FORMAT(/, ' ENTER PROBABILITY AND COST, SEPARATED BY COMMA'
      & /, ' ENTER 0,0 TO TERMINATE INPUT')
      DO 40 J=1, 30
      READ(5,*)PCOST(J),COST(J)
      IF(PCOST(J).EQ.0,0)GO TO 20
40  CONTINUE
      GO TO 50
20  J=J-1
50  WRITE(2,3)IPROJ,J,(COST(I),I=1,J)
      WRITE(2,4)RC,(PCOST(I),I=1,J)
      GO TO 100
200 CONTINUE
      WRITE(5,5)
5  FORMAT(' PROJECT NOT FOUND ')
      GO TO 100
3  FORMAT(215,/, (SF10,1))
4  FORMAT(E11,5,/, (SF10,3))
      END

```

CRE03780
 CRE03790
 CRE03800
 CRE03810
 CRE03820
 CRE03830
 CRE03840
 CRE03850
 CRE03860
 CRE03870
 CRE03880
 CRE03890
 CRE03900
 CRE03910
 CRE03920
 CRE03930
 CRE03940
 CRE03950
 CRE03960
 CRE03970
 CRE03980
 CRE03990
 CRE04000
 CRE04010
 CRE04020
 CRE04030

```

C *****
C
C
C THIS PROGRAM CHOOSES THE LEAST COSTLY PORTFOLIOS,
C GENERATES A LIST OF PORTFOLIOS AND A PLUT SYMBOL
C TABLE
C
C
C LAST MODIFIED BY JILL CHEN ON 04/10/79
C
C
C SUBROUTINES: YPAND
C              RANK
C              ENSAV
C              COMBIN
C              EXTRA
C              SYMPLT
C              AXES
C
C *****
C
C DIMENSION CCRFC(50),IPORT(15),PDFES(50),RC(15),EES(50)
C DIMENSION ES(50),COST(50),PCOST1(50),CDCOST(15,50),STORE(50,3)
C DIMENSION JBCSI(50)
C DIMENSION EPCOST(50),COST1(50),IPROJ(15),NPORT(50,15)
C DIMENSION LABEL(15),AVG(3),XPLO(200,2)
C REAL*4 YLAB(51),XLAB(51)
C DOUBLE PRECISION TODAY
C REAL*4 AMG,AMG1
C DATA TBCSI/30*0.0/
C DATA YLAB/10*'N','E','I','S','U','R','C','E',
C  &'S','A','V','I','N','G','S','I','L','O','I','A','*
C  &'B','I','S','I','4*'
C DATA XLAB/14*'P','O','R','T','F','O','I','L','I','O',
C  &'C','O','S','T','I','L','O','I','A','*
C  &'B','I','S','I','5*'
C
C ENTER INFORMATION FROM TERMINAL
C
C DEFINE FILE 9(100,20,E,10UM)
C WRITE(6,1)
C 1 FURNAL(' ENTER MARKET GROUP ')
C READ(5,99)AMG
C WRITE(6,711)
C 711 FURNAL(' ENTER MARKET PENETRATION YEAR')
C READ(5,211)YEAR
C 99 FURNAL(A4)
C NFLAG=0
C
C READ IN THE DESCRIPTION OF THE DESIRED MARKET GROUP
C
C READ(4,480,END=Z)AMG1,(LABEL(I),I=1,15)
C 480 FURNAL(A1,15A4)
C IF(AMG.NE.AMG1)GO TO 6
C 7 CONTINUE

```

AC00001
 AC00002
 AC00003
 AC00004
 AC00005
 AC00006
 AC00007
 AC00008
 AC00009
 AC00010
 AC00011
 AC00012
 AC00013
 AC00014
 AC00015
 AC00016
 AC00017
 AC00018
 AC00019
 AC00020
 AC00021
 AC00022
 AC00023
 AC00024
 AC00025
 AC00026
 AC00027
 AC00028
 AC00029
 AC00030
 AC00031
 AC00032
 AC00033
 AC00034
 AC00035
 AC00036
 AC00037
 AC00038
 AC00039
 AC00040
 AC00041
 AC00042
 AC00043
 AC00044
 AC00045
 AC00046
 AC00047
 AC00048
 AC00049
 AC00050
 AC00051
 AC00052
 AC00053
 AC00054
 AC00055
 AC00056
 AC00057
 AC00058
 AC00059
 AC00060


```

C READ IN ESC FILE (ENERGY SAVED VS COST CURVE) AC0005
C WHICH CONTAINS: 1. NET ENERGY SAVINGS 2. COSTS AC0005
C KNT=1 AC0005
C READ(1,2,ERR=500)NPTS,(ES(J),J=1,NPTS) AC0006
C READ(1,2,ERR=505)NPTS,(COST(J),J=1,NPTS) AC0006
C 2 FORMAT(I2,/, (SE10,3)) AC0006
C CALCULATE THE VALUE OF THE INTERVAL IN THE COST CURVE AC0006
C ZMIN=COST(1) AC0006
C N=0 AC0006
C CINT=COST(NPTS)-COST(1) AC0006
C CINT=CINT/49. AC0007
C EXPAND TAKES ESC CURVE DEFINED BY SOME NUMBER OF POINTS AND AC0007
C PRODUCES 50 POINTS ALONG THE SAME CURVE AC0007
C MM=1 AC0007
C CALL YPAND(N,NPTS,ES,COST,EES,CINT,K,NT,ZMIN,MM) AC0007
CMS AC0007
CMS N=1 AC0007
IF(NFLAG.NE.1)N=0 AC0008
EES(1)=ES(1) AC0008
C READ IN PC FILE (PROBABILITY COST CURVE) AC0008
C FOR EACH PROJECT AC0008
C K=0 AC0008
481 K=K+1 AC0008
READ(2,3,ERR=510,END=10) (PROJ(K),NPTS,(COST1(M),M=1,NPTS) AC0008
READ(2,4,ERR=515,END=10) (PC(K),(PCOST1(M),M=1,NPTS) AC0008
3 FORMAT(2I5,/, (SE10,1)) AC0009
4 FORMAT(1I1,5,/, (SE10,3)) AC0009
C EXPAND PC CURVE TO 50 POINTS FOR EACH PROJECT AC0009
C IF THE CURVE IS CUMULATIVE N = 0; OTHERWISE N = 1 AC0009
C MM=2 AC0009
CALL YPAND(N,NPTS,PCOST1,COST1,EPCOST,CINT,K,NT,ZMIN,MM) AC0009
C CHECK WHETHER PC CURVE IS CUMULATIVE ? AC0009
C IF(NFLAG.EQ.1)GO TO 100 AC0010
C IF PC CURVE IS CUMULATIVE USE DO LOOP TO LOAD CUMULATIVE AC0010
C DISTRIBUTION INTO MATRIX CXCOST DIRECTLY AC0010
C DO 90 J=1,50 AC0010
C CXCOST(K,J)=EPCOST(J) AC0010
90 CONTINUE AC0010
GO TO 5 AC0010
C AC0011

```

FILE: ACOMP1 FORTRAN A

CALL DATA MONITOR SYS

```

C      IF PC CURVE IS NOT CULULATIVE USE DO LOOP TO          ACU011
C      ACCUMULATE THE FREQUENCY PROBABILITY COST CURVE AND LOAD ACU011
C      CUMULATIVE DISTRIBUTION INTO MATRIX CDCOST             ACU011
C      ACU011
C      100 NUM=0                                               ACU011
C      DO 13 J=1,50                                           ACU011
C      IF(J.EQ.1)GO TO 11                                     ACU011
C      CDCOST(K,J)=CDCOST(K,J-1)+EPCOST(J)                   ACU011
C      GO TO 13                                               ACU011
C      11 CDCOST(K,J)=EPCOST(J)                               ACU012
C      13 CONTINUE                                           ACU012
C      CONTINUE                                               ACU012
C      GO TO 481                                              ACU012
C
C      THIS SECTION GENERATES PORTFOLIOS                      ACU012
C      BY COUNTING IN BINARY, UP TO THE NUMBER OF POSSIBLE ACU012
C      COMBINATIONS OF FUNDED PROJECTS                        ACU012
C      ACU012
C      10 NT=K-1                                              ACU012
C      ACU013
C      NT IS THE NUMBER OF PROJECTS                           ACU013
C      KTOT IS THE NUMBER OF POSSIBLE OCCURANCES             ACU013
C      ACU013
C      KTOT=2**NT-1                                           ACU013
C      DO 30N=1,KTOT                                          ACU013
C      IF(N.LT.2)GO TO 32                                     ACU013
C      ACU013
C      N IS THE PUNTER OF DO LOOP                             ACU013
C      ACU013
C      NT1=NT                                                 ACU014
C      NRES=N                                                 ACU014
C      ACU014
C      NREM IS THE REMAINDER OF NRES/2                       ACU014
C      THE VALUE OF NREM IS EITHER ZERO OR ONE               ACU014
C      ACU014
C      31 NREM=MOD(NRES,2)                                     ACU014
C      NRES=NRES/2                                            ACU014
C      ACU014
C      LOAD THE VALUE OF NREM INTO MATRIX IPORT WHICH        ACU014
C      CONTAINS THE COMBINATION OF PROJECTS                  ACU015
C      ACU015
C      IPORT(NT1)=NREM                                         ACU015
C      NT1=NT1-1                                              ACU015
C      IF(NRES.NE.0)GO TO 31                                  ACU015
C      IF(NT1.EQ.0)GO TO 37                                  ACU015
C      ACU015
C      USE DO LOOP TO ZERO OUT THE REST OF THE MATRIX IPORT ACU015
C      ACU015
C      DO 35 L=1,NT1                                          ACU015
C      IPORT(L)=0                                             ACU016
C      35 CONTINUE                                           ACU016
C      GO TO 37                                               ACU016
C      ACU016
C      IE N = 1 THEN IPORT(1) = 1 AND USE DO LOOP TO        ACU016
C      ZERO OUT THE REST OF THE MATRIX IPORT                 ACU016

```

```

C
32 NT2=NT-1
DO 25 N1=1,NT2
IPORT(N1)=0
25 CONTINUE
IPORT(NT)=1
C
C COMBINE THE CUMULATIVE PROBABILITY CURVES AND DETERMINE
C THE RESEARCH COST OF THE PORTFOLIO
C
37 CALL COMBIN(IPORT,CDCOST,NT,CCOFC,RC,CRC)
C
C FIND THE PROBABILITY DENSITY FUNCTION AND
C EXPECTED VALUE OF ENERGY SAVING
C
CALL ENSAV(CCOFC,EES,PDFES,EVES,NT)
C
C RANK SORTS THE PORTFOLIOS IN ORDER OF INCREASING RESEARCH COSTS
C AND DISCARDS ALL DOMINATED PORTFOLIOS IN THE PROCESS
C RANK RETAINS THE 50 LEAST COSTLY PORTFOLIOS
C
CALL RANK(STORE,EVES,CRC,NUM,NPORT,NT,IPORT)
30 CONTINUE
C
C CALCULATE THE EXTRA PORTFOLIO, INCLUDING ONE MORE 'AVERAGE' PROJECT
C
CALL EXTRA(NT,IPORT,CDCOST,RC,EES,AVG)
C
C SECTION TO GENERATE OUTPUT IN READABLE FORM
C
WRITE(6,459)
PAUSE
CALL DATE(TODAY)
WRITE(6,448) TODAY
448 FORMAT(//,2X,A8,/)
WRITE(6,454) AMG,(LABEL(NM),NM=1,15),IYEAR
456 FORMAT(//, ' MARKET GROUP ',A4,' : ',15A4,/,
8 ' YEAR : ',I4//)
WRITE(6,450)
450 FORMAT(5X, ' RES. COST ',2X, ' NET PRESENT ',3X, ' SAVING/S ',
4X, ' PRIVATE ',22X, ' PORTFOLIOS (FUNDING LEVELS) ',
8/,20X, ' VALUE ',17X, ' INVESTMENT ')
WRITE(6,449)
449 FORMAT(6X, '(5X10**6) ',3X, '(5X10**6) ',12X
8,3X, '(5X10**6) ')
WRITE(6,451)
451 FORMAT(1H, ' ',3X, ' ',5X, ' ',
33X, ' ',
4X, ' ')
WRITE(6,453) (IPROJ(K),K=1,NT)
453 FORMAT(1H,54X,15(13,2X))
C
C USE DO LOOP TO PRINT OUT THE 50 LEAST COSTLY
C PORTFOLIOS

```

ACU0166
ACU0167
ACU0168
ACU0169
ACU0170
ACU0171
ACU0172
ACU0173
ACU0174
ACU0175
ACU0176
ACU0177
ACU0178
ACU0179
ACU0180
ACU0181
ACU0182
ACU0183
ACU0184
ACU0185
ACU0186
ACU0187
ACU0188
ACU0189
ACU0190
ACU0191
ACU0192
ACU0193
ACU0194
ACU0195
ACU0196
ACU0197
ACU0198
ACU0199
ACU0200
ACU0201
ACU0202
ACU0203
ACU0204
ACU0205
ACU0206
ACU0207
ACU0208
ACU0209
ACU0210
ACU0211
ACU0212
ACU0213
ACU0214
ACU0215
ACU0216
ACU0217
ACU0218
ACU0219
ACU0220

```
C DO 470 I=1,NUM AC0022
C AC0022
C LOAD RESEARCH COST AND ENERGY SAVING OF AC0022
C EACH PORTFOLIO INTO MATRIX XPLO AC0022
C SCALE RESEARCH COST AND ENERGY SAVING AC0022
C AC0022
STORE(I,2)=STORE(I,2)/1.E6 AC0022
STORE(I,3)=STORE(I,3)/1.E6 AC0022
XPLO(I,1)=STORE(I,2) AC0023
XPLO(I,2)=STORE(I,3) AC0023
C AC0023
C IF ENERGY SAVING = 0.0 THEN JUMP OUT OF THE LOOP AC0023
C AC0023
IF(STORE(I,3).EQ.0.0)GO TO 471 AC0023
IBCST(I)=_0 AC0023
DO 900 J=1,NT AC0023
IF(NPORT(I,J).EQ.0)GO TO 900 AC0023
READ(9'J,6543)BENCST AC0023
6543 FORMAT(E10.4) AC0024
IBCST(I)=IBCST(I)+BENCST AC0024
900 CONTINUE AC0024
IBCST(I)=IBCST(I)/1.E6 AC0024
WRITE(6,452)I,STORE(I,2),STORE(I,3),STORE(I,1),IBCST(I), AC0024
&(NPORT(I,J),J=1,NT) AC0024
452 FORMAT(IX,I3,1X,4(E10.3,2X),4X,15(I1,4X)) AC0024
WRITE(3,455)I,(STORE(I,J),J=1,3) AC0024
455 FORMAT(18,3E11.3) AC0024
470 CONTINUE AC0024
C AC0025
PRINT OUT THE EXTRA PORTFOLIO AC0025
C AC0025
471 CONTINUE AC0025
NUM=NUM+1 AC0025
C AC0025
SCALE RESEARCH COST AND ENERGY SAVING AC0025
C AC0025
AVG(2)=AVG(2)/1.E6 AC0025
AVG(3)=AVG(3)/1.E6 AC0025
WRITE(6,457)AVG(2),AVG(3),AVG(1) AC0026
457 FORMAT(///,5X,3(E10.3,2X),12X,'<--- VALUES FOR COMPLETE PORTFOLIO') PAC0026
//ILUS ADDED AVERAGE PROJECT ',///) AC0026
XPLO(NUM,1)=AVG(2) AC0026
XPLO(NUM,2)=AVG(3) AC0026
WRITE(6,558) AC0026
558 FORMAT(//////) AC0026
459 EORMAL C SCROLL TO HEAD OF FORM ') AC0026
WRITE(5,458)AMG,(LABEL(NM),NM=1,15),IYEAR AC0026
458 FORMAT(/////////, AC0026
&'/' MARKET GROUP ',A4,' : ',1SA4,20X,'YEAR : ',I4,////) AC0027
C AC0027
PRINT OUT THE PLOT SYMBOL TABLE AC0027
C AC0027
CALL SYMLT(XPLO,NUM,YLAB,XLAB) AC0027
GO TO 580 AC0027
```

FILE: ACOMP1 FORTRAN A

A-39

CALLODATA MONITOR SYS

C		ACQ027
C	OUTPUT STATEMENTS INDICATING ERRORS IN THE DATA FILES	ACQ027
C		ACQ027
	500 WRITE(6,520)	ACQ028
	GO TO 580	ACQ028
	505 WRITE(6,525)	ACQ028
	GO TO 580	ACQ028
	510 WRITE(6,530)	ACQ028
	GO TO 580	ACQ028
	515 WRITE(6,535)	ACQ028
	GO TO 580	ACQ028
	520 FORMAT(1H, 'ERROR IN FILE 1: ENERGY SAVED')	ACQ028
	525 FORMAT(1H, 'ERROR IN FILE 1: COSTS')	ACQ028
	530 FORMAT(1H, 'ERROR IN FILE 2: COSTS')	ACQ028
	535 FORMAT(1H, 'ERROR IN FILE 2: PRIORABILITIES')	ACQ029
	580 STOP	ACQ029
	END	ACQ029

```

*****
THIS SUBROUTINE CALCULATES ENERGY SAVING
SUBROUTINE ENSAV(CCDFC,EES,PDFES,EVES,NT)
DIMENSION CCDFC(50),EES(50),PDFES(50)
EVES=0.0
CALCULATE PROBABILITY DENSITY FUNCTION OF ENERGY SAVINGS
DIFFERENTIALLY
DO 70 J=1,50
IF(J.EQ.1) GO TO 69
PDFES(J)=CCDFC(J)-CCDFC(J-1)
CALCULATE EXPECTED VALUE OF ENERGY SAVINGS
EVES=EVES+PDFES(J)*EES(J)
GO TO 70
69 PDFES(J)=CCDFC(J)
EVES=EVES+PDFES(J)*EES(J)
70 CONTINUE
RETURN
END
*****
THIS SUBROUTINE COMBINES CUMULATIVE PROBABILITY
CURVES OF ALL PROJECTS IN PORTFOLIO
SUBROUTINE COMBIN(IPORT,CDCOST,NT,CCDFC,RC,CRC)
DIMENSION IPORT(15),CDCOST(15,50),CCDFC(50),RC(15)
CRC=0.0
DO 49 J=1,50
CCDFC(J)=1.0
ALLOW CONTRIBUTIONS ONLY FROM FUNDED PROJECTS
CCDFC(J)=1.-(1.-P1)*(1.-P2)*...*(1.-PX)
DO 55 I=1,NT
IF(IPORT(I).LT.1) GO TO 55
CCDFC(J)=CCDFC(J)*(1.0-CDCOST(I,J))
55 CONTINUE
CCDFC(J)=1.0-CCDFC(J)
49 CONTINUE
CALCULATE TOTAL RESEARCH COST OF PORTFOLIO
DO 60 I=1,NT
IF(IPORT(I).EQ.0) GO TO 60
CRC=RC(I)+CRC
60 CONTINUE
RETURN
END
*****

```

COM00010
 COM00020
 COM00030
 COM00040
 COM00050
 COM00060
 COM00070
 COM00080
 COM00090
 COM00100
 COM00110
 COM00120
 COM00130
 COM00140
 COM00150
 COM00160
 COM00170
 COM00180
 COM00190
 COM00200
 COM00210
 COM00220
 COM00230
 COM00240
 COM00250
 COM00260
 COM00270
 COM00280
 COM00290
 COM00300
 COM00310
 COM00320
 COM00330
 COM00340
 COM00350
 COM00360
 COM00370
 COM00380
 COM00390
 COM00400
 COM00410
 COM00420
 COM00430
 COM00440
 COM00450
 COM00460
 COM00470
 COM00480
 COM00490
 COM00500
 COM00510
 COM00520
 COM00530
 COM00540
 COM00550

```

C      THIS SUBROUTINE EXPANDS ARRAY BY PLACING NEW          COM00560
C      POINTS LINEARLY BETWEEN ORIGINAL POINTS              COM00570
C      IF THE CURVE IS CUMULATIVE N=0; OTHERWISE N=1         COM00580
C      SUBROUTINE YPAND(N,NPTS,F,X,EF1,CINT,K,NT,ZM(N,MM)     COM00590
C      DIMENSION E(50),X(50),EF1(50)                        COM00600
C      INITIATIONS                                           COM00610
C      NZ=NPTS-1                                             COM00620
C      SUM1=0.0                                              COM00630
C      SUM2=0.0                                              COM00640
C      SUM3=0.0                                              COM00650
C      VAL=ZMIN-CINT                                         COM00660
C      DO 80 KOUNT=1,50                                       COM00670
C      VAL=VAL+CINT                                           COM00680
C      EF1(KOUNT)=0.                                          COM00690
C      USE DO LOOP TO FIND A NEW POINT WHICH FALLS IN      COM00700
C      BETWEEN TWO ORIGINAL POINTS                           COM00710
C      DO 50 J=1,NZ                                           COM00720
C      IF(VAL.LT.X(J))GO TO 50                                COM00730
C      IF(VAL.LT.X(J+1))GO TO 51                              COM00740
C      IF(J.EQ.NZ)GO TO 51                                    COM00750
C      50 CONTINUE                                           COM00760
C      GO TO 80                                               COM00770
C      WHEN NEW POINT IS FOUND, CALCULATE THE PROBABILITY OF COM00780
C      THIS POINT                                             COM00790
C      FORMULA = THE PROB. OF LOWER POINT + THE DIFF. OF TWO PROB. COM00800
C      OF ORIGINAL POINTS * THE RATIO OF THE DISTANCE BETWEEN THE COM00810
C      THE NEW POINT AND THE LOWER POINT TO THE DISTANCE    COM00820
C      BETWEEN TWO ORIGINAL POINTS                           COM00830
C      51 CONTINUE                                           COM00840
C      EF1(KOUNT)=F(J)+(F(J+1)-F(J))*(VAL-X(J))/(X(J+1)-X(J)) COM00850
C      IF(MM.EQ.2.AND.EF1(KOUNT).GT.1.)EF1(KOUNT)=1.         COM00860
C      SUM2=SUM2+EF1(KOUNT)                                   COM00870
C      80 CONTINUE                                           COM00880
C      CHECK WHETHER THE CURVE IS CUMULATIVE ?              COM00890
C      IF IT IS GO BACK TO MAIN PROGRAM                     COM00900
C      IF(N.EQ.0)RETURN                                       COM00910
C      IF IT IS NOT CUMULATIVE, USE DO LOOP TO CALCULATE    COM00920
C      THE TOTAL PROBABILITY OF ORIGINAL CURVE               COM00930
C      DO 91 K4=1,NPTS                                        COM00940
C      SUM1=SUM1+F(K4)                                         COM00950
C      91 CONTINUE                                           COM00960
C      USE DO LOOP TO CALCULATE THE NEW 50 PROBABILITIES OF COM00970
C      NEW EXPANDED CURVE                                     COM00980
C      DO 91 K4=1,NPTS                                        COM00990
C      SUM1=SUM1+F(K4)                                         COM1000
C      91 CONTINUE                                           COM1001
C      USE DO LOOP TO CALCULATE THE NEW 50 PROBABILITIES OF COM1002
C      NEW EXPANDED CURVE                                     COM1003
C      DO 91 K4=1,NPTS                                        COM1004
C      SUM1=SUM1+F(K4)                                         COM1005
C      91 CONTINUE                                           COM1006
C      USE DO LOOP TO CALCULATE THE NEW 50 PROBABILITIES OF COM1007
C      NEW EXPANDED CURVE                                     COM1008
C      DO 91 K4=1,NPTS                                        COM1009
C      SUM1=SUM1+F(K4)                                         COM1010
C      91 CONTINUE                                           COM1011

```

```

00 92 X6=1,50
EF1(K6)=EF1(K6)*SUM1/SUM2
SUM3=SUM3+EF1(K6)
92 CONTINUE
100 RETURN
END
*****
THIS SUBROUTINE SURS THE PORTFOLIOS IN ASCENDING ORDER
AND RETAINS THE 50 LEAST COSTLY PORTFOLIOS
SUBROUTINE RANK(STORE,EVES,CRC,NUM,NPORT,NT,IPORT)
DIMENSION STORE(50,3),AUX(3),NPORT(50,15),IPORT(15)
INTEGER STO
LOGICAL DFLAG
INITIALIZE FLAG, ARRAY POINTER, AND
TEMPORARY ARRAY OF VALUES
DFLAG=.FALSE.
IP=1
AUX(1)=EVES/CRC
AUX(2)=CRC
AUX(3)=EVES
TEST FOR FIRST SET OF VALUES
200 IF(NUM.NE.0)GO TO 215
USE DO LOOP TO STORE THE FIRST SET OF VALUES INTO
STORE MATRIX
NUM=NUM+1
DO 210 N=1,3
STORE(NUM,N)=AUX(N)
210 CONTINUE
STORE FUNDED PROJECTS AND GO BACK TO MAIN PROGRAM
DO 211 I=1,NT
NPORT (NUM,I)=IPORT(I)
211 CONTINUE
RETURN
WHEN IT IS NOT THE FIRST SET OF VALUES
TEST TO FIND PROJECT'S RANKING
AND WHETHER IT IS DOMINATED
215 CONTINUE
WHEN NEW RC IS LESS THAN OLD RC THEN GO TO 300
TO COMPARE ENERGY SAVINGS

```



```

C      IF(AUX(2).LT.STORE(IP,2))GO TO 300                                COM0166
C      WHEN NEW RC = OLD RC AND SAVE LESS ENERGY                      COM0167
C      THEN NO CONSIDERATION IS NECESSARY SO RETURN TO MAINPROGRAM.    COM0168
C      IF(AUX(3).LT.STORE(IP,3))RETURN                                  COM0169
C      WHEN NEW RC = OLD RC AND                                         COM0170
C      NEW ENERGY SAVING IS NOT LESS THAN OLD SAVING                  COM0171
C      THEN GO TO 300                                                  COM0172
C      IF(AUX(2).EQ.STORE(IP,2))GO TO 300                                COM0173
C      IP=IP+1                                                         COM0174
C      IF(IP.LE.NUM)GO TO 215                                           COM0175
C      DFLAG=TRUE                                                       COM0176
C      GO TO 425                                                         COM0177
C      300-CONTINUE                                                     COM0178
C      SHIFT MATRIX STORE AND FUNDING LEVELS DOWN                      COM0179
C      ONE SPACE TO MAKE ROOM FOR THE NEW PORTFOLIO                    COM0180
C      NCO=NUM+2                                                         COM0181
C      NCO1=NCO-1                                                         COM0182
C      DO 400 I=IP,NUM                                                  COM0183
C      NCO=NCO1                                                         COM0184
C      NCO1=NCO1-1                                                       COM0185
C      STORE(NCU,1)=STORE(NCO1,1)                                       COM0186
C      STORE(NCU,2)=STORE(NCO1,2)                                       COM0187
C      STORE(NCU,3)=STORE(NCO1,3)                                       COM0188
C      DO 400 J=1,NT                                                    COM0189
C      NPORT(NCU,J)=NPORT(NCO1,J)                                       COM0190
C      400-CONTINUE                                                     COM0191
C      NUM1=NUM+1                                                        COM0192
C      INSERT NEW VALUES INTO THE MATRIX STORE                        COM0193
C      425 CONTINUE                                                     COM0194
C      NUM=NUM+1                                                         COM0195
C      STORE(IP,1)=AUX(1)                                               COM0196
C      STORE(IP,2)=AUX(2)                                               COM0197
C      STORE(IP,3)=AUX(3)                                               COM0198
C      USE DO LOOP TO INSERT FUNDING LEVELS INTO MATRIX NPORT         COM0199
C      DO 450 I=1,NT                                                    COM0200
C      NPORT(IP,I)=IPORT(I)                                             COM0201
C      450 CONTINUE                                                     COM0202
C      IF(DFLAG)RETURN                                                  COM0203
C      500 CONTINUE                                                     COM0204
C      IJ=1                                                             COM0205
C      IF(NUM.EQ.1)RETURN                                               COM0206
C      MN=NUM-1                                                         COM0207
C      USE DO LOOP TO CHECK WHETHER HIGHER COST PORTFOLIO ALWAYS      COM0208

```

FILE: COMPSUB FORTRAN A

CALL DATA MONITOR SYST

```

      SAVES MORE ENERGY                                COM02210
      DO 510 IP=(J,MN)                                  COM02220
      IF (STORE(IP,3).GE.STORE(IP+1,3)) GO TO 520        COM02230
      510 CONTINUE                                       COM02240
      RETURN                                              COM02250
      WHEN IT COSTS MORE AND SAVES LESS, THEN          COM02260
      MOVE THE POINTER UP ONE TO ELIMINATE THAT PORTFOLIO COM02270
      520 CONTINUE                                       COM02280
      NUM=NUM+1                                           COM02290
      IJ=IP+1                                             COM02300
      IF (IJ.GT.NUM) RETURN                               COM02310
      MOVE MATRIX STORE AND COMBINATION OF FUNDED PROJECTS COM02320
      UP ONE SPACE                                       COM02330
      530 DO 540 I=IJ,NUM                                COM02340
      STORE(I,1)=STORE(I+1,1)                            COM02350
      STORE(I,2)=STORE(I+1,2)                            COM02360
      STORE(I,3)=STORE(I+1,3)                            COM02370
      DO 540 J=1,NT                                       COM02380
      NPORT(I,J)=NPORT(I+1,J)                            COM02390
      540 CONTINUE                                       COM02400
      GO TO 500                                           COM02410
      END                                                 COM02420
      *****                                           COM02430
      THIS SUBROUTINE CALCULATES ONE EXTRA PORTFOLIO    COM02440
      SUBROUTINE EXTRA(NT,IPOUT,CDCOST,RC,EES,AVG)      COM02450
      DIMENSION IPOUT(15),CDCUST(15,50),EES(50),AVG(3),CCDFC(50) COM02460
      DIMENSION ROEES(50),RC(15)                        COM02470
      XNT IS THE NUMBER OF PROJECTS                     COM02480
      XNT=NT                                              COM02490
      US DO LOOP TO CALCULATE THE SUM OF CUMULATIVE PROBABILITIES COM02500
      OF ALL PROJECTS AT EACH POINT ON THE CURVE        COM02510
      MT=NT+1                                             COM02520
      DO 100 I=1,50                                       COM02530
      SUM=0.0                                             COM02540
      DO 100 J=1,NT                                       COM02550
      SUM=SUM+CDCOST(J,I)                                COM02560
      100 CONTINUE                                       COM02570
      ASSUME THE CUMULATIVE PROBABILITY OF EXTRA PROJECT COM02580
      IS THE AVERAGE OF ALL OTHER PROJECTS             COM02590
      CDCOST(MT,I)=SUM/XNT                               COM02600
      200 CONTINUE                                       COM02610

```

```

C
C      ADD THE EXTRA PROJECT TO THE PORTFOLIO WHICH
C      INCLUDING ALL OTHER PROJECTS
C      IPORT(MT)=1
C
C      USE DO LOOP TO CALCULATE THE TOTAL RESEARCH COST
C
C      SUM=0
C      DO 300 I=1,NT
C      SUM=SUM+RC(I)
C      300 CONTINUE
C
C      ASSUME THE RC OF THE EXTRA ONE IS THE AVERAGE OF
C      ALL OF THE OTHER RESEARCH COSTS
C
C      RC(MT)=SUM/XNT
C
C      COMBINE CUMULATIVE PROBABILITY CURVES OF
C      ALL PROJECTS IN EXTRA PORTFOLIO
C
C      CALL COMBIN(IPORT,CDCOST,MT,CCDFC,RC,CRC)
C
C      CALCULATE THE EXPECTED ENERGY SAVING OF
C      EXTRA PORTFOLIO
C
C      CALL ENSAV(CCDFC,EES,POFES,EVES,MT)
C
C      AVG(1) : ENERGY SAVING PER DOLLAR
C      AVG(2) : RESEARCH COST
C      AVG(3) : ENERGY SAVING
C
C      AVG(1)=EVES/CRC
C      AVG(2)=CRC
C      AVG(3)=EVES
C
C      RETURN
C      END
C      *****
C
C      THIS SUBROUTINE PLOTS INPUT POINTS USING THE
C      ORDER OF THE POINTS AS THE KEY TO THE PLOT SYMBOL
C
C
C      SUBROUTINE SYMPLT(XNUM,NUM,YLAB,XLAB)
C      DIMENSION XNUM(200,2),YAX(11),XAX(11)
C      REAL*4 IPLOT(10,1,51),ISYM(10),DASH,BAR,STAR,BLANK
C      REAL*4 YLAB(51),XLAB(51)
C      DATA ISYM/1,1,2,1,3,1,4,1,5,1,6,1,7,1,8,1,9,1,0,1/
C      DATA DASH,BAR,STAR,BLANK/1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1/
C
C      DETERMINE NUMERICAL VALUES FOR AXES
C
C      CALL AXES(XNUM,NUM,YAX,XAX)
C
C      XLOW=XAX(1)
C      YHIGH=YAX(11)

```

COM02760
 COM02770
 COM02780
 COM02790
 COM02800
 COM02810
 COM02820
 COM02830
 COM02840
 COM02850
 COM02860
 COM02870
 COM02880
 COM02890
 COM02900
 COM02910
 COM02920
 COM02930
 COM02940
 COM02950
 COM02960
 COM02970
 COM02980
 COM02990
 COM03000
 COM03010
 COM03020
 COM03030
 COM03040
 COM03050
 COM03060
 COM03070
 COM03080
 COM03090
 COM03100
 COM03110
 COM03120
 COM03130
 COM03140
 COM03150
 COM03160
 COM03170
 COM03180
 COM03190
 COM03200
 COM03210
 COM03220
 COM03230
 COM03240
 COM03250
 COM03260
 COM03270
 COM03280
 COM03290
 COM03300

FILE: COMPSUB FORTRAN A

CALL DATA MONITOR SYST

```

XDEL=(XAX(11)-XLOW)/100.
YOEL=(YHIGH-YAX(11))/50.
-----FILL THE CENTER OF THE PLOT REGION WITH BLANKS
DO 500 I=1,51
DO 500 J=1,101
IPLOT(J,I)=BLANK
500 CONTINUE
-----FILL BORDERS OF THE PLOT REGION WITH DASHES
DO 100 I=1,101
IPLOT(I,1)=DASH
IPLOT(I,51)=DASH
100 CONTINUE
-----PLACE VERTICAL BARS EVERY TEN SPACES
DO 200 I=1,101,10
DO 200 J=1,51
IPLOT(I,J)=BAR
200 CONTINUE
DO 300 I=2,49
IPLOT(I,1)=BAR
IPLOT(101,I)=BAR
300 CONTINUE
-----PLACE HORIZONTAL DASHES EVERY FIVE SPACES
DO 400 I=6,46,5
DO 400 J=1,101
IPLOT(J,I)=DASH
400 CONTINUE
-----FILL THE CORNERS OF THE PLOT MATRIX WITH STARS
IPLOT(1,1)=STAR
IPLOT(101,1)=STAR
IPLOT(1,51)=STAR
IPLOT(101,51)=STAR
-----CALCULATE LOCATIONS OF EACH CURVE POINT
DO 700 I=L,NUM
IX=(XNUM(I,1)-XLOW)/XDEL+1.
IY=(YHIGH-XNUM(I,2))/YDEL+1.
-----DETERMINE WHICH SYMBOLS TO INSERT
ITEN=I/10.
IONE=I-10*ITEN.
-----IF POINT NUMBER IS LESS THAN 10, SYMBOL IS ONE POINT
SKIP TO STATEMENT 600. OTHERWISE, DETERMINE FIRST OF TWO

```

COM03310
COM03320
COM03330
COM03340
COM03350
COM03360
COM03370
COM03380
COM03390
COM03400
COM03410
COM03420
COM03430
COM03440
COM03450
COM03460
COM03470
COM03480
COM03490
COM03500
COM03510
COM03520
COM03530
COM03540
COM03550
COM03560
COM03570
COM03580
COM03590
COM03600
COM03610
COM03620
COM03630
COM03640
COM03650
COM03660
COM03670
COM03680
COM03690
COM03700
COM03710
COM03720
COM03730
COM03740
COM03750
COM03760
COM03770
COM03780
COM03790
COM03800
COM03810
COM03820
COM03830
COM03840
COM03850

```

C      SYMBOLS.
C
      IF (I.LT.10) GO TO 600
      IF (IUNE.EQ.0) IUNE=10
      IPILOT(IY,IY)=ISYM(ITEN)
      IY=IY+1
600  IPILOT(IY,IY)=ISYM(ITONE)
700  CONTINUE
      J=0
      N=12
C
C      OUTPUT
C
      DO 900 I=1,10
      N=N+1
      J=J+1
      WRITE(6,1) YLAB(J), YAX(N), (IPILOT(K,J), K=1,101)
      DO 800 M=1,4
      J=J+1
      WRITE(6,2) YLAB(J), (IPILOT(K,J), K=1,101)
800  CONTINUE
900  CONTINUE
      WRITE(6,1) YLAB(J), YAX(1), (IPILOT(K,51), K=1,101)
      WRITE(6,4)
      WRITE(6,4)
      WRITE(6,3) XAX(1), XAX(3), XAX(5), XAX(7), XAX(9), XAX(11)
      WRITE(6,5) (XLAB(KL), KL=1,51)
C
C      FORMATS
C
      1 FORMAT(1X,A1,2X,E10.3,' ',101A1)
      2 FORMAT(1X,A1,14X,101A1)
      3 FORMAT(14X,E10.3,4(7X,E10.3,3X),7X,E10.3,/)
      4 FORMAT(16X,10(1X,9X),1X)
      5 FORMAT(//,35X,50A1,///)
      RETURN
      END
      *****
C
C      THIS SUBROUTINE AXES DETERMINES LABLES FOR THE X AND Y AXES
C
      SUBROUTINE AXES(X,N,YAX,XAX)
      DIMENSION X(200,2), XAX(11), YAX(11)
C
      INITIALIZE X(1,1) AS HIGHEST X VALUE
      INITIALIZE X(1,2) AS HIGHEST Y VALUE
C
      XHIGH=X(1,1)
      YHIGH=X(1,2)
C
      USE DO LOOP TO FIND THE HIGHEST RESEARCH COST AND
      ENERGY SAVING
C
      DO 100 I=1,N
      IF (X(I,1).GT.XHIGH) XHIGH=X(I,1)

```

COM03860
COM03870
COM03880
COM03890
COM03900
COM03910
COM03920
COM03930
COM03940
COM03950
COM03960
COM03970
COM03980
COM03990
COM04000
COM04010
COM04020
COM04030
COM04040
COM04050
COM04060
COM04070
COM04080
COM04090
COM04100
COM04110
COM04120
COM04130
COM04140
COM04150
COM04160
COM04170
COM04180
COM04190
COM04200
COM04210
COM04220
COM04230
COM04240
COM04250
COM04260
COM04270
COM04280
COM04290
COM04300
COM04310
COM04320
COM04330
COM04340
COM04350
COM04360
COM04370
COM04380
COM04390
COM04400

FILE: COMPSUB FORTRAN A

CALL DATA MONITOR SYST

IF(X(I,2).GT.YHIGH)YHIGH=X(I,2)	COM04410
100 CONTINUE	COM04420
IXH=XHIGH	COM04430
IYH=YHIGH	COM04440
DETERMINE ORDER OF MAGNITUDE OF HIGH NUMBER	COM04450
IXH=0	COM04460
IYH=0	COM04470
200 CONTINUE	COM04480
IXH=IXH+1	COM04490
IXH=JXH/10	COM04500
IF(JXH.NE.0.)GO TO 200	COM04510
300 CONTINUE	COM04520
IYH=IYH+1	COM04530
IYH=JIYH/10	COM04540
IF(JIYH.NE.0.)GO TO 300	COM04550
DETERMINE UPPER LIMIT OF GRAPH	COM04560
XTEST=10.**IXH	COM04570
YTEST=10.**IYH	COM04580
DO 350 I=1,2	COM04590
IF(XHIGH.LT.XTEST)XTEST=XTEST*.5	COM04600
IF(YHIGH.LT.YTEST)YTEST=YTEST*.5	COM04610
350 CONTINUE	COM04620
IF(XHIGH.GT.XTEST)XTEST=2.*XTEST	COM04630
IF(YHIGH.GT.YTEST)YTEST=2.*YTEST	COM04640
XTEST=XTEST/10	COM04650
YTEST=YTEST/10	COM04660
USE DO LOOP TO LOAD ELEVEN X AND Y VALUES INTO	COM04670
MATRIX XAX AND YAX	COM04680
DO 400 J=1,11	COM04690
J=J-1	COM04700
XAX(J)=FLOAT(J)*XTEST	COM04710
YAX(J)=FLOAT(J)*YTEST	COM04720
400 CONTINUE	COM04730
RETURN	COM04740
END	COM04750
	COM04760
	COM04770
	COM04780
	COM04790
	COM04800
	COM04810

```

DEFINE FILE 10(200,830,E,IDUM),7(8,504,E,IDUM),13(300,4,E,IDUM)
DIMENSION CC(2),CMA(2),COP(65,2),SCP(2),YST(2),PMKT(4)
DIMENSION CE(2,6),IYRL(2),CF(25),RNFOM(2),FED(10),UMAR(25)
DIMENSION PRIN(15),TEVOM(6),EPR(5)
DIMENSION CMKT(25),IFED(11),MMS(400)
DIMENSION UNIT(25),TMKT(6),CFED(25),NFED(25)
DIMENSION PRIV(25),TCE(6),TEV(6),TEVD(6),EMP(25,5)

ENTER INFORMATION FROM TERMINAL

TMKT(2)=0.0
IPASS=0
TCOT=.1
AOJ=10500./3413.
IENX=8
READ(7,'IENX,2996')((EMP(KYR,KFUEL),KYR=1,25),KFUEL=1,4)
FORMAT(100E5,2)
WRITE(6,211)
111 FORMAT(/,' ENTER YEAR, 1=1981 2=1985 3=1990 4=2000')
READ(5,*)MMYEAR
ICALC=1
WRITE(6,4146)
146 FORMAT(1X,'ENTER NO OF PROJECTS TO BE RUN, FOLLOWED BY THEIR',
&1 NUMBERS')
READ(5,*) MPROJ,(MMS(MP),MP=1,MPROJ)
336 DO 370 I RANGE=1,MPROJ
IPROJ=MMS(I RANGE)
IPASS=1
RA=FIT=1.0

READ DETAIL RECORD FROM BIGFILEH

READ(10,IPROJ,2000)RIB,RIS,AC,CC(1),CMA(1),YST1,(CE(1,J),J=1,5),
&RNFOM(1),RPROJ,
&YRL1,SCP(1),CC(2),CMA(2),YST2,(CE(2,J),J=1,5),RNFOM(2),
&YRL2,SCP(2),RIP,EYR,CM,CD,CY,RIFYR,
&(FED(J),J=1,10),RIPYR,(PRIN(L),L=1,10),
&(CMKT(J),J=1,17),(TMKT(I),I=1,5),(EPR(K),K=1,5)
0000 FORMAT(80E10,4)

SHIFT AND STORE ROAD INVESTMENT
MEYR=EYR
I1=MEYR-1975
DO 1905 I=1,25
EMR(I,5)=ERR(5)*EXP(.025*(I-1))
905 CONTINUE
IEY=RIFYR-1976.
IPY=RIPYR-1976.
DO 1904 I=1,25
CFED(I)=0
PRIV(I)=0
904 CONTINUE
DO 1901 I=1,10
CEED(IEY+I)=FED(I)
PRIV(IPY+I)=PRIN(I)

```

FILE: CREATENO FORTRAN A

A-50
CALL DATA MONITOR SYST

```

1901 CONTINUE
      CHANGE REAL VARIABLES TO INTEGER VALUES
      IB=IIB
      IS=IIS
      IAC=AC
      IF(IAC.GT.25) IAC=25
      IYST(1)=YST1
      IF(IYST(1).EQ.0.AND.IB.EQ.2) YST1=1
      IF(IB.EQ.2.AND.IYST(1).EQ.0) IYST(1)=1
      IYST(2)=YST2
      IF(IYST(2).EQ.0) YST2=1
      IF(IYST(2).EQ.0) IYST(2)=1
      IYRL(1)=YRL1
      IYRL(2)=YRL2
      IP=IIP

      CALCULATE TOTAL OPERATING COSTS FOR NEW AND
      CONVENTIUNAL SYSTEM
      DO 119 KI=1,65
      COP(KI,1)=0.0
      COP(KI,2)=0.0
19 CONTINUE
      DO 2559 J=1,2
      IYRST=MEYR-1975
      IYREND=IYRL(J)+MEYR-1975+1
      IF(IYREND.GT.50) IYREND=50
      DO 1193 KY=IYRST,IYREND
      OPER=0.0
      OPCOST=0.0
      DO 2558 L=1,5
      IF(KY.GT.25) GO TO 94
      FUEL=EMP(KY,L)
      GO TO 195
14 FUEL=EMP(25,L)
195 CONTINUE
      OPCOST=OPCOST+CE(J,L)*FUEL/1.E6
1558 CONTINUE
      COP(KY,J)=OPCOST+RNFUM(J)
193 CONTINUE
1559 CONTINUE
      TCOP=0.0
      TCOP1=0.0
      DO 8112 MM=1,65
      TCOP=TCOP+COP(MM,2)
112 CONTINUE
      DO 333 MM=1,65
      TCOP1=TCOP1+COP(MM,1)
133 DO 6 K=1,25
      CF(K)=0.
      UMAR(K)=0.
      UNIT(K)=0.
      CONTINUE

```

CRE00560
 CRE00570
 CRE00580
 CRE00590
 CRE00600
 CRE00610
 CRE00620
 CRE00630
 CRE00640
 CRE00650
 CRE00660
 CRE00670
 CRE00680
 CRE00690
 CRE00700
 CRE00710
 CRE00720
 CRE00730
 CRE00740
 CRE00750
 CRE00760
 CRE00770
 CRE00780
 CRE00790
 CRE00800
 CRE00810
 CRE00820
 CRE00830
 CRE00840
 CRE00850
 CRE00860
 CRE00870
 CRE00880
 CRE00890
 CRE00900
 CRE00910
 CRE00920
 CRE00930
 CRE00940
 CRE00950
 CRE00960
 CRE00970
 CRE00980
 CRE00990
 CRE01000
 CRE01010
 CRE01020
 CRE01030
 CRE01040
 CRE01050
 CRE01060
 CRE01070
 CRE01080
 CRE01090
 CRE01100

FILE: CREATENO FORTRAN A

CALL DATA MONITOR SYST

Z	CONTINUE	CRE01110
C		CRE01120
C	CONVERT FEDERAL FUNDING TO DOLLARS	CRE01130
C		CRE01140
	DO 60 I=1,25	CRE01150
	CF(I)=GFED(I)*1.0E+6	CRE01160
60	CONTINUE	CRE01170
C		CRE01180
C	CALCULATE NUMBER OF UNITS BETWEEN 1990,1995,2000	CRE01190
C		CRE01200
	LIM=25	CRE01210
	UNIT(20)=CMKT(16)	CRE01220
	UNIT(25)=CMKT(17)	CRE01230
	DO 82 I=1,15	CRE01240
	UNIT(I)=CMKT(I)	CRE01250
82	CONTINUE	CRE01260
	DO 1902 I=1,2	CRE01270
	J1=(6+5*(I-1))	CRE01280
	J2=J1+3	CRE01290
	A=ALUG(CMKT(15+I)/CMKT(14+I))/5.	CRE01300
	R=EXP(A)-1	CRE01310
	DO 1903 J=J1,J2	CRE01320
	UNIT(J)=UNIT(J-1)*(L+R)+.5	CRE01330
1903	CONTINUE	CRE01340
1902	CONTINUE	CRE01350
	IF (IP,EQ,1) GO TO 90	CRE01360
	DO 85 I=2,LIM	CRE01370
	UNIT(I)=UNIT(I)+UNIT(I-1)	CRE01380
85	CONTINUE	CRE01390
90	CONTINUE	CRE01400
C		CRE01410
C	DETERMINE MARGINAL UNITS DUE TO FEDERAL INVESTMENT	CRE01420
C		CRE01430
	JAC=IAC*L	CRE01440
	DO 91 I=JAC,LIM	CRE01450
	UMAR(I)=UNIT(I)-UNIT(I-IAC)	CRE01460
91	CONTINUE	CRE01470
	DO 93 I=1,IAC	CRE01480
	UMAR(I)=UNIT(I)	CRE01490
93	CONTINUE	CRE01500
3229	CONTINUE	CRE01510
		CRE01520
	COMPUTE TOTAL AND DISCOUNTED INVESTMENTS	CRE01530
		CRE01540
300	CONTINUE	CRE01550
	TEI=0.0	CRE01560
	PIV=0.	CRE01570
	IFRID=0.	CRE01580
	PIVO=0.	CRE01590
	OC=CC(2)-CC(1)	CRE01600
	IPID=UNIT(1)*OC	CRE01610
	IFID=0.	CRE01620
	DO 310 I=L,LIM	CRE01630
	IFID=IFID+CF(I)	CRE01640
	PIV=PIV+PRIV(I)	CRE01650

FILE: CREATENO FORTRAN A

CALL DATA MONITOR SYS I

```

      J=I+3
      TFID=TFID+CF(I)/1.1**J
      TFRID=TFRID+(PRIV(I)+CF(I))/1.1**J
      PIVO=PIVO+PRIV(I)/1.1**J
      IF (I.EQ.1) GO TO 310
      TFRID=TFRID+(UNIT(I)-UNIT(I-1))*OC/1.1**J
310  CONTINUE
C
C  CALCULATE NET PRESENT VALUE OF NEW AND CONVENTIONAL
C  SYSTEM
C
      PV=TCOP*CC(2)
      IF (IYRL(1).EQ.0) PV=TCOP*CC(2)
      CONV=TCOP1+CC(1)
C
C  CALCULATE ANNUALIZED CAPITAL INVESTMENT PER UNIT
C
      CC(2)=CC(2)*1/(1,-1.1**(-IYRL(2)))
      IF (IYRL(1).EQ.0) GO TO 799
      CC(1)=CC(1)*1/(1,-1.1**(-IYRL(1)))
      GO TO 798
799  CC(1)=0
798  CONTINUE
      BENCST=CC(2)+CC(1)
C
C  ANNUALIZE NET PRESENT VALUE
C
      PV=PV*1/(1,-1.1**(-IYRL(2)))
      IF (IYRL(1).EQ.0) GO TO 777
      CONV=CONV*1/(1,-1.1**(-IYRL(1)))
      GO TO 778
777  CONV=0.0
778  CONTINUE
C
C  ASSIGN MARKET PENETRATION
C
      XMKT=CMKT(17)
      IF (MMYEAR.EQ.1) XMKT=CMKT(6)
      IF (MMYEAR.EQ.2) XMKT=CMKT(10)
      IF (MMYEAR.EQ.3) XMKT=CMKT(15)
C
C  DETERMINE EXPECTED NET ENERGY SAVINGS
C
      IF (IYRL(1).EQ.0) GO TO 4001
      EES=(CONV-PV)*XMKT
      GO TO 4002
4001 EES=PV*XMKT
4002 IF (EES.LT.0.0) EES=0.0
4000 CONTINUE
      WRITE(2,5100) (PROJ,EES,TFID
5100 FORMAT(14,2E10.4)
C
C  CALCULATE TOTAL PRIVATE INVESTMENT
C
      BENCST=BENCST*XMKT

```

CRE01660
 CRE01670
 CRE01680
 CRE01690
 CRE01700
 CRE01710
 CRE01720
 CRE01730
 CRE01740
 CRE01750
 CRE01760
 CRE01770
 CRE01780
 CRE01790
 CRE01800
 CRE01810
 CRE01820
 CRE01830
 CRE01840
 CRE01850
 CRE01860
 CRE01870
 CRE01880
 CRE01890
 CRE01900
 CRE01910
 CRE01920
 CRE01930
 CRE01940
 CRE01950
 CRE01960
 CRE01970
 CRE01980
 CRE01990
 CRE02000
 CRE02010
 CRE02020
 CRE02030
 CRE02040
 CRE02050
 CRE02060
 CRE02070
 CRE02080
 CRE02090
 CRE02100
 CRE02110
 CRE02120
 CRE02130
 CRE02140
 CRE02150
 CRE02160
 CRE02170
 CRE02180
 CRE02190
 CRE02200

A-53

FILE: CREATEND FORTRAN A

CALL DATA MONITOR SYST

WRITE(9,565)BENCST
565 FORMAT(E10.4)
370 CONTINUE
7000 STOP
END

CRE02210
CRE02220
CRE02230
CRE02240
CRE02250

FILE: ANON

FORTRAN A

CALL DATA MONITOR SYST

```

*****
THIS PROGRAM IS USED TO GENERATE AND RANK PORTFOLIOS OF NON-
COMPETITIVE PROJECTS.
-----
DIMENSION XSAVE(15),IPORT(15),POPES(50),RC(15),EES(50),AUXPOR(15)
DIMENSION TBCSL(30)
DIMENSION ES(50),COST(50),PCOST1(50),COCOST(15,50),STORE(50,3)
DIMENSION EPCOST(50),COST1(50),IPROJ(15),NPORT(50,15)
DIMENSION LABEL(15),TEMP(50),AVG(3),XPLD(200,2)
DOUBLE PRECISION TODAY
REAL*4 AMG,EMG
DEFINE FILE 9(100,20,E,IDUM)
DATA NUM/0/
WRITE(6,1001)
001 FORMAT(//, 'ENTER MARKET GROUP')
READ(5,44)AMG
14 FORMAT(A4)
WRITE(6,1003)
003 FORMAT(' ENTER YEAR')
READ(5,41)YEAR
09 CONTINUE
READ(4,78)EMG,(LABEL(I),I=1,15)
18 FORMAT(A4,15A4)
IF(AMG.NE.EMG)GO TO 109
NFLAG=0
WRITE(6,91)
9 FORMAT(' SCROLL TO HEAD OF FORM ')
PAUSE 0
CALL DATE(TODAY)
WRITE(6,448) TODAY
448 FORMAT(//,2X,A8,/)
WRITE(6,456)AMG,(LABEL(NM),NM=1,15),YEAR
156 FORMAT(//, ' MARKET GROUP ',A4,' : ',15A4,/, ' YEAR : ',I4//)
READ IN PROJECT'S EXPECTED ENERGY SAVINGS, RESEARCH
COST FROM FILE NUNPC
K=0
N=1
RSUM=0.
SAVSUM=0.
841 K=K+1
READ(2,3,ERR=510,END=10)IPROJ(K),EES(K),RC(K)
FORMAT(14,2E10,4)
STORE ENERGY SAVING IN TABLE XSAVE
XSAVE(K)=EES(K)
5 CONTINUE
GO TO 841
10 CONTINUE

```

FILE: ANON

FORTRAN A

CALL DATA MONITOR SYS I

```

C      CALCULATE TOTAL RESERACH COST , TOTAL          AN000560
C      ENERGY SAVING AND THE AVERAGE OF ALL PORTFOLIOS AN000570
C      ----- AN000580
C      NI=K=L AN000590
C      DO 15 I=L,NI AN000600
C      RSUM=RSUM+RC(I) AN000610
C      SAVSUM=SAVSUM+XSAVE(I) AN000620
C      15 CONTINUE AN000630
C      AVG(3)=SAVSUM/FLUAT(NI) AN000640
C      AVG(2)=RSUM/FLUAT(NI) AN000650
C      ----- AN000660
C      SECTION 10. GENERATE PORTFOLIOS AN000670
C      BY COUNTING IN BINARY, UP TO THE NUMBER OF POSSIBLE COMBINATIONS AN000680
C      OF FUNDING LEVELS FOR PROJECTS AN000690
C      ----- AN000700
C      KTOT=2**NI=L AN000710
C      DO 30N=1,KTOT AN000720
C      IF(N.LT.21)GO TO 32 AN000730
C      NT=NT AN000740
C      NRES=N AN000750
C      31 NRES=MOD(NRES,2) AN000760
C      NRES=NRES/2 AN000770
C      IPORT(NI)=NRES AN000780
C      NT=NT+1 AN000790
C      IF(NRES.NE.0)GO TO 31 AN000800
C      IF(NT.FQ.0)GO TO 37 AN000810
C      DO 35L=1,NT AN000820
C      IPORT(L)=0 AN000830
C      35 CONTINUE AN000840
C      GO TO 37 AN000850
C      32 NT2=NT-1 AN000860
C      DO 25 N1=1,NT2 AN000870
C      IPORT(N1)=0 AN000880
C      25 CONTINUE AN000890
C      IPORT(NI)=1 AN000900
C      37 CONTINUE AN000910
C      ----- AN000920
C      THIS SUBROUTINE CALCULATES RESEARCH COST AND ENERGY AN000930
C      SAVINGS FOR EACH PORTFOLIO AN000940
C      ----- AN000950
C      CALL ADDER(IPORT,XSAVE,NT,RC,CRC,EVES) AN000960
C      ----- AN000970
C      RANK SURTS THE PORTFOLIOS IN ORDER OF DECREASING RESEARCH COSTS AN000980
C      AND DISCARDS ALL DOMINATED PORTFOLIOS IN THE PROCESS AN000990
C      RANK RETAINS THE 50 LEAST COSTLY PORTFOLIOS AN001000
C      ----- AN001010
C      CALL RANK(STORE,EVES,CRC,NUM,NPORT,NT,IPORT) AN001020
C      IF(NUM.GE.50)GO TO 909 AN001030
C      30 CONTINUE AN001040
C      909 CONTINUE AN001050
C      ----- AN001060
C      CALCULATE AVERAGES OF ENERGY SAVING, RESEARCH AN001070
C      COST AND ENERGY SAVING PER DOLLAR AN001080
C      ----- AN001090
C      AVG(3)=AVG(3)+EVES AN001100

```

FILE: ANON

FORTRAN A

CALL DATA MONITOR SYST

```

      AVG(2)=AVG(2)+CHC
      AVG(1)=AVG(3)/AVG(2)
      AN001110
      AN001120
      AN001130
      SECTION TO GENERATE OUTPUT IN READABLE FORM
      AN001140
      AN001150
      AN001160
      AN001170
      AN001180
      AN001190
      AN001200
      AN001210
      AN001220
      AN001230
      AN001240
      AN001250
      AN001260
      AN001270
      AN001280
      AN001290
      AN001300
      AN001310
      AN001320
      AN001330
      AN001340
      AN001350
      AN001360
      AN001370
      AN001380
      AN001390
      AN001400
      AN001410
      AN001420
      AN001430
      AN001440
      AN001450
      AN001460
      AN001470
      AN001480
      AN001490
      AN001500
      AN001510
      AN001520
      AN001530
      AN001540
      AN001550
      AN001560
      AN001570
      AN001580
      AN001590
      AN001600
      AN001610
      AN001620
      AN001630
      AN001640
      AN001650

```

FILE: ANON FORTRAN A

CALL DATA MONITOR SYS 1

```

      GO TO 580
C
C   ---OUTPUT STATEMENTS INDICATING ERRORS IN THE DATA FILES
C
      500 WRITE(6,520)
      GO TO 580
      505 WRITE(6,525)
      GO TO 580
      510 WRITE(6,530)
      GO TO 580
      515 WRITE(6,535)
      GO TO 580
      520 FORMAT(1H,'ERROR IN FILE 1: ENERGY SAVED')
      525 FORMAT(1H,'ERROR IN FILE 1: COSTS')
      530 FORMAT(1H,'ERROR IN FILE 2: COSTS')
      535 FORMAT(1H,'ERROR IN FILE 2: PROBABILITIES')
      580 STOP
      END
C
C   *****
C
C   ---THIS SUBROUTINE CALCULATES THE ENERGY SAVING AND THE
C   ---RESEARCH COST OF EACH PORTFOLIO
C
      SUBROUTINE ADDER(IPORT,XSAVE,NT,RC,CRC,EVES)
      DIMENSION IPORT(15),XSAVE(15),RC(15)
      CRC=0.
      EVES=0.
      DO 100 I=1,NT
      IF(IPORT(I).NE.1)GO TO 100
      CRC=CRC+RC(I)
      EVES=EVES+XSAVE(I)
      100 CONTINUE
      RETURN
      END
      SUBROUTINE RANK(STORE,EVES,CRC,NUM,NPORT,NT,IPORT)
      DIMENSION STORE(50,3),AUX(3),NPORT(50,15),IPORT(15)
      INTEGER STO
      LOGICAL DFLAG
C
C   ---INITIALIZE FLAG, ARRAY POINTER, AND
C   ---TEMPORARY ARRAY OF VALUES
C
      DFLAG=.FALSE.
      IP=1
      AUX(1)=EVES/CRC
      AUX(2)=CRC
      AUX(3)=EVES
C
C   TEST FOR FIRST SET OF VALUES
C
      200 IF(NUM.NE.0)GO TO 215
C
C   USE DO LOOP TO STORE THE FIRST SET OF VALUES INTO
C   STORE MATRIX
C

```

```

NUM=NUM+1
DO 210 N=1,3
  STORE(NUM,N)=AUX(N)
210 CONTINUE

STORE FUNDED PROJECTS AND GO BACK TO MAIN PROGRAM

DO 211 I=1,NT
  NPORT (NUM,I)=IPORT(I)
211 CONTINUE
  RETURN

WHEN IT IS NOT THE FIRST SET OF VALUES
TEST TO FIND PROJECT'S RANKING
AND WHETHER IT IS DOMINATED
215 CONTINUE

WHEN NEW RC IS LESS THAN OLD RC THEN GO TO 300
TO COMPARE ENERGY SAVINGS

IF(AUX(2),LT,STORE(IP,2))GO TO 300

WHEN NEW RC >= OLD RC AND SAVE LESS ENERGY
THEN NO CONSIDERATION IS NECESSARY SO RETURN TO MAINPROGRAM

IF(AUX(3),LT,STORE(IP,3))RETURN

WHEN NEW RC = OLD RC AND
NEW ENERGY SAVING IS NOT LESS THAN OLD SAVING
THEN GO TO 300

IF(AUX(2),EQ,STORE(IP,2))GO TO 300
IP=IP+1
IF(IP,LE,NUM)GO TO 215
DFLAG=.TRUE.
GO TO 425
300 CONTINUE

SHIFT MATRIX STORE AND FUNDING LEVELS DOWN
ONE SPACE TO MAKE ROOM FOR THE NEW PORTFOLIO

NCO=NUM+2
NCU=NCO-1
DO 400 I=IP,NUM
  NCU=NCU-1
  STORE(NCU,1)=STORE(NCO,1)
  STORE(NCU,2)=STORE(NCO,2)
  STORE(NCU,3)=STORE(NCO,3)
DO 400 J=1,NT
  NPORT(NCU,J)=NPORT(NCO,J)
400 CONTINUE
NUM=NUM+1

```


FILE: ANON

FORTRAN A

A-59

CALLODATA MONITOR SYS I

```

C      INSERT NEW VALUES INTO THE MATRIX STORE
C
425 CONTINUE
      NUM=NUM+1
      STORE(IP,1)=AUX(1)
      STORE(IP,2)=AUX(2)
      STORE(IP,3)=AUX(3)
C
C      USE DO LOOP TO INSERT FUNDING LEVELS INTO MATRIX NPURT
C
      DO 450 I=1,NT
      NPURT(IP,I)=IPURT(I)
450 CONTINUE
      IF(DFLAG)RETURN
      500 CONTINUE
      IJ=1
      IF(NUM.EQ.1)RETURN
      MN=NUM-1
C
C      USE DO LOOP TO CHECK WHETHER HIGHER COST PORTFOLIO ALWAYS
C      SAVES MORE ENERGY
C
      DO 510 IP=IJ,MN
      IF(STORE(IP,3).GE.STORE(IP+1,3))GO TO 520
510 CONTINUE
      RETURN
C
C      WHEN IT COSTS MORE AND SAVES LESS, THEN
C      MOVE THE POINTER UP ONE TO ELIMINATE THAT PORTFOLIO
C
520 CONTINUE
      NUM=NUM-1
      IJ=IP+1
      IF(IJ.GE.NUM)RETURN
C
C      MOVE MATRIX STORE AND COMBINATION OF FUNDED PROJECTS
C      UP ONE SPACE
C
530 DO 540 I=IJ,NUM
      STORE(I,1)=STORE(I+1,1)
      STORE(I,2)=STORE(I+1,2)
      STORE(I,3)=STORE(I+1,3)
      DO 540 J=1,NT
      NPURT(I,J)=NPURT(I+1,J)
540 CONTINUE
      GO TO 500
      END
C
*****
C
C      THIS SUBROUTINE PLOTS INPUT POINTS USING THE
C      ORDER OF THE POINTS AS THE KEY TO THE PLOT SYMBOL
C
C
      SUBROUTINE SYMPLT(XNUM,NUM,YLAB,XLAB)
      DIMENSION XNUM(200,2),YAX(11),XAX(11)

```

AN002760

AN002770

AN002780

AN002790

AN002800

AN002810

AN002820

AN002830

AN002840

AN002850

AN002860

AN002870

AN002880

AN002890

AN002900

AN002910

AN002920

AN002930

AN002940

AN002950

AN002960

AN002970

AN002980

AN002990

AN003000

AN003010

AN003020

AN003030

AN003040

AN003050

AN003060

AN003070

AN003080

AN003090

AN003100

AN003110

AN003120

AN003130

AN003140

AN003150

AN003160

AN003170

AN003180

AN003190

AN003200

AN003210

AN003220

AN003230

AN003240

AN003250

AN003260

AN003270

AN003280

AN003290

AN003300

```

      REAL*4 IPLOT(101,51),ISYM(10),DASH,BAR,STAR,BLANK
      REAL*4 YLAB(51),XLAB(51)
      DATA ISYM/1,2,3,4,5,6,7,8,9,10/
      DATA DASH,BAR,STAR,BLANK/' ',' ',' ',' ',' ',' ',' ',' ',' '
C
C   DETERMINE NUMERICAL VALUES FOR AXES
C
      CALL AXES(XNUM,NUM,YAX,XAX)
      XLLOW=YAX(1)
      YHIGH=YAX(11)
      XDEL=(XAX(11)-XLLOW)/100
      YDEL=(YHIGH-YAX(1))/50
C
C   FILL THE CENTER OF THE PLOT REGION WITH BLANKS
C
      DO 500 I=1,51
      DO 500 J=1,101
      IPLOT(J,I)=BLANK
      500 CONTINUE
C
C   FILL BORDERS OF THE PLOT REGION WITH DASHES
C
      DO 100 I=1,101
      IPLOT(I,1)=DASH
      IPLOT(I,51)=DASH
      100 CONTINUE
C
C   PLACE VERTICAL BARS EVERY TEN SPACES
C
      DO 200 I=1,101,10
      DO 200 J=1,51
      IPLOT(J,I)=BAR
      200 CONTINUE
      DO 300 I=2,49
      IPLOT(1,I)=BAR
      IPLOT(101,I)=BAR
      300 CONTINUE
C
C   PLACE HORIZONTAL DASHES EVERY FIVE SPACES
C
      DO 400 I=6,46,5
      DO 400 J=1,101
      IPLOT(J,I)=DASH
      400 CONTINUE
C
C   FILL THE CORNERS OF THE PLOT MATRIX WITH STARS
C
      IPLOT(1,1)=STAR
      IPLOT(101,1)=STAR
      IPLOT(1,51)=STAR
      IPLOT(101,51)=STAR
C
C   CALCULATE LOCATIONS OF EACH CURVE POINT
C
      DO 700 I=1,NUM

```

AN00331
 AN00332
 AN00333
 AN00334
 AN00335
 AN00336
 AN00337
 AN00338
 AN00339
 AN00340
 AN00341
 AN00342
 AN00343
 AN00344
 AN00345
 AN00346
 AN00347
 AN00348
 AN00349
 AN00350
 AN00351
 AN00352
 AN00353
 AN00354
 AN00355
 AN00356
 AN00357
 AN00358
 AN00359
 AN00360
 AN00361
 AN00362
 AN00363
 AN00364
 AN00365
 AN00366
 AN00367
 AN00368
 AN00369
 AN00370
 AN00371
 AN00372
 AN00373
 AN00374
 AN00375
 AN00376
 AN00377
 AN00378
 AN00379
 AN00380
 AN00381
 AN00382
 AN00383
 AN00384
 AN00385

FILE: ANON

FORTRAN A

CALL DATA MONITOR SYS

```

      IX=(XNUM(I,1)-XLOW)/XDEL+1.
      IY=(YHIGH-XNUM(I,2))/YDEL+1.
C     DETERMINE WHICH SYMBOLS TO INSERT
C     ITEN=L/10.
      IONE=I-10*ITEN
C     IF POINT NUMBER IS LESS THAN 10, SYMBOL IS ONE POINT
C     SKIP TO STATEMENT 600. OTHERWISE, DETERMINE FIRST OF TWO
C     SYMBOLS.
C     IF(I.LT.10)GO TO 600
      IF(IONE.EQ.0) IONE=10
      IPLOT(IX,IY)=ISYM(ITEN)
      IY=IY+1
      600 IPLOT(IX,IY)=ISYM(IONE)
      700 CONTINUE
      J=0
      N=12
C     OUTPUT
C     DO 900 I=1,10
      N=N+1
      J=J+1
      WRITE(6,1)YLAB(J),YAX(N),(IPLOT(K,J),K=1,101)
      800 300 M=1,4
      J=J+1
      WRITE(6,2)YLAB(J),(IPLOT(K,J),K=1,101)
      800 CONTINUE
      900 CONTINUE
      WRITE(6,1)YLAB(J),YAX(1),(IPLOT(K,51),K=1,101)
      WRITE(6,4)
      WRITE(6,4)
      WRITE(6,3)XAX(1),XAX(3),XAX(5),XAX(7),XAX(9),XAX(11)
      WRITE(6,5)(XLAB(K1),K1=1,51)
C     FORMATS
C     1 FORMAT(1X,A1,2X,E10.3,10A1)
      2 FORMAT(1X,A1,14X,10A1)
      3 FORMAT(14X,E10.3,4(7X,E10.3,3X),7X,E10.3,/)
      4 FORMAT(16X,10(' ',9X),' ')
      5 FORMAT(17,35X,50A1,///)
      RETURN
      END
C     *****
C     THIS SUBROUTINE AXES DETERMINES LABLES FOR THE X AND Y AXES
C     SUBROUTINE AXES(X,N,YAX,XAX)
      DIMENSION X(200,2),XAX(11),YAX(11)
C     INITIALIZE X(1,1) AS HIGHEST X VALUE

```

```

C      INITIALIZE X(1,2) AS HIGHEST Y VALUE
C
C      XHIGH=X(1,1)
C      YHIGH=X(1,2)
C
C      USE DO LOOP TO FIND THE HIGHEST RESEARCH COST AND
C      ENERGY SAVING
C
C      DO 100 I=1,N
C      IF(X(1,I).GT.XHIGH)XHIGH=X(1,I)
C      IF(X(1,I).GT.YHIGH)YHIGH=X(1,I)
100 CONTINUE
C      JXH=XHIGH
C      JYH=YHIGH
C
C      DETERMINE ORDER OF MAGNITUDE OF HIGH NUMBER
C
C      IXH=0
C      IYH=0
200 CONTINUE
C      IXH=IXH+1
C      JXH=JXH/10
C      IF(JXH.NE.0)GO TO 200
300 CONTINUE
C      IYH=IYH+1
C      JYH=JYH/10
C      IF(JYH.NE.0)GO TO 300
C
C      DETERMINE UPPER LIMIT OF GRAPH
C
C      XTEST=10.**IXH
C      YTEST=10.**IYH
C      DO 350 I=1,2
C      IF(XHIGH.LT.XTEST)XTEST=XTEST*.5
C      IF(YHIGH.LT.YTEST)YTEST=YTEST*.5
350 CONTINUE
C      IF(XHIGH.GT.XTEST)XTEST=2.*XTEST
C      IF(YHIGH.GT.YTEST)YTEST=2.*YTEST
C      XTEST=XTEST/10
C      YTEST=YTEST/10
C
C      USE DO LOOP TO LOAD ELEVEN X AND Y VALUES INTO
C      MATRIX XAX AND YAX
C
C      DO 400 I=1,11
C      J=I-1
C      XAX(I)=ELUAT(I,J)*XTEST
C      YAX(I)=FLUAT(I,J)*YTEST
400 CONTINUE
C      RETURN
C      END

```

AN00441
 AN00442
 AN00443
 AN00444
 AN00445
 AN00446
 AN00447
 AN00448
 AN00449
 AN00450
 AN00451
 AN00452
 AN00453
 AN00454
 AN00455
 AN00456
 AN00457
 AN00458
 AN00459
 AN00460
 AN00461
 AN00462
 AN00463
 AN00464
 AN00465
 AN00466
 AN00467
 AN00468
 AN00469
 AN00470
 AN00471
 AN00472
 AN00473
 AN00474
 AN00475
 AN00476
 AN00477
 AN00478
 AN00479
 AN00480
 AN00481
 AN00482
 AN00483
 AN00484
 AN00485
 AN00486
 AN00487
 AN00488
 AN00489
 AN00490
 AN00491

	READPU	
	DIMENSION DATA(17)	READ001
	REAL*4 AMG,AMG1	READ001
40	WRITE(6,1)	READ003
1	FORMAT(1X,' ENTER MARKET GROUP ')	READ004
	REWIND 2	READ005
	READ(5,30)AMG	READ006
30	FORMAT(A4)	READ007
	WRITE(6,40)	READ008
40	FORMAT(' ENTER PROJECT NUMBER')	READ009
	READ(5,*)IPROJ	READ010
10	CONTINUE	READ011
	READ(3,6,END=99) AMG1,KPROJ	READ012
6	FORMAT(A4,I4)	READ013
	IF(AMG1.EQ.AMG.AND.IPROJ.EQ.KPROJ)GO TO 90	READ014
	GO TO 10	READ015
99	WRITE(6,20)	READ016
10	FORMAT(' NOT FOUND')	READ017
	GO TO 40	READ018
90	BACKSPACE 2	READ019
	READ(2,7)AMG1,IPROJ,IRISK,LIFE1,LIFE2,(DATA(KK),KK=1,17)	READ020
7	FORMAT(A4,4I4,17E10.4)	READ021
	WRITE(6,80)AMG1,IPROJ,IRISK,LIFE1,LIFE2	READ022
80	FORMAT(//,' MARKET GROUP ',A4,4(2X,I4))	READ023
	J1=1	READ024
	J2=4	READ025
	DO 3 I=1,4	READ026
	WRITE(6,4)(DATA(J),J=J1,J2)	READ027
4	FORMAT(1X,4E10.4)	READ028
	J1=J1+4	READ029
	J2=J2+4	READ030
8	CONTINUE	READ031
	WRITE(5,14)DATA(17)	READ032
14	FORMAT(1X,E10.4)	READ033
	STOP	READ034
	END	READ035

	WRITE(6,170)	
170	FORMAT(' ' CONTINUE ? 1=DIFF MG 2= SAME MG',	ERR0004
	17-17-15=SAME PROJECT ? 4=STOP')	ERR0007
	READ(5,*)II	ERR0001
	IF(II.EQ.1)GO TO 5	ERR0005
	IF(II.EQ.2)GO TO 110	ERR0005
	IF(II.EQ.4)GO TO 160	ERR0005
	GO TO 50	ERR0005
160	IF(XK.NE.1)GO TO 180	ERR0005
	REWIND 4	ERR0001
	K=0	ERR0005
200	CONTINUE	ERR0005
	READ(4,40,END=210)AMG1	ERR0006
	K=K+1	ERR0004
	GO TO 200	ERR0006
210	REWIND 4	ERR0001
	GO 220 I =1,K	ERR0006
	READ(2'I,40)AMG,IPROJ	ERR0006
	WRITE(4,40)AMG,IPROJ	ERR0006
220	CONTINUE	ERR0006
180	STOP	ERR0006
	END	ERR0006
		ERR0070

ERRDRPV

	DIMENSION DATA(17)	ERR0001
	REAL*4 AMG,AMG1	ERR0001
	DEFINE FILE 2(300,194,E,IDUM)	ERR0001
	KK=0	ERR0001
5	CONTINUE	ERR0001
	WRITE(6,10)	ERR0001
10	FORMAT(/,/, ' ENTER MARKET GROUP')	ERR0001
	READ(5,20)AMG	ERR0001
20	FORMAT(A4)	ERR0001
110	REWIND 4	ERR0001
	K=0	ERR0001
	WRITE(6,80)	ERR0001
50	FORMAT(/,1X, 'ENTER PROJECT NUMBER')	ERR0001
	READ(5,*) IPROJ	ERR0001
50	CONTINUE	ERR0001
	K=K+1	ERR0001
	READ(4,40,END=60)AMG1,IPROJ1	ERR0001
40	FORMAT(A4,I4)	ERR0001
	IF(AMG1.EQ.AMG.AND.IPROJ1.EQ.IPROJ)GO TO 50	ERR0001
	GO TO 30	ERR0001
60	WRITE(6,90)	ERR0001
90	FORMAT(/, ' PROJECT NOT FOUND')	ERR0001
	GO TO 5	ERR0001
50	WRITE(6,2)	ERR0001
2	FORMAT(1X, 'ENTER ITEM NUMBER(1-22)')	ERR0001
	READ(5,*)ITEM	ERR0001
	IF(ITEM.EQ.1.OR.ITEM.EQ.2)KK=1	ERR0001
130	READ(2,K,100)AMG1,IPROJ1,IRISK,LIFE1,LIFE2,(DATA(L),L=1,17)	ERR0001
100	FORMAT(A4,4I4,17E10.4)	ERR0001
	IF(ITEM.EQ.1)WRITE(6,150)AMG1	ERR0001
	IF(ITEM.EQ.2)WRITE(6,122)IPROJ1	ERR0001
	IF(ITEM.EQ.3)WRITE(6,122)IRISK	ERR0001
	IF(ITEM.EQ.4)WRITE(6,122)LIFE1	ERR0001
	IF(ITEM.EQ.5)WRITE(6,122)LIFE2	ERR0001
	NITEM=ITEM-5	ERR0001
	IF(ITEM.GT.5)WRITE(6,120)DATA(NITEM)	ERR0001
150	FORMAT(/, ' OLD = ',A4)	ERR0001
110	FORMAT(/, ' OLD = ',E10.4)	ERR0001
122	FORMAT(/, ' OLD = ',I4)	ERR0001
	WRITE(6,3)	ERR0001
3	FORMAT(/, ' ENTER CORRECT DATA')	ERR0001
	IF(ITEM.EQ.1)READ(5,20)AMG1	ERR0001
	IF(ITEM.EQ.2)READ(5,*)IPROJ1	ERR0001
	IF(ITEM.EQ.3)READ(5,*)IRISK	ERR0001
	IF(ITEM.EQ.4)READ(5,*)LIFE1	ERR0001
	IF(ITEM.EQ.5)READ(5,*)LIFE2	ERR0001
	IF(ITEM.GT.5)READ(5,*)DATA(NITEM)	ERR0001
	WRITE(2,K,100)AMG1,IPROJ1,IRISK,LIFE1,LIFE2,(DATA(L),L=1,17)	ERR0001

```

WRITEPV
      DIMENSION CE(2,5),RNFOM(2)
      REAL*4 AMG
1      WRITE(6,5)
3      FORMAT(/,' ENTER MARKET GROUP')
      READ(5,9)AMG
9      FORMAT(A4)
8      WRITE(6,10)
10     FORMAT(/,' ENTER PROJECT NUMBER AND RISK DATA'
2,/, ' 1=VERY LOW RISK  2=LOW RISK  3=MEDIUM RISK  4=HIGH RISK')
      READ(5,*)IPROJ,IRISK
      WRITE(6,15)
15     FORMAT(/,' ENTER USEFUL LIFE TIMES OF CONV. SYS. AND SUBST. SYS.')
      READ(5,*)LIFE1,LIFE2
      WRITE(6,20)
20     FORMAT(' ENTER 5 ENERGY USE AND NON FUEL OPER & MAINT.',/,
3, ' OF CONVENTIONAL SYSTEM')
      READ(5,*)(CE(1,I),I=1,5),RNFOM(1)
      WRITE(6,30)
30     FORMAT(' ENTER 5 ENERGY USE AND NON FUEL OPER & MAINT.',/,
2, ' OF SUBSTITUTE SYSTEM')
      READ(5,*)(CE(2,I),I=1,5),RNFOM(2)
      WRITE(6,40)
40     FORMAT(' ENTER CAPITAL COST,CC(1) AND CC(2)')
      READ(5,*)CC1,CC2
      WRITE(6,50)
50     FORMAT(' ENTER NUMBER OF UNITS IN USE FOR 1985,1990,2000')
      READ(5,*)CMKT1,CMKT2,CMKT3
      WRITE(1,60)AMG,IPROJ,IRISK,LIFE1,LIFE2,(CE(1,J),J=1,5),
6(CE(2,J),J=1,5),CC1,CC2,(RNFOM(J),J=1,2),CMKT1,CMKT2,CMKT3
10     FORMAT(A4,4I4,17E10.4)
      WRITE(2,80)AMG,IPROJ
80     FORMAT(A4,I4)
      WRITE(6,70)
70     FORMAT(' 1=SAME MARKET GROUP  2=DIFF. MARKET GROUP  3=STOP')
      READ(5,*)K
      IF(K.EQ.1)GO TO 8
      IF(K.EQ.2)GO TO 1
      STOP
      END

```

WRI0001
 WRI0002
 WRI0003
 WRI0004
 WRI0005
 WRI0006
 WRI0007
 WRI0008
 WRI0009
 WRI0010
 WRI0011
 WRI0012
 WRI0013
 WRI0014
 WRI0015
 WRI0016
 WRI0017
 WRI0018
 WRI0019
 WRI0020
 WRI0021
 WRI0022
 WRI0023
 WRI0024
 WRI0025
 WRI0026
 WRI0027
 WRI0028
 WRI0029
 WRI0030
 WRI0031
 WRI0032
 WRI0033
 WRI0034
 WRI0035
 WRI0036
 WRI0037
 WRI0038
 WRI0039

A.9 FILE SPECIFICATIONS

This section contains file information, including record descriptions, for all data files accessed by the RAM system:

- 'PV' - stores data with which ACOMP1 is run
- 'BIGFILEB' - contains Threshold system data for each project
- 'RISK' - specifies risk level for each project
- 'PRICES' - stores current energy price projections
(1976-2000)
- 'MG' - contains numbers and descriptions of all
market groups

File Information:

1) File Name = PV DATA A1
 File ID = 16
 Type = Disk
 Record Length = 194 bytes
 Blocking Factor = 1
 Data Prepared = March 3, 1979
 Record Information =

<u>Item #</u>	<u>Position</u>	<u>Name</u>	<u>Size</u>	<u>Character Format</u>	<u>Description</u>
1	1-4	AMG1	4	A 4	Market Group
2	5-8	KPROJ	4	I 4	Project Number
3	9-12	IRISK	4	I 4	Risk Level
4	13-16	LIFE1	4	I 4	Useful Lifetime (Conv.)
5	17-20	LIFE2	4	I 4	Useful Lifetime (Subst.)
6	21-30	CE(1,1)	10	E10.4	Energy Use (gas)(Conv.)
7	31-40	CE(1,2)	10	E10.4	Energy Use (oil)(Conv.)
8	41-50	CE(1,3)	10	E10.4	Energy Use (coal)(Conv.)
9	51-60	CE(1,4)	10	E10.4	Energy Use (elec)(Conv.)
10	61-70	CE(1,5)	10	E10.4	Energy Use (other)(Conv.)
11	71-80	CE(2,1)	10	E10.4	Energy Use (gas)(Subst.)
12	81-90	CE(2,2)	10	E10.4	Energy Use (oil)(Subst.)
13	91-100	CE(2,3)	10	E10.4	Energy Use (coal)(Subst.)
14	101-110	CE(2,4)	10	E10.4	Energy Use (elec)(Subst.)
15	111-120	CE(2,5)	10	E10.4	Energy Use (other)(Subst.)
16	121-130	CC(1)	10	E10.4	Capital Cost (Conv.)
17	131-140	CC(2)	10	E10.4	Capital Cost (Subst.)
18	141-150	RNFOM(1)	10	E10.4	Non Fuel Oper. & Maint. (Conv.)
19	151-160	RNFOM(2)	10	E10.4	Non Fuel Oper. & Maint. (Subst.)

20	161-170	CMKT(10)	10	E10.4	Units in Use (1985)
21	171-180	CMKT(15)	10	E10.4	Units in Use (1990)
22	181-190	CMKT(17)	10	E10.4	Units in Use (2000)

File Information:

2) File Name = BIGFILEB DATA A1

File ID = 10

Type = Disk

Record Length - 830 bytes

Blocking Factor = 1

Date prepared = March 3, 1979

Record Information =

<u>Item No.</u>	<u>Variable</u>	<u>Entry</u>
1	RIB	New=1/Substitute=2 Technology
2	RIS	Sector: 1=Residential 2=Commercial 3=Industrial 4=Residential/Commercial
3	AC	Number of years accelerated
4	CC(1)	Capital cost of conventional system unit
5	CMA(1)	Manufacturing cost of conventional system
6	YST(1)	Number of years to install conventional system
7	CE(1,1)	Energy use (savings), Btu/year, conv. system, gas
8	CE(1,2)	Energy use (savings), Btu/year, conv. system, oil
9	CE(1,3)	Energy use (savings), Btu/year, conv. system, coal
10	CE(1,4)	Energy use (savings), Btu/year, conv. system, elect.
11	CE(1,5)	Energy use (savings), Btu/year, conv. system, other
12	RNFOM(1)	Non-fuel oper. & maint. cost/savings (\$/yr), conv. system
13	RPROJ	Original project number
14	YRL(1)	Years of useful life of conventional system
15	SCP(1)	Scrapage value fraction of conventional system
16	CC(2)	Capital cost of new system unit
17	CMA(2)	Manufacturing cost of new system unit
18	YST(2)	Years to install new system

<u>Item No.</u>	<u>Variable</u>	<u>Entry</u>
19	CE(2,1)	Energy use (savings), Btu/year), new system, gas
20	CE(2,2)	Energy use (savings), Btu/year), new system, oil
21	CE(2,3)	Energy use (savings), Btu/year), new system, coal
22	CE(2,4)	Energy use (savings), Btu/year), new system, elect.
23	CE(2,5)	Energy use (savings), Btu/year), new system, other
24	RNFOM(2)	Non-fuel oper. & maint. cost/savings (\$/yr), new
25	YRL(2)	Years of useful life of new system
26	SCP(2)	Scrappage value fraction for new system
27	RIP	Basis of analysis 1=units in use, 2=No. sold
28	EYR	Market entry year
29	CM	Date (Month)
30	CD	Date (Day)
31	CY	Date (Year)
32	RIFYR	First year of Federal investment
33	CFED(1)	Federal investment ($\$10^6$) in 1st year
34	CFED(2)	Federal investment ($\$10^6$) in 2nd year
35	CFED(3)	Federal investment ($\$10^6$) in 3rd year
36	CFED(4)	Federal investment ($\$10^6$) in 4th year
37	CFED(5)	Federal investment ($\$10^6$) in 5th year
38	CFED(6)	Federal investment ($\$10^6$) in 6th year
39	CFED(7)	Federal investment ($\$10^6$) in 7th year
40	CFED(8)	Federal investment ($\$10^6$) in 8th year
41	CFED(9)	Federal investment ($\$10^6$) in 9th year
42	CFED(10)	Federal investment ($\$10^6$) in 10th year
43	RIPYR	First year of private investment
44	PRIV(1)	Private investment in 1st year
45	PRIV(2)	Private investment in 2nd year
46	PRIV(3)	Private investment in 3rd year
47	PRIV(4)	Private investment in 4th year
48	PRIV(5)	Private investment in 5th year
49	PRIV(6)	Private investment in 6th year

<u>Item No.</u>	<u>Variable</u>	<u>Entry</u>
50	PRIV(7)	Private investment in 7th year
51	PRIV(8)	Private investment in 8th year
52	PRIV(9)	Private investment in 9th year
53	PRIV(10)	Private investment in 10th year
54	CMKT(1)	No. of units in 1976
55	CMKT(2)	No. of units in 1977
56	CMKT(3)	No. of units in 1978
57	CMKT(4)	No. of units in 1979
58	CMKT(5)	No. of units in 1980
59	CMKT(6)	No. of units in 1981
60	CMKT(7)	No. of units in 1982
61	CMKT(8)	No. of units in 1983
62	CMKT(9)	No. of units in 1984
63	CMKT(10)	No. of units in 1985
64	CMKT(11)	No. of units in 1986
65	CMKT(12)	No. of units in 1987
66	CMKT(13)	No. of units in 1988
67	CMKT(14)	No. of units in 1989
68	CMKT(15)	No. of units in 1990
69	CMKT(16)	No. of units in 1995
70	CMKT(17)	No. of units in 2000
71	TMKT(1)	Total market in 1980
72	TMKT(2)	Total market in 1985
73	TMKT(3)	Total market in 1990
74	TMKT(4)	Total market in 1995
75	TMKT(5)	Total market in 2000

File Information

3) File Name = RISK DATA A1

File ID = 13

Type = Disk

Record Length = 4

Blocking Factor = 1

Date Prepared = March 3, 1979

Record Information =

<u>Item #</u>	<u>Position</u>	<u>Name</u>	<u>Size</u>	<u>Character Format</u>	<u>Description</u>
1	1-1	IRISK	1	I 1	Risk Level (1=Very Low, 2=Low, 3=Medium, 4=High)

File Information

4) File Name = PRICES DATA A1
 File ID = 7
 Type = Disk
 Record Length = 504
 Blocking Factor = 1
 Date Prepared = January 1, 1979
 Record Information =

<u>Item #</u>	<u>Position</u>	<u>Name</u>	<u>Size</u>	<u>Character Format</u>	<u>Description</u>
1	1-5	EMP(1,1)	5	F5.2	Gas price, 1976
2	6-10	EMP(2,1)	5	F5.2	Gas price, 1977
3	11-15	EMP(3,1)	5	F5.2	Gas price, 1978
4	16-20	EMP(4,1)	5	F5.2	Gas price, 1979
5	21-25	EMP(5,1)	5	F5.2	Gas price, 1980
6	26-30	EMP(6,1)	5	F5.2	Gas price, 1981
7	31-35	EMP(7,1)	5	F5.2	Gas price, 1982
8	36-40	EMP(8,1)	5	F5.2	Gas price, 1983
9	41-45	EMP(9,1)	5	F5.2	Gas price, 1984
10	46-50	EMP(10,1)	5	F5.2	Gas price, 1985
11	51-55	EMP(11,1)	5	F5.2	Gas price, 1986
12	56-60	EMP(12,1)	5	F5.2	Gas price, 1987
13	61-65	EMP(13,1)	5	F5.2	Gas price, 1988
14	66-70	EMP(14,1)	5	F5.2	Gas price, 1989
15	71-75	EMP(15,1)	5	F5.2	Gas price, 1990
16	76-80	EMP(16,1)	5	F5.2	Gas price, 1991
17	81-85	EMP(17,1)	5	F5.2	Gas price, 1992
18	86-90	EMP(18,1)	5	F5.2	Gas price, 1993
19	91-95	EMP(19,1)	5	F5.2	Gas price, 1994
20	96-100	EMP(20,1)	5	F5.2	Gas price, 1995
21	101-105	EMP(21,1)	5	F5.2	Gas price, 1996

22	106-110	EMP(22,1)	5	F5.2	Gas price, 1997
23	111-115	EMP(23,1)	5	F5.2	Gas price, 1998
24	116-120	EMP(24,1)	5	F5.2	Gas price, 1999
25	121-125	EMP(25,1)	5	F5.2	Gas price, 2000
26	126-130	EMP(1,2)	5	F5.2	Oil price, 1976
27	131-135	EMP(2,2)	5	F5.2	Oil price, 1977
28	136-140	EMP(3,2)	5	F5.2	Oil price, 1978
29	141-145	EMP(4,2)	5	F5.2	Oil price, 1979
30	146-150	EMP(5,2)	5	F5.2	Oil price, 1980
31	151-155	EMP(6,2)	5	F5.2	Oil price, 1981
32	156-160	EMP(7,2)	5	F5.2	Oil price, 1982
33	161-165	EMP(8,2)	5	F5.2	Oil price, 1983
34	166-170	EMP(9,2)	5	F5.2	Oil price, 1984
35	171-175	EMP(10,2)	5	F5.2	Oil price, 1985
36	176-180	EMP(11,2)	5	F5.2	Oil price, 1986
37	181-185	EMP(12,2)	5	F5.2	Oil price, 1987
38	186-190	EMP(13,2)	5	F5.2	Oil price, 1988
39	191-195	EMP(14,2)	5	F5.2	Oil price, 1989
40	196-200	EMP(15,2)	5	F5.2	Oil price, 1990
41	201-205	EMP(16,2)	5	F5.2	Oil price, 1991
42	206-210	EMP(17,2)	5	F5.2	Oil price, 1992
43	211-215	EMP(18,2)	5	F5.2	Oil price, 1993
44	216-220	EMP(19,2)	5	F5.2	Oil price, 1994
45	221-225	EMP(20,2)	5	F5.2	Oil price, 1995
46	226-230	EMP(21,2)	5	F5.2	Oil price, 1996
47	231-235	EMP(22,2)	5	F5.2	Oil price, 1997
48	236-240	EMP(23,2)	5	F5.2	Oil price, 1998
49	241-245	EMP(24,2)	5	F5.2	Oil price, 1999
50	246-250	EMP(25,2)	5	F5.2	Oil price, 2000
51	251-255	EMP(1,3)	5	F5.2	Coal price, 1976
52	256-260	EMP(2,3)	5	F5.2	Coal price, 1977
53	261-265	EMP(3,3)	5	F5.2	Coal price, 1978

54	266-270	EMP (4,3)	5	F5.2	Coal price, 1979
55	271-275	EMP (5,3)	5	F5.2	Coal price, 1980
56	276-280	EMP (6,3)	5	F5.2	Coal price, 1981
57	281-285	EMP (7,3)	5	F5.2	Coal price, 1982
58	286-290	EMP (8,3)	5	F5.2	Coal price, 1983
59	291-295	EMP (9,3)	5	F5.2	Coal price, 1984
60	296-300	EMP (10,3)	5	F5.2	Coal price, 1985
61	301-305	EMP (11,3)	5	F5.2	Coal price, 1986
62	306-310	EMP (12,3)	5	F5.2	Coal price, 1987
63	311-315	EMP (13,3)	5	F5.2	Coal price, 1988
64	316-320	EMP (14,3)	5	F5.2	Coal price, 1989
65	321-325	EMP (15,3)	5	F5.2	Coal price, 1990
66	326-330	EMP (16,3)	5	F5.2	Coal price, 1991
67	331-335	EMP (17,3)	5	F5.2	Coal price, 1992
68	336-340	EMP (18,3)	5	F5.2	Coal price, 1993
69	341-345	EMP (19,3)	5	F5.2	Coal price, 1994
70	346-350	EMP (20,3)	5	F5.2	Coal price, 1995
71	351-355	EMP (21,3)	5	F5.2	Coal price, 1996
72	356-360	EMP (22,3)	5	F5.2	Coal price, 1997
73	361-365	EMP (23,3)	5	F5.2	Coal price, 1998
74	366-370	EMP (24,3)	5	F5.2	Coal price, 1999
75	371-375	EMP (25,3)	5	F5.2	Coal price, 2000
76	376-380	EMP (1,4)	5	F5.2	Elec. price, 1976
77	381-385	EMP (2,4)	5	F5.2	Elec. price, 1977
78	386-390	EMP (3,4)	5	F5.2	Elec. price, 1978
79	391-395	EMP (4,4)	5	F5.2	Elec. price, 1979
80	396-400	EMP (5,4)	5	F5.2	Elec. price, 1980
81	401-405	EMP (6,4)	5	F5.2	Elec. price, 1981
82	406-410	EMP (7,4)	5	F5.2	Elec. price, 1982
83	411-415	EMP (8,4)	5	F5.2	Elec. price, 1983
84	416-420	EMP (9,4)	5	F5.2	Elec. price, 1984
85	421-425	EMP (10,4)	5	F5.2	Elec. price, 1985

86	426-430	EMP(11,4)	5	F5.2	Elec. price, 1986
87	431-435	EMP(12,4)	5	F5.2	Elec. price, 1987
88	436-440	EMP(13,4)	5	F5.2	Elec. price, 1988
89	441-445	EMP(14,4)	5	F5.2	Elec. price, 1989
90	446-450	EMP(15,4)	5	F5.2	Elec. price, 1990
91	451-455	EMP(16,4)	5	F5.2	Elec. price, 1991
92	456-460	EMP(17,4)	5	F5.2	Elec. price, 1992
93	461-465	EMP(18,4)	5	F5.2	Elec. price, 1993
94	466-470	EMP(19,4)	5	F5.2	Elec. price, 1994
95	471-475	EMP(20,4)	5	F5.2	Elec. price, 1995
96	476-480	EMP(21,4)	5	F5.2	Elec. price, 1996
97	481-485	EMP(22,4)	5	F5.2	Elec. price, 1997
98	486-490	EMP(23,4)	5	F5.2	Elec. price, 1998
99	491-495	EMP(24,4)	5	F5.2	Elec. price, 1999
100	496-500	EMP(25,4)	5	F5.2	Elec. price, 2000

File Information

5) File Name = MG DATA A1
File ID = 4
Type = Disk
Record Length = 80
Blocking Factor = 1
Date Prepared =
Record Information =

<u>Item #</u>	<u>Position</u>	<u>Name</u>	<u>Size</u>	<u>Character Format</u>	<u>Description</u>
1	1-4	AMG1	4	A 4	Market Group Number
2	5-64	LABEL ((I),I=1,15)	4	A 4	Description of Market Group

APPENDIX B - RAM OUTPUT FOR MARKET GROUPS 2-14

B.1 EXPLANATION

Although the revised RAM methodology has only been applied to projects in the Residential Space Heating market groups, other BCS projects may be run using original data and techniques. This Appendix contains output for these other projects, which have been divided into the following market groups:

<u>Market Group Number</u>	<u>Definition</u>
2	Residential Space Cooling
3	Residential Lighting
4	Residential Water Heating
5	Commercial Space Heating
6	Commercial Water Heating
7	Architecture/Engineering - Schools
8	Architecture/Engineering - Offices
9	Architecture/Engineering - Hospitals
10	Non-Competitive Consumer Products
11	Consumer Motivation (Non-Competitive)
12	Urban Waste Technology (Non-Competitive)
13	Community Systems (Non-Competitive)
14	NEA Projects (Non-Competitive)
15	Other Architecture/Engineering (Non-Competitive)

All projects have been run using the new programs, and the data stored in the Threshold data files. No new information has been collected, and market penetration projections have been made exogenously, not by BECOM.

Runs have been made for the years 1981, 1985, and 2000. Since many technologies are not expected to enter the market until after 1981, zero energy savings are estimated, and RAM produces no results.

Table B-1 contains a list of all BCS projects currently on the Threshold System, and the RAM market groups into which each has been entered. This table may be used to locate individual projects in the runs which follow.

TABLE B-1

BCS PROJECTS ON THRESHOLD SYSTEM AND RAMCONSUMER PRODUCTS BRANCH

<u>Proj. No.</u>	<u>Name</u>	<u>RAM Market Group</u>
38	Electrodeless Fluorescent Lamp - Commercial	10
45	Electrodeless Fluorescent Lamp - Residential	3
46	Innovative Window Design	10
47	Furnace/Boiler Combustion Efficiency Meter	10
48	Microprocessor Controlled Thermostat	1I,1J,1K,1L,1M,1N
49	40 KW Fuel Cell	10
50	Infrared Flyover	10
51	Zone Controls for Hydronic Systems	1I, 1J, 1K
52	Variable Low Firing Rate Oil Burner	1A, 1D, 1J
53	High Efficiency Gas Furnace	1A,1B,1C,1F,1I,1L
54	Gas Heat Pumps - Commercial	5
55	Integrated Appliances - Sp.ht./wtr.htr.	1A,1B,1C,1F,1I,1L,4
56	Oil Retrofit	1J
57	High Efficiency Electric Heat Pump	1A,1B,1E,1H,2
58	Gas Heat Pumps - Residential	1A, 1C, 2
59	High Efficiency Motor Compressor for A/C	2
60	High Frequency Solid State Ballast - Demo.	3
61	Sun Lighting Design and Controls	5
62	Demo High SPF Gas Heat Pump	5
63	Demo Stirling/Rankine Gas Heat Pump	1A, 1C, 2
64	Weather Resistant IR Mirror	5
65	Appliance Controls	10
66	Efficient Light Sources	3
67	High Efficiency Refrigerator/Freezer	10
68	High Efficiency Electric Water Heater - Brayton	4
69	High Efficiency Electric Water Heater - Rankine	4
70	Integ. Appliances - A/C/Wtr. Heater	4
71	Commercial Appliances	5, 6
72	Automated Energy Management Systems	10
73	Integ. Appliances - Comm. Range/Wtr. Heater	6
74	High Efficiency Gas Domestic Water Heater	4

NEA PROJECTS BRANCH

42	BEPS - Residential	14
43	BEPS - Commercial	14
44	Appliance Standards	14
95	Residential Retrofit Program	14
101	FEMP - Buildings	14
102	FEMP - Operations	14

TABLE B-1

COMMUNITY SYSTEMS BRANCH

<u>Proj. No.</u>	<u>Name</u>	<u>RAM Market Group</u>
1	Grid Connected ICES	13
3	District Heating and Cooling Systems	13
4	Coal Using ICES	13
5	Power Plant Retrofit to ICES	13
7	Community Service Systems	13
8	Natural Chilled Water ICES	13
9	Heat Pump Centered ICES	13
12	Site and Neighborhood Design	13

URBAN WASTE TECHNOLOGY BRANCH

75	Activated Carbon Enhancement	12
76	Enzymatic Hydrolysis	12
77	Pompano Beach - Commercial 1000 TPD Plant	12
78	ANFLOW	12
79	Small Scale Incinerator Systems	12
80	Innovative Size Reduction - Biometh	12
82	Combined MSW/Sewage Treat Plant	12
84	Urban Waste Loan Guarantee/Demo Program	12
85	Revolving Loan Program - UWT	12

CONSUMER MOTIVATION BRANCH

86	Financing 1st Mortgage Lenders	11
87	Feedback - Residential	11
88	Feedback - Commercial	11
89	Energy Cost of Ownership	11
90	Tenant Information/Incentives	11
91	Training Programs	11
92	Small Business Program	11
96	Federal Financial Assistance Program	11
97	Financial Training	11

TABLE B-1

ARCHITECTURE/ENGINEERING BRANCH

<u>Proj. No.</u>	<u>Name</u>	<u>RAM Market Group</u>
15	GSA Manchester Demo	8
18	Minimum Energy Dwelling	1A
19	Energy Use in Office Buildings - New	8
22	ACES - New Office Buildings	8
23	ACES - Implementation	15
24	Innovative Shelter Design	15
25	ACES - Single Family	1A
28	Energy Conservation in Hotels and Motels	15
103	Schoolhouse Energy Program	7
104	Automatic Variable Vent	7
105	Air-to-air Heat Exchanger	1A
106	Hospitals Program	9
107	Hospital Ventilation Standards	9

09/12/79

MARKET GROUP 2 1

YEAR 1 1985

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/4	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)			
					57	58	59	63
1	0.132E101	0.109E102	0.823E101	0.360E102	1	0	0	0
2	0.157E101	0.212E103	0.134E103	0.195E100	0	0	1	0
3	0.967E101	0.212E103	0.219E102	0.210E102	1	1	1	1
	0.121E102	0.212E103	0.176E102	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT				

DATA 1 GROUP 2

YEAR 1 1965

PORTFOLIO COST 10446

09/19/79

MARKET GROUP 02 : RESIDENTIAL SPACE COOLING

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)			
					57	58	59	63
1	0.132E+01	0.374E+03	0.283E+03	0.122E+04	1	0	0	0
2	0.157E+01	0.114E+04	0.725E+03	0.648E+01	0	0	1	0
3	0.289E+01	0.129E+04	0.447E+03	0.615E+03	1	0	1	0
4	0.309E+01	0.141E+04	0.455E+03	0.783E+03	0	1	0	0
5	0.369E+01	0.148E+04	0.401E+03	0.806E+03	0	0	0	1
6	0.441E+01	0.159E+04	0.361E+03	0.100E+04	1	1	0	0
7	0.466E+01	0.201E+04	0.432E+03	0.395E+03	0	1	1	0
8	0.598E+01	0.209E+04	0.350E+03	0.671E+03	1	1	1	0
9	0.678E+01	0.222E+04	0.327E+03	0.795E+03	0	1	0	1
10	0.810E+01	0.228E+04	0.281E+03	0.938E+03	1	1	0	1
11	0.835E+01	0.247E+04	0.296E+03	0.532E+03	0	1	1	1
12	0.967E+01	0.250E+04	0.258E+03	0.705E+03	1	1	1	1
	0.121E+02	0.269E+04	0.223E+03		<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT			

MARKET GROUP 02 : RESIDENTIAL SPACE COOLING

YEAR : 2000

09/19/79

MARKET GROUP 03 : RESIDENTIAL LIGHTING

YEAR : 1981

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					45	60	66
1	0.846E+00	0.756E+00	0.894E+00	0.460E+00	0	0	1
2	0.135E+01	0.299E+01	0.222E+01	0.529E+00	1	0	0
3	0.219E+01	0.299E+01	0.136E+01	0.495E+00	1	0	1
4	0.221E+01	0.299E+01	0.135E+01	0.412E+00	1	1	0
5	0.306E+01	0.299E+01	0.978E+00	0.428E+00	1	1	1
	0.408E+01	0.302E+01	0.741E+00				

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

PORTFOLIO COST 10**6\$

09/13/79

MARKET GROUP 03 : RESIDENTIAL LIGHTING

YEAR 1 1985

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/4	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					45	60	66
1	0.046E100	0.303E102	0.350E102	0.104E102	0	0	1
2	0.066E100	0.177E103	0.205E103	0.110E102	0	1	0
3	0.171E101	0.177E103	0.104E103	0.151E102	0	1	1
4	0.221E101	0.177E103	0.001E102	0.170E102	1	1	0
5	0.306E101	0.177E103	0.500E102	0.100E102	1	1	1
	0.400E101	0.170E103	0.437E102		--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/19/79

MARKET GROUP 03 : RESIDENTIAL LIGHTING

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					45	60	66
1	0.846E+00	0.106E+03	0.125E+03	0.644E+02	0	0	1
2	0.135E+01	0.419E+03	0.311E+03	0.832E+02	1	0	0
3	0.219E+01	0.419E+03	0.191E+03	0.738E+02	1	0	1
4	0.221E+01	0.419E+03	0.189E+03	0.623E+02	1	1	0
5	0.306E+01	0.419E+03	0.137E+03	0.630E+02	1	1	1
0.408E+01 0.423E+03 0.104E+03					<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT		

MARKET GROUP 03 : RESIDENTIAL LIGHTING

YEAR : 2000

09/19/79

MARKET GROUP 04 : RESIDENTIAL WATER HEATING

YEAR : 1981

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)				
					55	68	69	70	74
1	0.376E+00	0.337E+00	0.898E+00	0.114E+01	0	0	1	0	0
2	0.551E+00	0.133E+01	0.241E+01	0.407E+00	0	0	0	0	1
3	0.927E+00	0.146E+01	0.158E+01	0.773E+00	0	0	1	0	1
4	0.128E+01	0.180E+01	0.140E+01	0.142E+01	0	0	0	1	1
5	0.166E+01	0.190E+01	0.114E+01	0.133E+01	0	0	1	1	1
6	0.254E+01	0.194E+01	0.764E+00	0.133E+01	0	1	1	1	1
7	0.630E+01	0.197E+01	0.313E+00	0.140E+01	1	0	1	1	1
8	0.718E+01	0.201E+01	0.280E+00	0.139E+01	1	1	1	1	1
	0.861E+01	0.218E+01	0.253E+00						

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

MARKET GROUP 04 : RESIDENTIAL WATER HEATING

YEAR : 1981

02/12/79

MARKET GROUP 04 1 RESIDENTIAL WATER HEATING

YEAR 1 1985

	RES. COST (\$X10 ¹¹)	NET RESOURCE SAVING (\$X10 ¹¹)	SAVING/1	PRIVATE INVESTMENT (\$X10 ¹¹)	PORTFOLIOS (FUNDING LEVELS)				
					55	60	69	70	74
1	0.375E100	0.236E101	0.629E101	0.797E101	0	0	1	0	0
2	0.551E100	0.231E101	0.169E102	0.205E101	0	0	0	0	1
3	0.927E100	0.102E102	0.111E102	0.541E101	0	0	1	0	1
4	0.128E101	0.126E102	0.902E101	0.997E101	0	0	0	1	1
5	0.166E101	0.133E102	0.001E101	0.930E101	0	0	1	1	1
6	0.254E101	0.136E102	0.535E101	0.933E101	0	1	1	1	1
7	0.430E101	0.130E102	0.219E101	0.901E101	1	0	1	1	1
8	0.710E101	0.141E102	0.196E101	0.973E101	1	1	1	1	1
	0.861E101	0.153E102	0.177E101	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT					

MODEL GROUP 04 1 RESIDENTIAL WATER HEATING

YEAR 1 1985

PORTFOLIO COST 104444

09/19/79

MARKET GROUP 04 : RESIDENTIAL WATER HEATING

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)				
					55	68	69	70	74
1	0.376E+00	0.101E+02	0.269E+02	0.342E+02	0	0	1	0	0
2	0.551E+00	0.399E+02	0.723E+02	0.122E+02	0	0	0	0	1
3	0.927E+00	0.439E+02	0.473E+02	0.232E+02	0	0	1	0	1
4	0.128E+01	0.540E+02	0.421E+02	0.427E+02	0	0	0	1	1
5	0.166E+01	0.569E+02	0.343E+02	0.399E+02	0	0	1	1	1
6	0.254E+01	0.581E+02	0.229E+02	0.400E+02	0	1	1	1	1
7	0.630E+01	0.592E+02	0.940E+01	0.420E+02	1	0	1	1	1
8	0.718E+01	0.602E+02	0.839E+01	0.417E+02	1	1	1	1	1
	0.861E+01	0.654E+02	0.759E+01		<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

02-12-79

MARKET GROUP 05 : COMMERCIAL SPACE CONDITIONING

YEAR : 1983

	REL. COST (X10445)	NET RESOURCE SAVING (X10446)	SAVING/\$	PRIVATE INVESTMENT (X10446)	PORTFOLIOS (FINANCING LEVELS)				
					54	61	62	64	71
1	0.342E100	0.571E102	0.450E103	0.447E102	0	1	0	0	0
2	0.413E100	0.143E103	0.345E103	0.179E102	0	0	0	0	1
3	0.775E100	0.167E103	0.216E103	0.313E102	0	1	0	0	1
4	0.940E100	0.215E103	0.222E103	0.334E102	0	0	0	1	1
5	0.133E101	0.227E103	0.171E103	0.372E102	0	1	0	1	1
6	0.240E101	0.250E103	0.104E103	0.321E102	1	0	0	1	1
7	0.250E101	0.261E103	0.101E103	0.272E102	0	0	1	1	1
8	0.204E101	0.264E103	0.929E102	0.352E102	1	1	0	1	1
9	0.295E101	0.267E103	0.907E102	0.316E102	0	1	1	1	1
10	0.410E101	0.209E103	0.706E102	0.277E102	1	0	1	1	1
11	0.443E101	0.292E103	0.656E102	0.311E102	1	1	1	1	1
	0.535E101	0.309E103	0.570E102	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/19/79

MARKET GROUP 05 : COMMERCIAL SPACE CONDITIONING

YEAR : 2000

	RES. COST	NET RESOURCE	SAVING/\$	PRIVATE	PORTFOLIOS (FUNDING LEVELS)				
	(\$X10**6)	SAVING (\$X10**6)		INVESTMENT (\$X10**6)					
					54	61	62	64	71
1	0.362E+00	0.270E+03	0.746E+03	0.201E+03	0	1	0	0	0
2	0.413E+00	0.617E+03	0.149E+04	0.805E+02	0	0	0	0	1
3	0.775E+00	0.739E+03	0.953E+03	0.141E+03	0	1	0	0	1
4	0.968E+00	0.935E+03	0.966E+03	0.150E+03	0	0	0	1	1
5	0.133E+01	0.996E+03	0.749E+03	0.167E+03	0	1	0	1	1
6	0.239E+01	0.100E+04	0.419E+03	0.116E+03	0	1	1	0	1
7	0.248E+01	0.113E+04	0.455E+03	0.144E+03	1	0	0	1	1
8	0.258E+01	0.114E+04	0.441E+03	0.122E+03	0	0	1	1	1
9	0.284E+01	0.116E+04	0.408E+03	0.159E+03	1	1	0	1	1
10	0.295E+01	0.117E+04	0.397E+03	0.142E+03	0	1	1	1	1
11	0.410E+01	0.127E+04	0.309E+03	0.125E+03	1	0	1	1	1
12	0.446E+01	0.128E+04	0.287E+03	0.140E+03	1	1	1	1	1

0.535E+01 0.135E+04 0.253E+03

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/14/79

MARKET GROUP 06 : COMMERCIAL WATER HEATING

YEAR : 1985

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					71	73
1	0.773E-01	0.213E+00	0.276E+01	0.112E+01	0	1
2	0.491E+00	0.213E+00	0.435E+00	0.122E+01	1	1
	0.736E+00	0.252E+00	0.342E+00			

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

N
E
T

R
E
S
O
U
R
C
E

S
A
V
I
N
G
S

1
0
*
*
6
\$

PORTFOLIO COST 10**6\$

09/19/79

MARKET GROUP 06 : COMMERCIAL WATER HEATING

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					71	73
1	0.773E+01	0.141E+02	0.132E+03	0.738E+02	0	1
2	0.491E+00	0.141E+02	0.287E+02	0.803E+02	1	1

0.736E+00 0.166E+02 0.226E+02

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

MARKET GROUP 06 : COMMERCIAL WATER HEATING

YEAR : 2000

MARKET GROUP 07 : A/E SCHOOLS

YEAR : 1981

09/12/79

MARKET GROUP 07 : A/E SCHOOLS

YEAR 1 1985

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/%	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					103	104
1	0.332E100	0.600E102	0.109E103	0.250E101	0	1
2	0.101E101	0.940E102	0.536E102	0.500E102	1	0
3	0.213E101	0.103E103	0.402E102	0.263E102	1	1
	0.319E101	0.112E103	0.349E102	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/19/79

MARKET GROUP 07 : A/E SCHOOLS

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					103	104
1	0.322E+00	0.210E+03	0.653E+03	0.881E+01	0	1
2	0.181E+01	0.341E+03	0.189E+03	0.176E+03	1	0
3	0.213E+01	0.357E+03	0.168E+03	0.925E+02	1	1
	0.319E+01	0.386E+03	0.121E+03	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT		

MARKET GROUP 07 : A/E SCHOOLS

YEAR : 2000

09/12/79

HARVEST GROUP OR 1 A/E OFFICE BLDGS

YEAR 1 1985

RES. COST	NET RESOURCE	SAVING/6	PRIVATE
(X10**6)	SAVING		INVESTMENT
(X10**6)	(X10**6)		(X10**6)

PORTFOLIO (FUNDING LEVELS)

15 19 22

0.405E101 0.116E103 0.169E102

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/19/79

MARKET GROUP 09 : A/E HOSPITALS

YEAR : 1981

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					106	107
1	0.434E+00	0.316E+03	0.728E+03	0.610E+01	0	1
2	0.130E+01	0.671E+03	0.517E+03	0.732E+01	1	0
3	0.173E+01	0.680E+03	0.392E+03	0.671E+01	1	1
	0.260E+01	0.728E+03	0.280E+03	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT		

10**6\$
S
G
N
I
V
A
S
E
R
C
U
O
S
E
T
H

0.900E+03

0.800E+03

0.700E+03

0.600E+03

0.500E+03

0.400E+03

0.300E+03

0.200E+03

0.100E+03

0.0

0.0

0.100E+01

0.200E+01

0.300E+01

0.400E+01

0.500E+01

PORTFOLIO COST 10**6\$

09/12/79

MARKET GROUP 09 : A/E HOSPITALS

YEAR 1 1985

	RES. COST	NET RESOURCE	SAVING/	PRIVATE	PORTFOLIO (FUNDING LEVEL)	
	($\times 10^{16}$)	SAVING ($\times 10^{16}$)		INVESTMENT ($\times 10^{16}$)		
					106	107
1	0.434E100	0.357E103	0.021E103	0.673E101	0	1
2	0.130E101	0.730E103	0.569E103	0.800E101	1	0
3	0.173E101	0.749E103	0.432E103	0.740E101	1	1
	0.260E101	0.002E103	0.309E103			

<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT

09/19/79

MARKET GROUP 09 : A/E HOSPITALS

YEAR : 2000

	RES. COST (\$X10**6)	NET RESOURCE SAVING (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)	
					106	107
1	0.434E+00	0.466E+03	0.107E+04	0.899E+01	0	1
2	0.130E+01	0.988E+03	0.761E+03	0.108E+02	1	0
3	0.173E+01	0.100E+04	0.578E+03	0.989E+01	1	1
	0.260E+01	0.107E+04	0.413E+03	<--- VALUES FOR COMPLETE PORTFOLIO PLUS ADDED AVERAGE PROJECT		

MARKET GROUP 09 : A/E HOSPITALS

YEAR : 2000

07/24/77

MARKET GROUP 10 : NON-COMPETITIVE CONSUMER PRODUCTS

YEAR : 1985

	RES. COST (X10 ¹⁰ +)0)	NET FOLLOEY VALUE (X10 ¹⁰ +)0)	SAVING/4	PRIVATE INVESTMENT (X10 ¹⁰ +)0)	PORTFOLIOS (FUNDING LEVELS)							
					78	46	47	48	50	67	72	85
1	0.200E+00	0.310E+00	0.140E+01	0.789E+01	0	0	0	0	0	0	0	1
2	0.173E+00	0.274E+02	0.580E+02	0.162E+02	0	0	0	0	0	1	0	0
3	0.582E+00	0.621E+02	0.107E+03	0.104E+02	0	1	0	0	0	0	0	0
4	0.673E+00	0.684E+02	0.102E+03	0.979E+01	0	0	0	0	0	0	1	0
5	0.882E+00	0.687E+02	0.779E+02	0.906E+01	0	0	0	0	0	0	1	1
6	0.105E+01	0.894E+02	0.840E+02	0.364E+02	0	1	0	0	0	1	0	0
7	0.115E+01	0.958E+02	0.934E+02	0.260E+02	0	0	0	0	0	1	1	0
8	0.124E+01	0.131E+03	0.104E+03	0.242E+02	0	1	0	0	0	0	1	0
9	0.146E+01	0.131E+03	0.894E+02	0.242E+02	0	1	0	0	0	0	1	1
10	0.173E+01	0.138E+03	0.913E+02	0.404E+02	0	1	0	0	0	1	1	0
11	0.194E+01	0.150E+03	0.817E+02	0.404E+02	0	1	0	0	0	1	1	1
12	0.223E+01	0.158E+03	0.710E+02	0.405E+02	0	1	1	0	0	1	1	1
13	0.308E+01	0.168E+03	0.546E+02	0.410E+02	1	1	0	0	0	1	1	0
14	0.328E+01	0.149E+03	0.512E+02	0.410E+02	1	1	0	0	0	1	1	1
15	0.358E+01	0.168E+03	0.470E+02	0.411E+02	1	1	1	0	0	1	1	1
16	0.558E+01	0.200E+03	0.358E+02	0.280E+02	0	1	0	0	1	0	0	0
17	0.567E+01	0.206E+03	0.363E+02	0.234E+02	0	0	0	0	1	0	1	0
18	0.588E+01	0.206E+03	0.351E+02	0.235E+02	0	0	0	0	1	0	1	1
19	0.605E+01	0.227E+03	0.175E+02	0.442E+02	0	1	0	0	1	1	0	0
20	0.613E+01	0.234E+03	0.380E+02	0.396E+02	0	0	0	0	1	1	1	0
21	0.625E+01	0.268E+03	0.429E+02	0.378E+02	0	1	0	0	1	0	1	0
22	0.614E+01	0.249E+03	0.416E+02	0.379E+02	0	1	0	0	1	0	1	1
23	0.673E+01	0.294E+03	0.439E+02	0.540E+02	0	1	0	0	1	1	1	0
24	0.694E+01	0.294E+03	0.427E+02	0.541E+02	0	1	0	0	1	1	1	1
25	0.723E+01	0.294E+03	0.410E+02	0.512E+02	0	1	1	0	1	1	1	1
26	0.808E+01	0.306E+03	0.379E+02	0.546E+02	1	1	0	0	1	1	1	0
27	0.828E+01	0.306E+03	0.349E+02	0.547E+02	1	1	0	0	1	1	1	1
28	0.859E+01	0.306E+03	0.357E+02	0.548E+02	1	1	1	0	1	1	1	1
29	0.483E+02	0.306E+03	0.635E+01	0.551E+02	1	1	1	1	1	1	1	1
0.543E+02					0.344E+03							
0.635E+01					0.635E+01							

←--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

NET
RESOURCES
SAVINGS
LOSSES

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 10 : NON-COMPETITIVE CONSUMER PRODUCTS

YEAR = 2000

RES.	COST	NET PRESENT	SAVING/4	PRIVATE	PORTFOLIOS (FUNDING LEVELS)								
		VALUE		INVESTMENT									
(4X10**6)	(4X10**6)			(4X10**6)									
					38	46	47	49	50	67	72	65	
1	0.208E+00	0.769E+02	0.370E+03	0.196E+02	0	0	0	0	0	0	0	1	
2	0.473E+00	0.199E+03	0.421E+03	0.117E+03	0	0	0	0	0	1	0	0	
3	0.582E+00	0.102E+04	0.176E+04	0.237E+03	0	1	0	0	0	0	0	0	
4	0.790E+00	0.110E+04	0.139E+04	0.256E+03	0	1	0	0	0	0	0	1	
5	0.105E+01	0.122E+04	0.116E+04	0.354E+03	0	1	0	0	0	1	0	0	
6	0.126E+01	0.152E+04	0.121E+04	0.308E+03	0	1	0	0	0	0	1	0	
7	0.146E+01	0.160E+04	0.109E+04	0.328E+03	0	1	0	0	0	0	1	1	
8	0.173E+01	0.172E+04	0.995E+03	0.426E+03	0	1	0	0	0	1	1	0	
9	0.194E+01	0.180E+04	0.928E+03	0.445E+03	0	1	0	0	0	1	1	1	
10	0.223E+01	0.186E+04	0.905E+03	0.445E+03	0	1	1	0	0	1	1	1	
11	0.328E+01	0.184E+04	0.561E+03	0.448E+03	1	1	0	0	0	1	1	1	
12	0.358E+01	0.184E+04	0.514E+03	0.448E+03	1	1	1	0	0	1	1	1	
13	0.473E+01	0.186E+04	0.276E+03	0.439E+03	0	1	0	0	1	1	1	0	
14	0.494E+01	0.194E+04	0.279E+03	0.459E+03	0	1	0	0	1	1	1	1	
15	0.723E+01	0.194E+04	0.268E+03	0.459E+03	0	1	1	0	1	1	1	1	
16	0.828E+01	0.198E+04	0.239E+03	0.461E+03	1	1	0	0	1	1	1	1	
17	0.858E+01	0.198E+04	0.231E+03	0.461E+03	1	1	1	0	1	1	1	1	
18	0.493E+02	0.198E+04	0.410E+02	0.476E+03	1	1	1	1	1	1	1	1	
	0.543E+02	0.223E+04	0.410E+02		----- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT								

NET
RESOURCES
SAVINGS
LOANS

PORTFOLIO COST 10**64

07/24/79

MARKET GROUP 11 : CONSUMER MOTIVATION (NC)

YEAR : 1981

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)					
					B6	B7	B9	90	91	92
1	0.447E+00	0.242E+02	0.541E+02	0.200E+02	1	0	0	0	0	0
2	0.154E+01	0.328E+02	0.214E+02	0.247E+02	1	1	0	0	0	0
3	0.585E+01	0.466E+02	0.797E+01	0.249E+00	0	0	0	0	0	1
4	0.630E+01	0.709E+02	0.112E+02	0.202E+02	1	0	0	0	0	1
5	0.739E+01	0.794E+02	0.108E+02	0.249E+02	1	1	0	0	0	1
6	0.177E+02	0.868E+02	0.491E+01	0.134E+01	0	0	0	0	1	1
7	0.181E+02	0.111E+03	0.613E+01	0.213E+02	1	0	0	0	1	1
8	0.192E+02	0.120E+03	0.623E+01	0.260E+02	1	1	0	0	1	1
9	0.259E+02	0.125E+03	0.485E+01	0.330E+02	1	0	0	1	0	0
10	0.269E+02	0.134E+03	0.497E+01	0.377E+02	1	1	0	1	0	0
11	0.308E+02	0.148E+03	0.479E+01	0.213E+02	1	0	1	0	1	1
12	0.313E+02	0.148E+03	0.473E+01	0.133E+02	0	0	0	1	0	1
13	0.317E+02	0.172E+03	0.543E+01	0.332E+02	1	0	0	1	0	1
14	0.328E+02	0.181E+03	0.551E+01	0.379E+02	1	1	0	1	0	1
15	0.431E+02	0.188E+03	0.436E+01	0.144E+02	0	0	0	1	1	1
16	0.435E+02	0.212E+03	0.487E+01	0.343E+02	1	0	0	1	1	1
17	0.446E+02	0.221E+03	0.495E+01	0.390E+02	1	1	0	1	1	1
18	0.558E+02	0.225E+03	0.403E+01	0.144E+02	0	0	1	1	1	1
19	0.562E+02	0.249E+03	0.442E+01	0.343E+02	1	0	1	1	1	1
20	0.573E+02	0.257E+03	0.449E+01	0.390E+02	1	1	1	1	1	1
0.669E+02 0.300E+03 0.449E+01					<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT					

NET
RESOURCES
SAVINGS
10**6\$

PORTFOLIO COST 10**6\$

!

YEAR : 1985

PORTFOLIOS (FUNDING LEVELS)

86	87	88	89	90	91	92
1	0	0	0	0	0	0
0	1	0	0	0	0	0
1	1	0	0	0	0	0
1	1	1	0	0	0	0
1	0	0	0	0	0	1
0	1	0	0	0	0	1
1	1	0	0	0	0	1
1	1	1	0	0	0	1
0	1	0	0	0	1	1
1	1	0	0	0	1	1
1	1	1	0	0	1	1
1	1	0	1	0	1	1
1	1	0	0	1	0	1
1	1	1	0	1	1	1
1	1	1	0	1	1	1
1	1	1	0	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

NET
RESOURCES
SAVINGS
10**6\$

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 11 : CONSUMER MOTIVATION (NC)

YEAR : 2000

RES. COST	NET PRESENT VALUE	SAVING/\$	PRIVATE INVESTMENT	PORTFOLIOS (FUNDING LEVELS)						
(\$X10**6)	(\$X10**6)		(\$X10**6)	B6	B7	B8	B9	90	91	92
1	0.447E+00	0.126E+04	0.281E+04	0.104E+04	1	0	0	0	0	0
2	0.109E+01	0.137E+04	0.126E+04	0.164E+02	0	0	1	0	0	0
3	0.154E+01	0.263E+04	0.171E+04	0.105E+04	1	0	1	0	0	0
4	0.262E+01	0.320E+04	0.122E+04	0.137E+04	1	1	1	0	0	0
5	0.630E+01	0.342E+04	0.544E+03	0.130E+04	1	0	0	0	0	1
6	0.694E+01	0.353E+04	0.509E+03	0.278E+03	0	0	1	0	0	1
7	0.739E+01	0.479E+04	0.649E+03	0.132E+04	1	0	1	0	0	1
8	0.848E+01	0.536E+04	0.633E+03	0.163E+04	1	1	1	0	0	1
9	0.192E+02	0.553E+04	0.288E+03	0.132E+04	1	0	1	0	1	1
10	0.201E+02	0.647E+04	0.322E+03	0.191E+04	1	0	1	1	0	1
11	0.212E+02	0.704E+04	0.332E+03	0.222E+04	1	1	1	1	0	1
12	0.319E+02	0.720E+04	0.226E+03	0.192E+04	1	0	1	1	1	1
13	0.330E+02	0.778E+04	0.236E+03	0.223E+04	1	1	1	1	1	1
14	0.455E+02	0.835E+04	0.184E+03	0.193E+04	1	0	1	1	0	1
15	0.466E+02	0.893E+04	0.192E+03	0.225E+04	1	1	1	1	0	1
16	0.573E+02	0.909E+04	0.159E+03	0.194E+04	1	0	1	1	1	1
17	0.584E+02	0.966E+04	0.165E+03	0.225E+04	1	1	1	1	1	1
0.668E+02	0.110E+05	0.165E+03	<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT							

NET
RESOURCE
SAVINGS

PORTFOLIO COST 10**6\$

02/21/79

TABLE GROUP 12 : URBAN WASTE TECHNOLOGY (NC)

YEAR : 1981

RES. COST	NET PRESENT	SAVING/*	PRIVATE	PORTFOLIOS (FUNDING LEVELS)									
(\$X10**6)	VALUE		INVESTMENT										
	(\$X10**6)		(\$X10**6)	76	76	77	78	79	80	82	84	85	
1	-0.155E+01	0.384E+00	-0.247E+00	0.991E-01	0	0	0	0	0	0	0	0	1
2	-0.116E+01	0.149E+02	-0.135E+02	0.221E+01	0	0	0	0	0	1	0	0	1
3	0.705E+01	0.151E+02	0.214E+01	0.226E+01	0	0	0	0	1	1	0	0	1
4	0.774E+01	0.224E+02	0.288E+01	0.184E+01	0	0	1	0	0	0	0	0	1
5	0.821E+01	0.369E+02	0.449E+01	0.395E+01	0	0	1	0	0	1	0	0	1
6	0.164E+02	0.371E+02	0.226E+01	0.408E+01	0	0	1	0	1	1	0	0	1
7	0.197E+02	0.443E+02	0.223E+01	0.358E+01	0	0	1	0	0	0	0	1	1
8	0.204E+02	0.588E+02	0.289E+01	0.569E+01	0	0	1	0	0	1	0	1	1
9	0.285E+02	0.590E+02	0.207E+01	0.574E+01	0	0	1	0	1	1	0	1	1
10	0.353E+02	0.590E+02	0.167E+01	0.574E+01	1	0	1	1	1	1	0	1	1
11	0.358E+02	0.590E+02	0.165E+01	0.574E+01	1	0	1	1	1	1	1	1	1
12	0.370E+02	0.590E+02	0.159E+01	0.574E+01	1	1	1	0	1	1	0	1	1
13	0.375E+02	0.590E+02	0.157E+01	0.574E+01	1	1	1	0	1	1	1	1	1
14	0.396E+02	0.590E+02	0.149E+01	0.574E+01	1	1	1	1	1	1	0	1	1
15	0.409E+02	0.590E+02	0.147E+01	0.574E+01	1	1	1	1	1	1	1	1	1
0	0.145E+02	0.454E+02	0.147E+01	<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT									

[illegible]

PORTFOLIO COST 10***6*

07/24/79

MARKET GROUP 12 : URBAN WASTE TECHNOLOGY (HC)

YEAR : 1985

RES. COST	NET PRESENT	SAVING/\$	PRIVATE	PORTFOLIOS (FUNDING LEVELS)										
(\$X10**6)	VALUE		INVESTMENT											
	(\$X10**6)		(\$X10**6)	75	76	77	78	79	80	82	84	85		
1	-0.155E+01	0.787E+01	-0.596E+01	0.203E+01	0	0	0	0	0	0	0	1		
2	-0.110E+01	0.153E+03	-0.139E+03	0.232E+02	0	0	0	0	1	0	0	1		
3	-0.914E+00	0.254E+03	-0.277E+03	0.198E+02	1	0	0	0	0	0	0	1		
4	0.460E+00	0.399E+03	-0.866E+03	0.409E+02	1	0	0	0	1	0	0	1		
5	0.410E+02	0.450E+03	0.112E+06	0.442E+02	1	0	0	0	1	1	0	1		
6	0.207E+01	0.565E+03	0.273E+03	0.886E+02	1	0	0	1	0	1	0	1		
7	0.253E+01	0.625E+03	0.247E+03	0.919E+02	1	0	0	1	0	1	1	0	1	
8	0.479E+01	0.649E+03	0.956E+02	0.951E+02	1	1	0	1	0	1	1	0	1	
9	0.932E+01	0.680E+03	0.730E+02	0.616E+02	1	0	1	0	0	1	1	0	1	
10	0.114E+02	0.785E+03	0.690E+02	0.106E+03	1	0	1	1	0	1	0	0	1	
11	0.118E+02	0.846E+03	0.714E+02	0.109E+03	1	0	1	1	0	1	1	0	1	
12	0.147E+02	0.846E+03	0.576E+02	0.109E+03	1	0	0	1	0	1	1	1	1	
13	0.161E+02	0.869E+03	0.540E+02	0.113E+03	1	1	1	1	0	1	1	0	1	
14	0.215E+02	0.900E+03	0.419E+02	0.790E+02	1	0	1	0	0	1	1	1	1	
15	0.235E+02	0.100E+04	0.427E+02	0.123E+03	1	0	1	1	0	1	0	1	1	
16	0.240E+02	0.107E+04	0.444E+02	0.127E+03	1	0	1	1	0	1	1	1	1	
17	0.283E+02	0.109E+04	0.385E+02	0.130E+03	1	1	1	1	0	1	1	1	1	
18	0.364E+02	0.110E+04	0.301E+02	0.132E+03	1	1	1	1	1	1	1	1	1	
	0.405E+02	0.122E+04	0.301E+02											

----- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

R
E
T
E
S
O
D
R
C
E
S
A
U
T
I
N
G
S
I
O
*
*
*
*
\$

PORTFOLIO COST 10**4\$

100

YEAR : 2000

RES. COST	NET PRESENT	SAVING/±	PRIVATE	PORTFOLIOS (FUNDING LEVELS)								
(\$X10 ⁴ ±6)	VALUE (\$X10 ⁴ ±6)		INVESTMENT (\$X10 ⁴ ±6)	75	76	77	78	79	80	82	84	85
1	-0.155E+01	0.200E+02	-0.120E+02	0.515E+01	0	0	0	0	0	0	0	1
2	-0.110E+01	0.191E+04	-0.173E+04	0.280E+03	0	0	0	0	0	1	0	1
3	-0.916E+00	0.321E+04	-0.351E+04	0.235E+03	1	0	0	0	0	0	0	1
4	-0.460E+00	0.510E+04	-0.111E+05	0.510E+03	1	0	0	0	1	0	0	1
5	0.410E-02	0.571E+04	0.139E+07	0.543E+03	1	0	0	0	0	1	0	1
6	0.207E+01	0.643E+04	0.311E+04	0.892E+03	1	0	0	1	0	1	0	1
7	0.253E+01	0.704E+04	0.278E+04	0.925E+03	1	0	0	1	0	1	0	1
8	0.380E+01	0.738E+04	0.194E+04	0.829E+03	1	1	0	0	0	1	0	1
9	0.427E+01	0.800E+04	0.187E+04	0.862E+03	1	1	0	0	0	1	0	1
10	0.633E+01	0.871E+04	0.138E+04	0.121E+04	1	1	0	1	0	1	0	1
11	0.679E+01	0.933E+04	0.137E+04	0.124E+04	1	1	0	1	0	1	0	1
12	0.118E+02	0.990E+04	0.836E+03	0.115E+04	1	0	1	1	0	1	0	1
13	0.131E+02	0.102E+05	0.781E+03	0.105E+04	1	1	1	0	0	1	0	1
14	0.136E+02	0.102E+05	0.799E+03	0.109E+04	1	1	1	0	0	1	0	1
15	0.156E+02	0.116E+05	0.740E+03	0.144E+04	1	1	1	1	0	1	0	1
16	0.161E+02	0.122E+05	0.756E+03	0.147E+04	1	1	1	1	0	1	0	1
17	0.240E+02	0.128E+05	0.532E+03	0.138E+04	1	0	1	1	0	1	1	1
18	0.253E+02	0.131E+05	0.518E+03	0.128E+04	1	1	1	0	0	1	0	1
19	0.257E+02	0.137E+05	0.533E+03	0.131E+04	1	1	1	0	0	1	1	1
20	0.278E+02	0.144E+05	0.519E+03	0.166E+04	1	1	1	1	0	1	0	1
21	0.283E+02	0.150E+05	0.532E+03	0.170E+04	1	1	1	1	0	1	1	1
22	0.344E+02	0.151E+05	0.414E+03	0.170E+04	1	1	1	1	1	1	1	1
0.405E+02	0.167E+05	0.414E+03		←--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT								

D
E
T

R
E
S
O
U
R
C
E

S
A
V
I
N
G
S

I
N
T
E
R
E
S
T

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 13 : COMMUNITY SYSTEMS (NC)

YEAR : 2000

	RES. COST	NET PRESENT	SAVING/\$	PRIVATE	PORTFOLIOS (FUNDING LEVELS)						
	(\$X10**6)	VALUE (\$X10**6)		INVESTMENT (\$X10**6)							
					1	3	4	5	7	9	12
1	0.462E+01	0.135E+03	0.291E+02	0.389E+02	0	0	0	0	0	0	1
2	0.549E+01	0.483E+03	0.879E+02	0.475E+02	1	0	0	0	0	0	0
3	0.708E+01	0.747E+03	0.106E+03	0.121E+03	0	0	0	1	0	0	0
4	0.844E+01	0.541E+04	0.642E+03	0.388E+03	0	0	0	0	1	0	0
5	0.130E+02	0.106E+05	0.812E+03	0.552E+03	0	1	0	0	0	0	0
6	0.176E+02	0.107E+05	0.606E+03	0.591E+03	0	1	0	0	0	0	1
7	0.185E+02	0.110E+05	0.597E+03	0.400E+03	1	1	0	0	0	0	0
8	0.201E+02	0.113E+05	0.563E+03	0.673E+03	0	1	0	1	0	0	0
9	0.214E+02	0.160E+05	0.745E+03	0.940E+03	0	1	0	0	1	0	0
10	0.261E+02	0.161E+05	0.618E+03	0.979E+03	0	1	0	0	1	0	1
11	0.269E+02	0.164E+05	0.611E+03	0.987E+03	1	1	0	0	1	0	0
12	0.285E+02	0.167E+05	0.586E+03	0.106E+04	0	1	0	1	1	0	0
13	0.331E+02	0.168E+05	0.508E+03	0.110E+04	0	1	0	1	1	0	1
14	0.340E+02	0.172E+05	0.506E+03	0.111E+04	1	1	0	1	1	0	0
15	0.386E+02	0.173E+05	0.449E+03	0.115E+04	1	1	0	1	1	0	1
16	0.391E+02	0.174E+05	0.444E+03	0.117E+04	0	1	1	1	1	0	0
17	0.437E+02	0.175E+05	0.400E+03	0.121E+04	0	1	1	1	1	0	1
18	0.446E+02	0.178E+05	0.400E+03	0.122E+04	1	1	1	1	1	0	0
19	0.492E+02	0.180E+05	0.365E+03	0.126E+04	1	1	1	1	1	0	1
20	0.503E+02	0.180E+05	0.358E+03	0.129E+04	1	1	1	1	1	1	0
21	0.549E+02	0.181E+05	0.330E+03	0.132E+04	1	1	1	1	1	1	1
	0.628E+02	0.207E+05	0.330E+03								

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

NET
RESOURCES
SAVINGS
10**6\$

PORTFOLIO COST 10**6\$

0. 24/75

MARKET GROUP 14 : NEA PROJECTS (NC)

YEAR : 1981

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/*	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)					
					42	43	44	95	101	102
1	0.673E+01	0.694E+03	0.103E+03	0.717E+02	0	0	0	0	1	0
2	0.673E+01	0.763E+03	0.113E+03	0.342E+03	0	0	0	0	0	1
3	0.135E+02	0.146E+04	0.108E+03	0.414E+03	0	0	0	0	1	1
4	0.146E+02	0.164E+04	0.112E+03	0.646E+03	0	0	0	1	0	0
5	0.213E+02	0.233E+04	0.109E+03	0.718E+03	0	0	0	1	1	0
6	0.213E+02	0.240E+04	0.113E+03	0.988E+03	0	0	0	1	0	1
7	0.230E+02	0.114E+05	0.497E+03	0.738E+03	0	1	0	0	0	0
8	0.297E+02	0.121E+05	0.408E+03	0.809E+03	0	1	0	0	1	0
9	0.297E+02	0.122E+05	0.410E+03	0.108E+04	0	1	0	0	0	1
10	0.365E+02	0.129E+05	0.353E+03	0.115E+04	0	1	0	0	1	1
11	0.376E+02	0.131E+05	0.348E+03	0.138E+04	0	1	0	1	0	0
12	0.443E+02	0.138E+05	0.310E+03	0.146E+04	0	1	0	1	1	0
13	0.443E+02	0.138E+05	0.312E+03	0.173E+04	0	1	0	1	0	1
14	0.460E+02	0.192E+05	0.417E+03	0.227E+04	1	1	0	0	0	0
15	0.528E+02	0.199E+05	0.377E+03	0.234E+04	1	1	0	0	1	0
16	0.528E+02	0.200E+05	0.378E+03	0.261E+04	1	1	0	0	0	1
17	0.595E+02	0.207E+05	0.347E+03	0.268E+04	1	1	0	0	1	1
18	0.606E+02	0.208E+05	0.344E+03	0.292E+04	1	1	0	1	0	0
19	0.673E+02	0.215E+05	0.320E+03	0.299E+04	1	1	0	1	1	0
20	0.673E+02	0.216E+05	0.321E+03	0.326E+04	1	1	0	1	0	1
21	0.721E+02	0.245E+05	0.339E+03	0.330E+04	1	1	1	0	0	0
22	0.788E+02	0.251E+05	0.319E+03	0.337E+04	1	1	1	0	1	0
23	0.788E+02	0.252E+05	0.320E+03	0.364E+04	1	1	1	0	0	1
24	0.855E+02	0.259E+05	0.303E+03	0.371E+04	1	1	1	0	1	1
25	0.866E+02	0.261E+05	0.301E+03	0.395E+04	1	1	1	1	0	0
26	0.934E+02	0.268E+05	0.287E+03	0.402E+04	1	1	1	1	1	0
27	0.934E+02	0.269E+05	0.288E+03	0.429E+04	1	1	1	1	0	1
28	0.100E+03	0.275E+05	0.275E+03	0.436E+04	1	1	1	1	1	1
	0.117E+03	0.321E+05	0.275E+03							

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

NET
RESOURCES
SAVINGS
10**6\$

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 14 : NEA PROJECTS (NC)

YEAR : 1985

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)					
					42	43	44	95	101	102
1	0.673E+01	0.446E+03	0.662E+02	0.461E+02	0	0	0	0	1	0
2	0.673E+01	0.512E+03	0.761E+02	0.230E+03	0	0	0	0	0	1
3	0.135E+02	0.958E+03	0.712E+02	0.276E+03	0	0	0	0	1	1
4	0.230E+02	0.250E+04	0.109E+03	0.162E+03	0	1	0	0	0	0
5	0.297E+02	0.295E+04	0.992E+02	0.208E+03	0	1	0	0	1	0
6	0.297E+02	0.302E+04	0.101E+03	0.391E+03	0	1	0	0	0	1
7	0.365E+02	0.346E+04	0.949E+02	0.437E+03	0	1	0	0	1	1
8	0.460E+02	0.456E+04	0.990E+02	0.567E+03	1	1	0	0	0	0
9	0.528E+02	0.500E+04	0.948E+02	0.613E+03	1	1	0	0	1	0
10	0.528E+02	0.507E+04	0.941E+02	0.796E+03	1	1	0	0	0	1
11	0.595E+02	0.552E+04	0.927E+02	0.842E+03	1	1	0	0	1	1
12	0.721E+02	0.593E+04	0.823E+02	0.835E+03	1	1	1	0	0	0
13	0.788E+02	0.637E+04	0.809E+02	0.881E+03	1	1	1	0	1	0
14	0.788E+02	0.644E+04	0.817E+02	0.106E+04	1	1	1	0	0	1
15	0.855E+02	0.689E+04	0.805E+02	0.111E+04	1	1	1	0	1	1
16	0.100E+03	0.726E+04	0.725E+02	0.126E+04	1	1	1	1	1	1
0.117E+03 0.847E+04 0.725E+02					<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 14 : NEA PROJECTS (NC)

YEAR : 2000

	RES. COST	NET PRESENT	SAVING/\$	PRIVATE	PORTFOLIOS (FUNDING LEVELS)					
	(X10**6)	VALUE (X10**6)		INVESTMENT (X10**6)						
					42	43	44	95	101	102
1	0.673E+01	0.694E+03	0.103E+03	0.717E+02	0	0	0	0	1	0
2	0.673E+01	0.763E+03	0.113E+03	0.342E+03	0	0	0	0	0	1
3	0.135E+02	0.146E+04	0.108E+03	0.414E+03	0	0	0	0	1	1
4	0.146E+02	0.164E+04	0.112E+03	0.646E+03	0	0	0	1	0	0
5	0.213E+02	0.233E+04	0.109E+03	0.718E+03	0	0	0	1	1	0
6	0.213E+02	0.240E+04	0.113E+03	0.988E+03	0	0	0	1	0	1
7	0.230E+02	0.114E+05	0.497E+03	0.730E+03	0	1	0	0	0	0
8	0.297E+02	0.121E+05	0.408E+03	0.809E+03	0	1	0	0	1	0
9	0.297E+02	0.122E+05	0.410E+03	0.108E+04	0	1	0	0	0	1
10	0.365E+02	0.129E+05	0.353E+03	0.115E+04	0	1	0	0	1	1
11	0.376E+02	0.131E+05	0.348E+03	0.138E+04	0	1	0	1	0	0
12	0.443E+02	0.138E+05	0.310E+03	0.146E+04	0	1	0	1	1	0
13	0.443E+02	0.138E+05	0.312E+03	0.173E+04	0	1	0	1	0	1
14	0.460E+02	0.192E+05	0.417E+03	0.227E+04	1	1	0	0	0	0
15	0.528E+02	0.199E+05	0.377E+03	0.234E+04	1	1	0	0	1	0
16	0.528E+02	0.200E+05	0.378E+03	0.261E+04	1	1	0	0	0	1
17	0.595E+02	0.207E+05	0.347E+03	0.268E+04	1	1	0	0	1	1
18	0.606E+02	0.208E+05	0.344E+03	0.292E+04	1	1	0	1	0	0
19	0.673E+02	0.215E+05	0.320E+03	0.299E+04	1	1	0	1	1	0
20	0.673E+02	0.216E+05	0.321E+03	0.326E+04	1	1	0	1	0	1
21	0.721E+02	0.245E+05	0.339E+03	0.330E+04	1	1	1	0	0	0
22	0.788E+02	0.251E+05	0.319E+03	0.337E+04	1	1	1	0	1	0
23	0.788E+02	0.252E+05	0.320E+03	0.364E+04	1	1	1	0	0	1
24	0.855E+02	0.259E+05	0.303E+03	0.371E+04	1	1	1	0	1	1
25	0.866E+02	0.261E+05	0.301E+03	0.395E+04	1	1	1	1	0	0
26	0.934E+02	0.268E+05	0.287E+03	0.402E+04	1	1	1	1	1	0
27	0.934E+02	0.269E+05	0.288E+03	0.429E+04	1	1	1	1	0	1
28	0.100E+03	0.275E+05	0.275E+03	0.436E+04	1	1	1	1	1	1
	0.117E+03	0.321E+05	0.275E+03		←-- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT					

NET
RESOURCES
SAVINGS
10**6\$

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 15 : OTHER A/E (NC)

YEAR : 1981

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					23	24	28
1	0.117E+01	0.208E+02	0.178E+02	0.158E+01	0	0	1
2	0.364E+01	0.338E+02	0.928E+01	0.481E+01	1	0	1
3	0.700E+01	0.338E+02	0.483E+01	0.481E+01	1	1	1
	0.934E+01	0.451E+02	0.483E+01				

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

NET
RESOURCES
SAVINGS
10***\$

PORTFOLIO COST 10***\$

07/24/79

MARKET GROUP 15 : OTHER A/E (NC)

YEAR : 1985

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)
1	0.117E+01	0.659E+02	0.564E+02	0.502E+01
2	0.247E+01	0.297E+03	0.120E+03	0.738E+02
3	0.364E+01	0.363E+03	0.997E+02	0.788E+02
4	0.583E+01	0.441E+03	0.756E+02	0.155E+03
5	0.700E+01	0.507E+03	0.724E+02	0.160E+03

PORTFOLIOS (FUNDING LEVELS)

	23	24	28
	0	0	1
	1	0	0
	1	0	1
	1	1	0
	1	1	1

0.934E+01 0.676E+03 0.724E+02

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

PORTFOLIO COST 10**6\$

07/24/79

MARKET GROUP 15 : OTHER A/E (NC)

YEAR : 2000

	RES. COST (\$X10**6)	NET PRESENT VALUE (\$X10**6)	SAVING/\$	PRIVATE INVESTMENT (\$X10**6)	PORTFOLIOS (FUNDING LEVELS)		
					23	24	28
1	0.117E+01	0.252E+03	0.215E+03	0.192E+02	0	0	1
2	0.247E+01	0.398E+04	0.161E+04	0.988E+03	1	0	0
3	0.364E+01	0.423E+04	0.116E+04	0.101E+04	1	0	1
4	0.583E+01	0.720E+04	0.123E+04	0.280E+04	1	1	0
5	0.700E+01	0.746E+04	0.106E+04	0.282E+04	1	1	1
	0.934E+01	0.994E+04	0.106E+04				

<--- COMPLETE PORTFOLIO WITH ADDED AVERAGE PROJECT

PORTFOLIO COST 10**6\$