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ABSTRACT

This is the teacher's guide to accompany the student guide which together comprise one of five computer-oriented environmental/energy education units. This unit explores the possible effects of the thirteen main energy-related decisions proposed in President Ford's 1975 State of the Union Address. The computer program at the base of the unit simulates the effects of any combination of the decisions on energy supply and consumption, on domestic production and reserves, and on pollution. This unit is designed for grades 9 through 12 and can be used in social studies or in environmental science. The teacher's guide presents: (1) unit objectives; (2) background information on the lessons or parts of the unit along with study questions; (3) notes on using the unit in class; and (4) program documentation with a sample run. (MR)

COMPUTER TECHNOLOGY PROGRAM
ENVIRONMENTAL EDUCATION UNITS

OUR U.S. ENERGY
FUTURE

TEACHER GUIDE

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ADDITIONAL PUBLICATIONS

Additional Publications Available in the Area of Computer Technology are Listed on the Last Page of This Booklet

This edition is based on earlier developmental work conducted with a limited test sample. The material was reviewed in order to correct any noted technical errors prior to printing of the October 1977 edition. However, purchasers are urged to first run the sample simulation program provided in order to determine any needed or desired adjustments prior to actual use. The Laboratory would appreciate hearing from users concerning any suggestions for corrections to subsequent editions.

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INTRODUCTION TO THE UNIT

Unit Description

Subject Area: Social Studies

Topic: Energy supply and demand in the United States between 1975 and 1985.

Abstract: This unit explores the possible effects of the thirteen main energy-related decisions proposed in President Ford's 1975 State of the Union Address. The program FUTURE at the base of the unit simulates the effects of any combination of the decisions on energy supply and consumption, on domestic production and reserves, and on pollution.

Computer Language: BASIC

Grade Level: 9-12

Program Name: FUTURE

Reasons for Studying the Unit

Three of the most important issues facing the world today are the shortage of energy, economic problems, and pollution. At least part of the difficulty in dealing with these issues is attributable to their interdependence: the energy crisis produces economic problems; the economy, in its industrial output, produces pollution; the pollution problem is an important constraint in choosing solutions to the energy crisis. Because of this interdependence, decisions relating to energy, the economy, and pollution are extremely complex. The U.S. has goals in each of the areas that are incompatible with goals in the other areas. Solutions for the energy crisis may create more serious economic and pollution problems; strengthening the economy may lead to more serious energy and pollution problems; reducing the level of pollution may depress the economy and cause greater energy shortages.

The purpose of this unit is to provide students with an appreciation of the complexity of energy-related decisions by allowing them to try out the decisions President Ford proposed in his 1975 State of the Union Address in their attempts to solve the energy problem without increasing inflation and pollution. Even though President Ford's energy plan is several years old, its goals address energy problems which still confront our country today. President Carter also has energy independence as one of the top priorities of his administration. Although the two presidents' plans differ somewhat, this unit is still appropriate for study as an example of a comprehensive energy plan. It may be desirable to extend this unit to include a comparison and analysis of President Carter's energy plan.

Using the computer simulation called FUTURE, the student selects among the thirteen proposed decisions and evaluates their effects on the energy and pollution problems using a computer simulation called FUTURE. The use of the computer is made necessary by the great complexity of the simulation; energy consumption by five users from each of five sources and pollution of eight different categories are differentially affected by thirteen possible decisions over a time span of ten years.

Objectives

This unit allows students to make energy-related decisions like those proposed for Project Independence. When the unit is completed, the students should be able to:

1. List the goals and options associated with Project Independence.
2. Describe the effect of each option on
    a. Energy supply and consumption
    b. Domestic production of oil, natural gas and coal
    c. Pollution

3. Describe the relative effects of increasing energy supply and reducing energy demand on

   a. Total consumption

   b. Domestic production and reserves of oil, natural gas, and coal

   c. Pollution

4. Describe an energy plan which optimizes the trade-off between reducing dependence on imported fuel and level of pollution.

BACKGROUND INFORMATION

Introduction

This section provides background information in five areas relevant to President Ford's tenets for Project Independence as defined in his State of the Union Address, 1975. It discusses the concept of independence, the general effects of Project Independence, electricity consumption, geothermal and solar energy, and gasoline consumption. Although the student material for the U.S. Energy FUTURE unit does not deal directly with any of these areas, it provides a context in which they can be discussed. The following background information in each area concludes with questions which you might wish to use in class discussion or as the basis of class projects.

Defining Independence

The Arab oil embargo began in October 1973. In November 1973, President Nixon proposed Project Independence, which he defined as "the potential to meet our own energy needs without depending on any foreign enemy--foreign energy sources." He suggested that the goal of total self-sufficiency could be met by 1980.

President Ford has redefined Project Independence as meaning the degree of self-sufficiency necessary to avoid economic disruption from the withholding of energy by foreign suppliers. This degree of self-sufficiency does not mean zero imports; it means cutting oil imports to about 4 million barrels of oil a day in 1985 (about 8×10^{15} BTU's per year), the amount imported during the oil embargo from non-Arab suppliers.

Study Questions

1. According to the FUTURE simulation, is it possible to have total self-sufficiency by 1980? By 1985? Why do you think President Nixon proposed total self-sufficiency as a goal?

2. Does President Ford's plan cut oil imports to 4 million barrels a day by 1985? Why do you think President Ford proposed cutting imports to 4 million barrels a day as a goal?

General Effects of Project Independence

Following are four of the major effects anticipated from Project Independence:

- Energy prices would increase. Gasoline is expected to stabilize at \$.65 per gallon. Assuming a 5% annual rate of inflation, the price of gasoline would be \$1 per gallon in 1985.

- Environmental damage would increase due to increased use of high-sulfur coal, increased strip-mining of coal and surface mining of oil shale, increased use of nuclear reactors to generate electricity.

- Economic instability might result from an inflationary increase in energy prices and an interest-raising demand for money by industries attempting to meet the goal of Project Independence (shifting from oil and gas to coal, developing synthetic oil and gas, producing cars with 40% better mileage, etc.) This might lead to greater unemployment and a recession. On the other hand, the activity stimulated by new development could, in the long run, improve economic conditions.

- International relations might be threatened if other countries see Project Independence as a new isolationism--that is, we solve our own energy problem by relying on our domestic resources, but, we don't help countries having fewer resources, e.g. Japan, solve their energy problem. President Ford has tried to reassure our allies, saying that Project Independence will enable the United States to help the rest of the world by allowing us to eventually become a major exporter of energy.

Study Questions

1. President Ford's goal was to reduce our dependence on imported oil. In attempting to achieve this goal, however, we jeopardize other goals--like low energy prices, an unpolluted environment, economic stability, and good international relations. Which of these five goals do you think is most important? Why? Defend your choice against someone who disagrees with you.

2. Play the role of a consumer, the president of a large labor union, a member of the Sierra Club, or a representative of the Japanese government. Which of the five goals do you think is most important? Why? Defend your choice against someone playing another role who disagrees with you.

Electricity Consumption

Electrical utilities are unique as users of energy in that they produce as well as consume energy. The energy produced by the electrical utilities is consumed by two of the five energy users assumed by the FUTURE program: industry and residential/commercial.

Predicted electricity consumption for 1975 and 1985 is shown below. These figures assume that 1975 trends continue, i.e., that no Project Independence decisions are made. The numbers are in units of BTU x 10^{15}.

USER*	1975	1985
Industry	3.4	6.9
Residential/Commercial	5.3	13.9
Total	8.7	20.8

You will notice that the totals are about 40% of the energy consumed by electrical utilities in a standard (no decisions) run of FUTURE. This is because the conversion efficiency for electricity generation is about 40%; 60% of the input energy is lost.

You will also notice that residential/commercial users consume most of the electricity, 61% in 1975 and 67% in 1985. Table 1 shows specific residential uses of energy in a single home. You may wish to use these data in asking students to consider how they might conserve electricity in their homes. The actual numbers, which apply to an average-sized home in Portland, Oregon, are not as important as the relative size of the numbers as reflected by the figures for percent of the total.

The greatest use of residential electricity is for heating. One obvious way to conserve electricity used for heating is to lower the thermostat setting. Table 2 shows annual electricity consumption for heating at different thermostat settings. As this table shows, the energy savings is 3.1% for every degree the thermostat setting is lowered. As with Table 1, the Table 2 data apply to a typical home in Portland, Oregon.

Another way to save on heating is to insulate a home. It is estimated that full insulation as opposed to the standard insulation present in most homes, will reduce electricity consumption for heating by about 20%.

After heating, the greatest residential use of electricity is for the water heater. It takes 1 kilowatt-hour of electricity (3,412 BTU's) to raise the temperature of 4.1 gallons of water 100 degrees. An automatic dishwasher requires 8 to 10 gallons of hot water. A tub bath requires 10 to 15 gallons of hot water; a shower requires 8 to 12 gallons. Automatic clothes washing requires about 18 gallons of hot water.

* Source: Hughes, B. Public Policy: U.S. Energy, Environment and Economic Problems. American Political Science Association. Washington, D.C., 1974.

TABLE 1

YEARLY ELECTRICITY CONSUMPTION FOR A SINGLE HOME

[illegible]	KILOWAT-HOURS	BTU x 10^7	% OF TOTAL
Electric Heat	28,000	9.83	59.04
Water Heater (family of 4)	7,200	2.46	14.77
Range	2,400	.82	4.92
Lighting	1,800	.61	3.66
Refrigerator/Freezer (standard)	1,200	.41	2.46
Food Freezer (20 cubic feet)	1,200	.41	2.46
Dishwasher (includes hot water)	1,200	.41	2.46
Clothes Dryer (5 loads a week)	1,200	.41	2.46
Furnace Fan	1,080	.37	2.22
TV (color)	600	.20	1.20
Stereo/Radio	480	.16	.96
TV (black and white)	360	.12	.72
Electric Blanket	300	.10	.60
Iron	240	.08	.48
Automatic Washer (hot water not included)	180	.06	.36
Fry Pan	180	.06	.36
Radio	180	.06	.36
Coffee Maker	120	.04	.24
Waste Disposer	60	.02	.11
Toaster	60	.02	.11
TOTAL	48,840	16.65	

TABLE 2

THERMOSTAT SETTING AND YEARLY ELECTRICITY CONSUMPTION FOR HEATING*

SETTING	KILOWAT-HOURS	BTU x 10^7	% CHANGE FROM 70° CONSUMPTION
75	38,264.0	11.35	15.5
74	32,371.2	11.05	12.4
73	31,478.4	74	9.3
72	30,585.6	10.44	6.2
71	29,692.8	10.13	3.1
70	28,800.0	9.83	0
69	27,907.2	9.53	-3.1
68	27,014.4	9.22	-6.2
67	26,121.6	8.92	-9.3
66	25,228.8	8.61	-12.4
65	24,336.0	8.31	-15.5

* Source: Pacific Power and Light Company

Study Questions

1. What can an individual citizen do to reduce the consumption of electricity?

2. How will reducing the consumption of electricity reduce our dependence on imported oil and natural gas, conserve domestic oil and natural gas, and reduce pollution?

Geothermal and Solar Energy

Geothermal energy (based on heat from the earth's interior) and solar energy (based on heat from the sun) are possible alternative sources of energy for electrical generation. Both are relatively "clean" sources with respect to environmental damage. The technologies required for their large-scale use are, however, at least a decade away. Because of technological uncertainties, it is difficult to predict the future contribution of each source to total electrical generation. Estimates of the contribution of geothermal energy to total electric power in the U.S. in the year 2000, for example, range from 10% to 20%. Solar power is even more uncertain.

The Pacific Gas and Electric Company is already operating electric generators in California's Sonoma Valley using hot water from geysers. Geysers also produce electricity in Larderello, Italy and heat buildings in Reykjavik, Iceland. We don't, however, have to rely on geysers for geothermal energy. We can reach hot rock by simply drilling a hole in the ground. If you drill deep enough, say from one to three miles, you reach rock having extremely high temperatures, maybe 800° or 900° F. When you drop water into the hole, you can produce steam which can be used to drive electric generators. Unfortunately, the steam that is produced by this process is not powerful enough to generate electricity efficiently. There is also a possible pollution problem—the steam may contain large quantities of sulfur.

The use of solar energy for electric generation obviously requires sun. This means that solar power plants would be most feasible in very sunny regions of the country, e.g., the southwest and southern California. Even in these areas, the heat that could be collected from the sun wouldn't produce steam that was hot enough to generate electricity with optimum efficiency. With less than optimum efficiency, the electricity produced would be extremely expensive—some experts believe that the cost of electricity produced by solar power would be 100 times as great as that produced by coal, oil or gas.

Solar energy is, however, an economically-feasible alternative to electricity for home heating. Solar energy heats a home by heating water, which is then passed through radiators inside the house. As shown in Table 1 on page 7 (which is discussed in the section on "Electricity Consumption"), home heating accounts for a major portion of residential electricity consumption. The widespread use of solar energy for home heating would, therefore, produce a significant reduction in residential electricity consumption and, consequently, in the consumption of oil, gas, and coal by electric utilities.

Study Questions

1. Estimated contributions of geothermal and solar energy for 1975 and 1985, with and without Project Independence, are shown below.* The numbers are BTU's x 10^{15}.

Standard--Without Project Independence		
	1975	1985
Geothermal	0.3	0.8
Solar	0.0	0.0

With Project Independence		
	1975	1985
Geothermal	0.3	3.9
Solar	0.0	1.0

Assuming that geothermal and solar energy will be used by electric utilities instead of oil and natural gas, to what extent would these alternative energy sources change the 1985 predictions of program FUTURE with the Project Independence decisions (decision options 1, 2, 3, 4, 5, 6, 10, 11, and 12)?

* Hughes, B. Public Policy: U.S. Energy, Environment and Economic Problems. The American Political Science Association, Washington, D.C. 1974.

2. Estimated energy usage by electric utilities in the year 2000, without Project Independence, is shown below.* The numbers are BTU's x 10^{15}.

OIL	GAS	COAL	HYDRO	NUCLEAR	GEOTHERMAL	SOLAR	TOTAL
9.9	11.0	36.6	6.0	40.2	1.9	0.0	114.6

Project Independence is predicted to increase the contribution of nuclear power to 52.8, of geothermal power to 11.8, and of solar power to 3.0.* What impact will the geothermal and solar power produced by Project Independence have on energy usage by electric utilities in 2000? Could we export significant amounts of energy?

3. How could the use of solar energy for home heating reduce our consumption of oil, gas, and coal and increase our ability to export energy?

Gasoline Consumption

Transportation is the biggest user of oil, primarily in the form of gasoline. One of the key goals of Project Independence is to reduce gasoline consumption by 20%. Decisions 6, 7, 8 and 9 in program FUTURE, which are listed below, are all assumed to reduce gasoline consumption:

6--Increase price of oil and natural gas by taxing imported and domestic oil and gas and deregulating the price of domestic oil and gas

7--Increase price of gasoline by direct excise tax at the pump

8--Reduce supply of gasoline by rationing

9--Reduce supply of gasoline by allocation

Decisions 6 and 7 will reduce gasoline consumption if gasoline is "price elastic," i.e., if the demand for gasoline falls as the price rises. The graph on the next page, which is included in the Student Guide for U.S. ENERGY FUTURE, suggests that gasoline is not price elastic--consumption falls when the supply is limited, but not when the price rises. This graph, of course, doesn't prove that gasoline is not price elastic. First, it is possible that a price of 55¢ a gallon is not high enough to reduce demand. What would happen if the price were 65¢ or 75¢ a gallon? We don't know.

* op. cit.

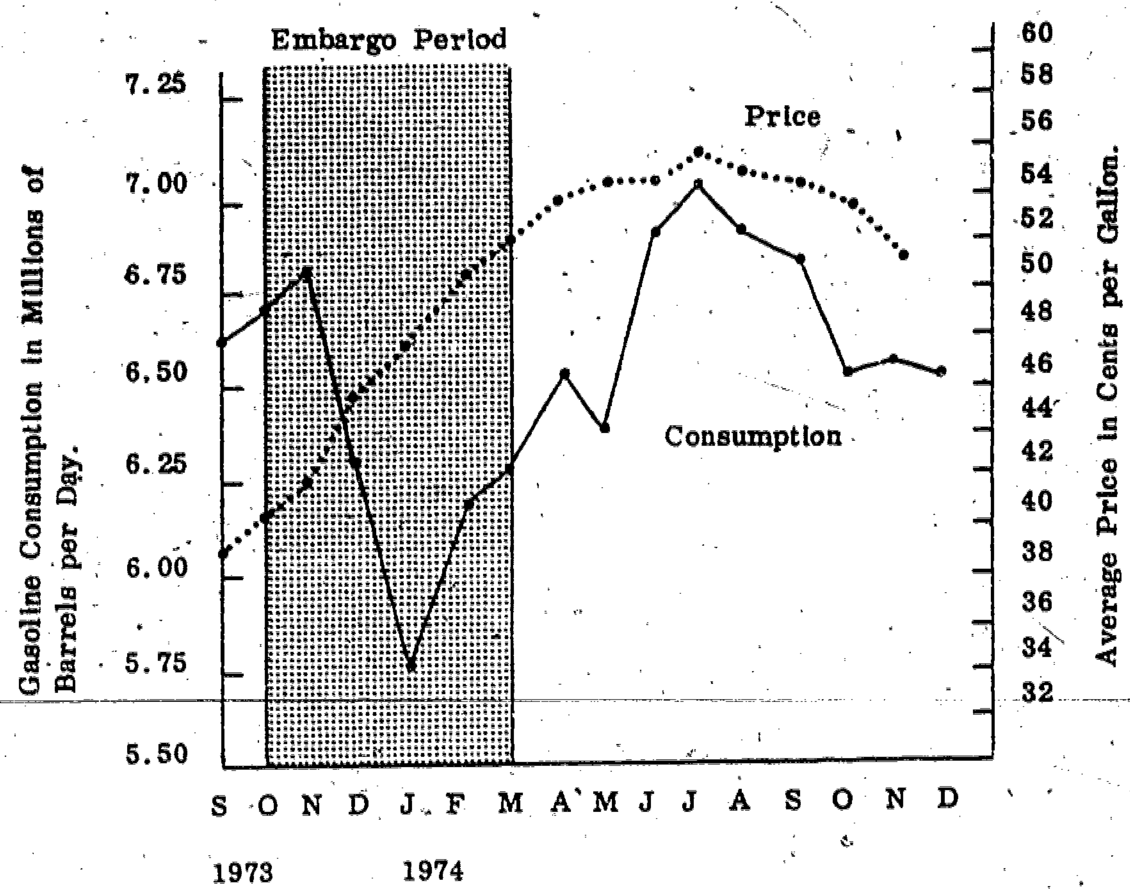

Fig. 1. Conditions produced by the oil embargo.*

* Source: "Newsweek," January 27, 1975 and Federal Energy Administration

Second, the large increase in consumption in 1974 occurs during the summer months, the months when consumption is always highest. We should compare consumption in the summer of 1974 with consumption in the summers of 1970, 1971, 1972 and 1973. If consumption in 1974 was less than the level predicted from the 1970-1973 data, we could conclude that gasoline is price elastic. In the absence of these data, we can use the data shown in the graph in Fig. 1 to compare consumption in September and October, 1973 (representing low price and an embargo, respectively) with consumption in September and October, 1974 (representing high price and no embargo, respectively). The small difference suggests little price elasticity.*

Another way to evaluate the price elasticity of gasoline is to ask people if they would reduce their consumption of gasoline if the price increased. The unit ATITUD, which is intended to supplement U.S. ENERGY FUTURE, contains data on public attitudes toward the energy crisis collected by pollsters Louis Harris and George Gallup in polls conducted in January, 1975. The data relevant to price elasticity is:

- "If the price of gasoline goes up 10¢ a gallon, do you believe you will cut down your driving?"

YES	49%
NO	48%

- "If yes, will you cut down your driving a great deal, some, or only a little?"

A great deal	11%
Some	26%
A little	11%

If behavior is related to attitudes, it appears that the reduction in demand produced by a 10¢ a gallon rise in the price of gasoline will not be great. Why? Are people simply unwilling to cut down their driving or would such a cut be too difficult? Another Gallup question from January, 1975 is relevant:

- "Suppose you had to reduce the number of miles you drive by one-fourth. How difficult would it be for you to meet this requirement--very difficult, fairly difficult, or not at all difficult?"

Very difficult	31%
Fairly difficult	23%
Not at all difficult	40%
Don't know	6%

About half of the people believe that it would be difficult to reduce their driving by the amount required by Project Independence.

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*Neither the price of gasoline nor the rate of consumption has changed substantially between the end of 1974 and the summer of 1977; the three-year period provides no additional data to determine "price elasticity."

What does "difficult" mean in this context? We don't know for sure what the people responding to the Gallup poll meant, of course, but the data in Table 3 might give us some idea by suggesting where the cut in gasoline consumption might be made. Table 3 shows gasoline consumption by all users for the second and third quarters of 1974. The obvious nonessential use is pleasure driving in passenger cars. If all pleasure driving was eliminated, we would have reduced gasoline consumption by 20%--the goal of Project Independence.

Study Questions

1. Does the graph in Figure 1 above showing the relation of price and consumption of gasoline prove that gasoline is not price elastic? Why?

2. Do public attitudes suggest price elasticity? Do students, teachers, and townspeople have attitudes different from those reported in the Gallup poll? (The ATTITUDE unit can be used to answer this question.)

3. Table 3 below shows that we could reduce gasoline consumption by 20% if we eliminate all pleasure driving. Do you think that this would be difficult for you to do? Do you think that it is necessary?

4. Increasing the price of gasoline (FUTURE Decisions 6 or 7) would presumably cause us to reduce our consumption by reducing demand--that is, we couldn't afford to drive as much. Rationing or allocation (FUTURE Decisions 8 or 9) would cause us to reduce our consumption by reducing supply--we couldn't buy more gasoline even if we could afford it. Assuming that both would be effective, which method--reducing demand or reducing supply--seems best to you? Why? Which is the fairest method? Do you think that rich people and poor people would have different opinions? What about people who must drive great distances as part of their jobs versus those who don't? Or people who live in big cities versus people who live in small towns?

TABLE 3

GASOLINE USAGE: SECOND AND THIRD QUARTERS, 1974*

USER	BARRELS/DAY	BTUs/DAY	% OF TOTAL
Passenger Cars	4,970,000	26.09×10^{12}	73.1
Work	1,770,000	9.29×10^{12}	26.0
Pleasure	1,360,000	7.14×10^{12}	20.0
Personal Business	1,020,000	5.36×10^{12}	15.0
Business/ Government	820,000	4.30×10^{12}	12.1
Trucks	1,430,000	7.51×10^{12}	21.1
Farm Vehicles	200,000	1.05×10^{12}	2.9
Other	200,000	1.05×10^{12}	2.9
TOTAL	6,800,000	35.70×10^{12}	100.0

* Source: U.S. Department of Transportation

The Effects of Decisions

The thirteen possible decisions used in the FUTURE simulation are:

1. New oil wells on the outer continental shelf
2. Wells on the Naval Reserve at Elk Hills, California
3. New oil wells on the Alaskan Naval Reserves
4. Produce synthetic oil and gas from coal, synthetic oil from shale
5. Convert utilities from oil and gas to coal
6. Increase price of oil and natural gas by taxing imported and domestic oil and gas and deregulating the price of domestic oil and gas
7. Increase price of gasoline by direct excise tax at the pump
8. Reduce supply of gasoline by rationing
9. ~~Reduce supply of gasoline by allocation~~
10. Produce cars with 40% better mileage
11. Encourage better insulation in homes
12. Encourage more efficient appliances
13. Accelerate the building of nuclear power plants

The effects of each decision on the value output by the program are shown in Figure 2. Note that the layout in Figure 2 is identical in layout to FUTURE's printed output. The numbers in the boxes are the decision numbers. If a number is in a box, the decision has an effect on the value represented by the box. Decision 13, for example, has an effect on the consumption of oil, gas, and nuclear power by electric utilities. If a number has a "minus" sign, the effect of the decision is to reduce the value. If a number has no sign, the decision increases the value. Decision 13, for example, reduces the electric utilities' consumption of oil and gas but increases their consumption of nuclear energy.

TOTAL U.S. ENERGY CONSUMPTION

Sources and Consumption (BTU x 10^{15})

	Oil	Gas	Coal	Hydro	Nuclear
Industry	-6	-6	6		
Electrical Utility	-5, -12	-5, -12	5		12
Transportation	(-6, -7, -8, -9), -10				
Residential/ Commercial	-11	-11			
Nonenergy					

DOMESTIC NONRENEWABLE ENERGY

Consumption

	Oil	Gas	Coal
BTU x 10^{15}	1, 2, 3, 4	4	4, 5, 6
Source Total	1,2,3,4,5, (6,7, 8,9),10,11,12	4, 5, 6, 11, 12	4

Reserves

	Oil	Gas	Coal
BTU x 10^{15}	-1, -2, -3		-4, -5, -6
Years Remaining	-1, -2, -3		-4, -5, -6

Air Pollution	5, 6, (-7, -8, -9), -10, -11, -12
Carbon Monoxide	(-6, -7, -8, -9), -10
Sulfur Dioxide	5, 6, -11, -12

Land Waste from Strip Mining	4, 5, 6

Water Pollution:

Brine from Oil Wells:	1, 2, 3
Oil	1, 2, 3,
Silt	1, 2, 3

Radioactive Waste	12

Parameters and How to Change Them

1. Total U.S. energy consumed in 1975 is represented by the matrix of values shown below. Row and column totals and percentages are calculated from these values. To change the matrix, change the DATA statements at lines 5000, 5010, 5020, 5030 and 5040 for rows 1, 2, 3, 4 and 5 respectively.

User	Sources and Consumption (BTU x 10^{15})				
	Oil	Gas	Coal	Hydro	Nuclear
Industry	5.4	10.4	5.6	0.0	0.0
Electric Utility	1.8	4.6	9.2	3.6	2.6
Transportation	18.7	0.6	0.0	0.0	0.0
Residential/ Commercial	6.1	8.5	0.4	0.0	0.0
Nonenergy	4.3	0.4	0.1	0.0	0.0

2. The grand total of U.S. energy consumption (81.9 x 10^{15} BTU's in 1975) is assumed to increase at a rate of 5% per year. To change the rate of increase, change line 425. If you wanted a 4% annual increase, for example, the statement of line 425 would be:

```
425 LET T9 = T9 + T9 * .04.
```

3. The percentage of the total consumption which is used by industry, electric utilities, transportation, residential/commercial and non-energy changes each year as shown below:

USER	CHANGE
Industry	-.59
Electrical Utilities	.89
Transportation	-.09
Residential/ Commercial	-.33
Nonenergy	.14

To change these values, change the DATA statement at line 5050. Note that values are preceded by two zeros, e.g., for an annual reduction of -.59, enter -.0059.

4. The percentages of energy consumption from each source by each user change each year by the amounts shown below.

USER	OIL	GAS	COAL	HYDRO	NUCLEAR
Industry	.01	-.008	-.003	0	0
Electrical Utilities	.002	-.007	0	-.008	.013
Transportation	.003	-.003	0	0	0
Residential/ Commercial	.003	-.002	-.001	0	0
Nonenergy	.01	-.008	0	0	0

5. Beginning reserves of oil, gas and coal in BTU's x 10^{15} are 580, 1032, and 40960 respectively. To change these values, change the DATA statement at line 5080.

6. Domestic production of oil and gas in BTU's x 10^{15} for each year is respresented by the values below:

YEAR	OIL PRODUCTION	GAS PRODUCTION
1975	24.2	22.6
1976	24.6	22.8
1977	24.9	23.0
1978	25.3	23.2
1979	25.6	23.4
1980	25.9	23.6
1981	26.2	23.8
1982	26.4	24.0
1983	26.7	24.2
1984	28.2	24.4
1985	29.8	24.6

To change these values, change the DATA statements at lines 5100 and 5120 for oil and gas, respectively.

7. Each decision changes appropriate assumed values by the amounts shown below:

DECISION	VARIABLE NAME	AMOUNT
1	W1	3.20
2	W2	0.34
3	W3	1.40
4	M1 (oil)	2.10
	M2 (gas)	1.00
5	B1	0.45
6	B2 (trans.)	2.10
	B6 (industry)	0.45
7	B2	2.10

NOTES ON USING THE UNIT IN CLASS

Before using the program, ask all students to read the Student Guide to U.S. ENERGY FUTURE and to try to anticipate the effects of the various decisions. Anticipating effects can be done individually or by the entire class as the goal of a discussion period.

The questions printed at the end of the manual are intended to help guide students in their use of the program. They are asked to determine the effects of each decision separately and the effects of several decisions made together. This can be done by individual students or, in the usual case where the availability of terminals is limited, by the entire class. In determining the effects of several decisions together, the Project Independence decisions should be made.

After using the program, ask students to go through a values clarification exercise, evaluating the relative importance of reducing our dependence on imported energy, stabilizing the economy, and controlling pollution. After they have ranked these goals, they can evaluate Project Independence and their own plans with respect to achieving their valued goals.

PROGRAM DOCUMENTATION

```
GET-FUTURE
RUN
FUTURE

DO YOU NEED INSTRUCTIONS?YES

THIS IS A SIMULATION OF ENERGY SUPPLY AND CONSUMPTION IN THE
UNITED STATES FOR THE YEARS 1975 TO 1985.  IT ALLOWS YOU TO MAKE
THE KIND OF ENERGY-RELATED DECISIONS FACING OUR COUNTRY IN 1975
AND TO SEE THE EFFECT OF YOUR DECISIONS ON OUR ENERGY FUTURE.
YOU WILL BE ABLE TO SEE HOW YOUR DECISIONS AFFECT OUR TOTAL ENERGY
CONSUMPTION, THE PERCENTAGE OF THE TOTAL CONSUMED BY INDUSTRY,
ELECTRIC UTILITIES, TRANSPORTATION, RESIDENTIAL AND COMMERCIAL
USERS, AND NONENERGY USES.  YOU WILL ALSO SEE HOW YOUR DECISIONS
AFFECT THE PERCENTAGES OF TOTAL ENERGY OBTAINED FROM DOMESTIC
SOURCES AND HOW THE USE OF DOMESTIC SOURCES AFFECTS OUR RESERVES
OF OIL, GAS, AND COAL.

YOU CAN MAKE ANY COMBINATION OF DECISIONS FROM THE 13 POSSIBLE
DECISIONS LISTED BELOW.  AFTER YOU SEE THE LIST, YOU WILL BE ASKED
TO ENTER YOUR DECISIONS AND A QUESTION MARK WILL BE TYPED.  ALL
YOU HAVE TO DO IS TYPE THE NUMBER CORRESPONDING TO A DECISION YOU
WANT TO MAKE AND THEN PRESS THE CARRIAGE RETURN BUTTON.  QUESTION
MARKS WILL KEEP APPEARING UNTIL YOU ENTER A "0" (ZERO).  AFTER
YOU ENTER YOUR ENERGY DECISIONS YOU WILL BE ASKED TO INDICATE
HOW OFTEN YOU WANT TO SEE INFORMATION DISPLAYED.  YOU CAN
SEE (1) ALL YEARS FROM 1975 TO 1985, (2) ONLY 1975 AND 1985, OR
(3) ONLY 1985.  WE RECOMMEND EITHER (2) OR (3) SINCE (1) REQUIRES
20 MINUTES TO PRINT.

THE NUMBERS THAT WILL BE PRINTED ARE EITHER PERCENTAGES OR
BRITISH THERMAL UNITS (BTU) TIMES 10 TO THE 15TH POWER.
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POSSIBLE DECISIONS

1. NEW OIL WELLS ON THE OUTER CONTINENTAL SHELF.

2. WELLS ON THE NAVAL RESERVE AT ELK HILLS, CALIF.

3. NEW OIL WELLS ON THE ALASKAN NAVAL RESERVES.

4. PRODUCE SYNTHETIC OIL FROM COAL AND SHALE.

5. CONVERT UTILITIES FROM OIL AND GAS TO COAL.

6. INCREASE PRICE OF OIL AND NATURAL GAS BY TAXING IMPORTED AND DOMESTIC OIL AND GAS AND DEREGULATING THE PRICE OF DOMESTIC OIL AND GAS.

7. INCREASE PRICE OF GASOLINE BY DIRECT EXCISE TAX AT THE PUMP.

8. REDUCE SUPPLY OF GASOLINE BY RATIONING.

9. REDUCE SUPPLY OF GASOLINE BY ALLOCATION.

10. PRODUCE CARS WITH 40% BETTER MILEAGE.

11. ENCOURAGE BETTER INSULATION IN HOMES.

12. ENCOURAGE MORE EFFICIENT APPLIANCES.

13. INCREASE THE NUMBER OF NUCLEAR POWER PLANTS.

ENTER YOUR DECISIONS
?3
?5
?8
?9
?0

HOW OFTEN DO YOU WANT INFORMATION DISPLAYED?
1 = ALL YEARS, 2 = 1975 AND 1985, 3 = ONLY 1985.?2

1975

USER	OIL	GAS	COAL	HYDRO	NUCLEAR	TOTAL	PERCENT
			SOURCE				
INDUSTRY	6.4	10.6	4.0	0.0	0.0	21.0	25.6
ELEC UTIL	2.6	4.1	8.9	3.6	2.6	21.8	26.6
TRANSPORT.	18.6	0.7	0.0	0.0	0.0	19.3	23.5
RES./COM'L.	7.0	7.6	0.4	0.0	0.0	15.0	18.3
NONENERGY	3.9	0.7	0.2	0.0	0.0	4.8	5.8
TOTAL	38.5	23.7	13.5	3.6	2.6	81.9	
PERCENT	47.0	28.9	16.4	4.3	3.1		
DOMESTIC	24.2	21.3	13.5				
PERCENT	62.8	89.3	100.0				

DOMESTIC RESERVES

FUEL	BTU X 10↑15	YEARS AT 1975 RATE
OIL	555.8	22.9669
GAS	1010.7	47.4507
COAL	40946.5	3033.07

1985

USER	OIL	GAS	COAL	HYDRO	NUCLEAR	TOTAL	PERCENT
			SOURCE				
INDUSTRY	8.0	13.3	5.0	0.0	0.0	26.5	20.3
ELEC UTIL	3.4	4.5	25.7	7.7	5.6	47.1	36.2
TRANSPORT.	25.9	1.0	0.0	0.0	0.0	27.0	20.7
RES./COM'L.	9.3	10.1	0.5	0.0	0.0	20.1	15.4
NONENERGY	7.8	1.4	0.4	0.0	0.0	9.6	7.4
TOTAL	54.6	30.6	31.7	7.7	5.6	130.1	
PERCENT	42.0	23.5	24.3	5.9	4.3		
DOMESTIC	29.8	28.2	31.7				
PERCENT	54.4	92.0	100.0				

DOMESTIC RESERVES

FUEL	BTU X 10↑15	YEARS AT 1985 RATE
OIL	283.8	9.52349
GAS	761	26.9858
COAL	40721.	1284.49

DO YOU WANT TO RUN THE SIMULATION AGAIN? NO

DONE

25/26

FUTURE Program Listing

```
GET-FUTURE
LIST
FUTURE

1  REM FUTURE ENERGY SUPPLY AND CONSUMPTION SIMULATION
2  REM W. BEWLEY, NWREL
5  DIM B$[10]
6  LET O5=O6=O7=O8=0
7  LET S5=S6=S7=S8=S9=N=0
10  PRINT "DO YOU NEED INSTRUCTIONS";
15  INPUT B$
20  IF B$[1,1]="N" THEN 700
25  GOTO 4000
40  REM A HOLDS SOURCE X USER MATRIX, P HOLDS YEARLY CHANGE IN
50  REM PROPORTION USER CONSUMPTION, R HOLDS ROW TOTALS, C HOLDS
60  REM COLUMN TOTALS
70  DIM A[5,5],P[5],R[6],C[6],B[5,5]
80  DIM A$[10]
85  DIM O[11],G[11]
90  LET A$="1234567890"
91  LET T9=0
92  PRINT "HOW OFTEN DO YOU WANT INFORMATION DISPLAYED?"
93  PRINT "1 = ALL YEARS, 2 = 1975 AND 1985, 3 = ONLY 1985.";
94  INPUT Z5
95  MAT R=ZER
96  MAT C=ZER
97  IF Z5<1 OR Z5>3 THEN 93
100  MAT  READ A
110  MAT  READ P
112  READ O1,G1,C1
115  MAT  READ O
116  MAT  READ G
120  FOR I=1 TO 5
122  FOR J=1 TO 5
124  LET R[I]=R[I]+A[I,J]
126  LET C[J]=C[J]+A[I,J]
128  NEXT J
130  NEXT I
131  FOR I=1 TO 5
132  FOR J=1 TO 5
133  LET B[I,J]=A[I,J]/R[I]
134  NEXT J
136  LET T9=T9+R[I]
138  NEXT I
140  LET D=1975
141  IF Z5=3 AND D=1985 THEN 148
142  IF Z5=2 AND D=1975 THEN 148
143  IF Z5=2 AND D=1985 THEN 148
144  IF Z5=1 THEN 148
145  GOTO 390
148  PRINT LIN(4)
149  PRINT D
150  PRINT
155  LET H=1
160  PRINT
170  PRINT " "," ","SOURCE"
180  PRINT TAB(3);"USER";TAB(15);
181  PRINT "OIL";TAB(22);
182  PRINT "GAS";TAB(29);
183  PRINT "COAL";TAB(36);
```

```
184  PRINT "HYDRO";TAB(43);
185  PRINT "NUCLEAR";TAB(54);
186  PRINT "TOTAL";TAB(60);
187  PRINT "PERCENT"
190  PRINT "INDUSTRY";TAB(14);
200  LET I=1
210  GOSUB 1000
220  PRINT "ELEC UTIL";TAB(14);
230  LET I=2
240  GOSUB 1000
250  PRINT "TRANSPORT.";TAB(14);
260  LET I=3
270  GOSUB 1000
280  PRINT "RES./COM'L.";TAB(14);
290  LET I=4
300  GOSUB 1000
310  PRINT "NONENERGY";TAB(14);
320  LET I=5
330  GOSUB 1000
340  PRINT
350  PRINT "TOTAL";TAB(14);
360  GOSUB 1300
370  PRINT
375  PRINT
380  PRINT "DOMESTIC";TAB(14);
390  GOSUB 3000
400  REM CALCULATE NEXT YEAR'S VALUES
410  LET D=D+1
415  IF D=1986 THEN 520
420  LET W=T9
425  LET T9=T9+T9*.05
440  FOR I=1 TO 5
450  LET R[I]=((R[I]/W)+P[I])*T9
455  NEXT I
462  MAT C=ZER
465  FOR I=1 TO 5
470  FOR J=1 TO 5
475  IF A[I,J]=0 THEN 490
480  LET A[I,J]=B[I,J]*R[I]
485  LET C[J]=C[J]+A[I,J]
490  NEXT J
500  NEXT I
505  GOSUB 1500
510  GOTO 141
520  RESTORE
525  PRINT LIN(3)
530  PRINT "DO YOU WANT TO RUN THE SIMULATION AGAIN";
540  INPUT B$
550  IF B$[1,1]="N" THEN 990
554  LET O5=O6=O7=O8=0
556  LET S5=S6=S7=S8=S9=N=0
560  PRINT "DO YOU WANT THE LIST OF POSSIBLE DECISIONS";
570  INPUT B$
580  IF B$[1,1]="N" THEN 700
590  PRINT "POSSIBLE DECISIONS"
595  PRINT
600  PRINT "1.  NEW OIL WELLS ON THE OUTER CONTINENTAL SHELF."
602  PRINT
605  PRINT "2.  WELLS ON THE NAVAL RESERVE AT ELK HILLS, CALIF."
607  PRINT
```

```
610  PRINT "3.  NEW OIL WELLS ON THE ALASKAN NAVAL RESERVES."
612  PRINT
615  PRINT "4.  PRODUCE SYNTHETIC OIL FROM COAL AND SHALE."
617  PRINT
620  PRINT "5.  CONVERT UTILITIES FROM OIL AND GAS TO COAL."
622  PRINT
625  PRINT "6.  INCREASE PRICE OF OIL AND NATURAL GAS BY TAXING IMPORTED
626  PRINT "    DOMESTIC OIL AND GAS AND DEREGULATING THE PRICE OF DOMES
627  PRINT "    OIL AND GAS."
628  PRINT
630  PRINT "7.  INCREASE PRICE OF GASOLINE BY DIRECT EXCISE TAX AT THE P
632  PRINT
635  PRINT "8.  REDUCE SUPPLY OF GASOLINE BY RATIONING."
637  PRINT
640  PRINT "9.  REDUCE SUPPLY OF GASOLINE BY ALLOCATION."
642  PRINT
645  PRINT "10.  PRODUCE CARS WITH 40% BETTER MILEAGE."
647  PRINT
650  PRINT "11.  ENCOURAGE BETTER INSULATION IN HOMES."
652  PRINT
655  PRINT "12.  ENCOURAGE MORE EFFICIENT APPLIANCES."
657  PRINT
660  PRINT "13.  INCREASE THE NUMBER OF NUCLEAR POWER PLANTS."
670  PRINT LIN(4)
700  PRINT "ENTER YOUR DECISIONS"
710  INPUT D9
715  IF D9>13 THEN 6000
716  IF D9<0 THEN 6020
720  IF D9=0 THEN 970
721  IF D9=6 THEN 910
722  IF D9 <= 5 THEN 730
724  IF D9 <= 9 THEN 728
726  LET D9=D9-3
727  GOTO 730
728  LET D9=6
730  GOTO D9 OF 740,760,780,800,820,840,860,880,710,900
740  REM WELLS ON OUTER CONTINENTAL SHELF
745  LET O5=3.2
750  GOTO 710
760  REM WELLS AT ELK HILLS
765  LET O6=.34
770  GOTO 710
780  REM WELLS IN ALASKAN RESERVE
785  LET O7=1.4
790  GOTO 710
800  REM OIL FROM SHALE & COAL
805  LET O8=2.1
810  GOTO 710
820  REM CONVERT UTILITIES TO COAL
825  LET S5=.45
830  GOTO 710
840  REM REDUCE DRIVING 20%
845  LET S6=2.1
850  GOTO 710
860  REM CARS WITH BETTER MILEAGE
865  LET S7=2.3
870  GOTO 710
880  REM HOMES WITH BETTER INSULATION
885  LET S8=1.5
890  GOTO 710
```

```
900  REM INCREASE NUCLEAR CAPABILITY
902  LET N=.18
905  GOTO 710
910  LET S9=.45
920  GOTO 840
970  PRINT LIN(2)
980  GOTO 40
990  STOP
1000  REM PRINT A LINE OF THE MATRIX WITH ROW TOTAL AND PERCENT
1005  LET G=1
1010  FOR J=1 TO 5
1020  LET T=A[I,J]
1030  REM PICK OFF 100'S DIGIT
1031  LET A=INT(T/100+.0005)
1032  LET F=1
1033  GOSUB 2000
1034  REM PICK OFF 10'S DIGIT
1035  LET A=INT((T-(A*100))/10+.0005)
1036  IF T<100 THEN 1040
1038  LET F=0
1040  GOSUB 2000
1042  REM PICK OFF 1'S DIGIT
1045  IF T<100 THEN 1060
1050  LET A=100+(10*A)
1055  GOTO 1070
1060  LET A=10*A
1070  LET A=INT(T-A+.0005)
1075  LET F=0
1080  GOSUB 2000
1100  PRINT ".";
1105  REM PICK OFF .1'S DIGIT
1110  LET A=INT((T-INT(T)+.0005)*10)
1115  LET F=0
1120  GOSUB 2000
1122  IF G=7 THEN 3260
1125  IF G>1 THEN 1140
1130  IF T=R[I] THEN 1180
1135  IF T=(R[I]/T9)*100 THEN 1200
1140  PRINT TAB(14+J*7);
1145  GOTO G OF 1150,1335,3080,3150,3180,3230,3260,3300
1150  NEXT J
1152  IF H <> 1 THEN 1370
1155  PRINT TAB(54);
1158  IF G>1 THEN 1340
1160  LET T=R[I]
1170  GOTO 1030
1180  LET T=(R[I]/T9)*100
1185  PRINT TAB(60);
1190  GOTO 1030
1200  PRINT
1210  RETURN
1300  REM PRINT COLUMN TOTALS AND PERCENTS
1302  LET C[6]=T9
1305  LET H=1
1308  LET G=2
1310  FOR J=1 TO 6
1320  LET T=C[J]*H
1330  GOTO 1030
1335  IF J=5 THEN 1152
1340  NEXT J
```

29/30

```
1342 PRINT
1345 IF H <> 1 THEN 1370
1350 LET H=100/T9
1360 PRINT "PERCENT";TAB(14);
1365 GOTO 1310
1370 RETURN
1500 REM CHANGE BASE VALUES ACCORDING TO DECISIONS
1501 REM CONVERT UTILITIES TO COAL
1502 LET A[2,3]=A[2,3]+S5
1504 LET C[3]=C[3]+S5
1506 LET A[2,1]=A[2,1]-S5/3
1508 LET C[1]=C[1]-S5/3
1510 LET A[2,2]=A[2,2]-2*(S5/3)
1512 LET C[2]=C[2]-2*(S5/3)
1513 REM REDUCE DRIVING BY 20%
1514 IF D>1976 THEN 1521
1515 LET A[3,1]=A[3,1]-S6
1516 LET R[3]=R[3]-S6
1518 LET C[1]=C[1]-S6
1520 LET T9=T9-S6
1521 REM CARS WITH BETTER MILEAGE
1522 IF D<1978 OR D>1980 THEN 1542
1524 LET A[3,1]=A[3,1]-S7
1526 LET R[3]=R[3]-S7
1528 LET C[1]=C[1]-S7
1530 LET T9=T9-S7
1541 REM BETTER HOME INSULATION
1542 IF D>1976 THEN 1553
1543 LET A[4,1]=A[4,1]-S8/3
1544 LET R[4]=R[4]-S8
1546 LET C[1]=C[1]-S8/3
1548 LET T9=T9-S8
1550 LET A[4,2]=A[4,2]-2*(S8/3)
1552 LET C[2]=C[2]-2*(S8/3)
1553 REM NUCLEAR CAPABILITY
1554 LET A[2,5]=A[2,5]+N
1556 LET C[5]=C[5]+N
1558 LET A[2,2]=A[2,2]-2*(N/3)
1560 LET C[2]=C[2]-2*(N/3)
1562 LET A[2,1]=A[2,1]-(N/3)
1564 LET C[1]=C[1]-(N/3)
1566 REM TARIFF ON OIL AND GAS -- INDUSTRY SHIFTS TO COAL
1568 LET A[1,3]=A[1,3]+S9
1570 LET C[3]=C[3]+S9
1572 LET A[1,1]=A[1,1]-S9/3
1574 LET C[1]=C[1]-S9/3
1576 LET A[1,2]=A[1,2]-2*(S9/3)
1578 LET C[2]=C[2]-2*(S9/3)
1580 FOR I=1 TO 5
1582 FOR J=1 TO 5
1584 LET B[I,J]=A[I,J]/R[I]
1586 NEXT J
1588 NEXT I
1590 RETURN
2000 REM CONVERTING NUMERIC TO ALPHA
2010 IF A=0 THEN 2030
2020 PRINT A$[A,A];
2025 GOTO 2040
2030 IF F=1 THEN 2035
2032 PRINT A$[10,10];
```

```
2034  GOTO 2040
2035  PRINT " ";
2040  RETURN
3000  REM CALCULATE AND PRINT DOM. & FOR. SUPPLY & DOM. RESERVES
3010  REM OIL
3012  LET J=1
3015  LET G=3
3018  LET P=D-1975+1
3022  LET R1=O[P]/C[1]
3024  GOTO P+1 OF 3026,3026,3026,3032,3032,3036,3036,3036,3040,3040,3040
3026  LET T=R1*C[1]+O5+O6
3027  IF O6<.3 THEN 3060
3028  LET O6=O6+.1
3030  GOTO 3060
3032  LET T=R1*C[1]+O5+O6
3034  GOTO 3060
3036  LET T=R1*C[1]+O5+O6+O8
3038  GOTO 3060
3040  LET T=R1*C[1]+O5+O6+O7+O8
3050  LET O7=O7+1.4
3060  LET R1=T/C[1]
3065  IF D<1980 THEN 3070
3067  LET O1=O1-T+O8
3068  GOTO 3071
3070  LET O1=O1-T
3071  IF Z5>1 AND D=1985 THEN 1030
3072  IF Z5=2 AND D=1975 THEN 1030
3075  IF Z5=1 THEN 1030
3080  REM GAS
3082  LET J=2
3085  LET G=4
3090  LET P=D-1975+1
3110  LET R2=G[P]/C[2]
3120  LET T=R2*C[2]
3140  LET G1=G1-T
3141  IF Z5>1 AND D=1985 THEN 1030
3142  IF Z5=2 AND D=1975 THEN 1030
3145  IF Z5=1 THEN 1030
3150  REM COAL
3152  LET J=3
3155  LET G=5
3160  LET C1=C1-C[3]
3170  LET T=C[3]
3171  IF Z5>1 AND D=1985 THEN 1030
3172  IF Z5=2 AND D=1975 THEN 1030
3175  IF Z5=1 THEN 1030
3176  GOTO 3360
3180  PRINT
3190  PRINT "PERCENT";TAB(14);
3200  LET G=6
3205  LET J=1
3210  LET T=R1*100
3220  GOTO 1030
3230  LET G=7
3235  LET J=2
3240  LET T=R2*100
3250  GOTO 1030
3260  PRINT TAB(28);
3270  PRINT "100.0"
```

```
3300 PRINT
3310 PRINT
3320 PRINT "DOMESTIC RESERVES"
3325 PRINT "FUEL","BTU X 10↑15","YEARS AT";D;"RATE"
3330 PRINT "OIL",O1,O1/(R1*C[1])
3340 PRINT "GAS",G1,G1/(R2*C[2])
3350 PRINT "COAL",C1,C1/C[3]
3360 RETURN
4000 REM INSTRUCTIONS
4010 PRINT
4015 PRINT "THIS IS A SIMULATION OF ENERGY SUPPLY AND CONSUMPTION IN THE
4020 PRINT "UNITED STATES FOR THE YEARS 1975 TO 1985.  IT ALLOWS YOU TO
4025 PRINT "THE KIND OF ENERGY-RELATED DECISIONS FACING OUR COUNTRY IN
4030 PRINT "AND TO SEE THE EFFECT OF YOUR DECISIONS ON OUR ENERGY FUTURE
4035 PRINT "YOU WILL BE ABLE TO SEE HOW YOUR DECISIONS AFFECT OUR TOTAL
4040 PRINT "CONSUMPTION, THE PERCENTAGE OF THE TOTAL CONSUMED BY INDUST
4045 PRINT "ELECTRIC UTILITIES, TRANSPORTATION, RESIDENTIAL AND COMMERC
4050 PRINT "USERS, AND NONENERGY USES.  YOU WILL ALSO SEE HOW YOUR DECI
4055 PRINT "AFFECT THE PERCENTAGES OF TOTAL ENERGY OBTAINED FROM DOMEST
4060 PRINT "SOURCES AND HOW THE USE OF DOMESTIC SOURCES AFFECTS OUR RES
4065 PRINT "OF OIL, GAS, AND COAL."
4070 PRINT
4075 PRINT "YOU CAN MAKE ANY COMBINATION OF DECISIONS FROM THE 13 POSSI
4080 PRINT "DECISIONS LISTED BELOW.  AFTER YOU SEE THE LIST, YOU WILL B
4081 PRINT "TO ENTER YOUR DECISIONS AND A QUESTION MARK WILL BE TYPED.
4082 PRINT "YOU HAVE TO DO IS TYPE THE NUMBER CORRESPONDING TO A DECISI
4083 PRINT "WANT TO MAKE AND THEN PRESS THE CARRIAGE RETURN BUTTON.  QU
4084 PRINT "MARKS WILL KEEP APPEARING UNTIL YOU ENTER A '0' (ZERO).  AF
4085 PRINT "YOU ENTER YOUR ENERGY DECISIONS YOU WILL BE ASKED TO INDICA
4086 PRINT "HOW OFTEN YOU WANT TO SEE INFORMATION DISPLAYED.  YOU CAN"
4087 PRINT "SEE (1) ALL YEARS FROM 1975 TO 1985, (2) ONLY 1975 AND 1985
4088 PRINT "(3) ONLY 1985.  WE RECOMMEND EITHER (2) OR (3) SINCE (1) RE
4089 PRINT "20 MINUTES TO PRINT."
4090 PRINT
4091 PRINT "THE NUMBERS THAT WILL BE PRINTED ARE EITHER PERCENTAGES OR"
4092 PRINT "BRITISH THERMAL UNITS (BTU) TIMES 10 TO THE 15TH POWER."
4093 PRINT LIN(2)
4094 GOTO 590
4095 REM A
5000 DATA 6.4,10.6,4,0,0
5010 DATA 2.6,4.1,8.9,3.6,2.6
5020 DATA 18.6,.7,0,0,0
5030 DATA 7,7.6,.4,0,0
5040 DATA 3.9,.7,.2,0,0
5045 REM P
5050 DATA -.0059,.0089,-.0009,-.0033,.0014
5075 REM O1,G1,C1
5080 DATA 580,1032,40960.
5090 REM O
5100 DATA 24.2,24.6,24.9,25.3,25.6,25.9,26.2,26.4,26.7,28.2,29.8
5110 REM G
5120 DATA 21.3,21.9,22.5,23.2,23.9,24.6,25.3,26,26.7,27.4,28.2
6000 PRINT "THERE ARE ONLY 13 POSSIBLE DECISIONS. TRY AGAIN."
6010 GOTO 710
6020 PRINT "PLEASE ENTER ONLY POSITIVE NUMBERS."
6030 GOTO 710
9999 END
```

Publications Available in the Area of Computer Technology*

Environmental Education Units

Five environmental education units are available for student use, with guides for the teacher and the student. The computer language in each case is Basic. The suggested grade levels are 9–14. The most common use is in classes of social studies, science, mathematics, environmental education and computer sciences.

- Our U.S. Energy (FUTURE) Teacher Guide (32 pp.) and Student Guide (26 pp.)
- The Global Energy Situation (EARTH) Teacher Guide (40 pp.) and Student Guide (23 pp.)
- A Computer Simulation of the U.S. Energy Crisis (ENERGY) Teacher Guide (24 pp.) and Student Guide (28 pp.)
- Computer Oriented Exercises on Attitudes and U.S. Gasoline Consumption (ATTITUDE) Teacher Guide (21 pp.) and Student Guide (25 pp.)
- A Computer Oriented Problem Solving Unit (CONSUME) Teacher Guide (15 pp.) and Student Guide (49 pp.)

Elements of Computer Careers

This book introduces high school students to the world of computers through problem solving, simulation and hands-on activities. By developing the skills learned in the text, students experience the many careers related to computers. It can be used in a classroom setting without computer hardware, with a remote terminal or with a computer installation. A Teacher's Guide and Student Guide accompany the text.

REACT (Relevant Educational Applications of Computer Technology) Course 1

Computers in Education: A Survey

The course provides 30 hours of instruction for all educational personnel to develop an understanding of computer equipment and operation, to communicate with computers, to use computers in education and to understand the impact of computers on society. The course is composed of nine units, or "packages," which can be used for a structured course or workshop, individual self-study or as independent reference materials.

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The course provides 30 hours of instruction for teachers to develop an understanding of applications in social studies, English, business education, sciences and mathematics. The course is composed of applications in each of the five subject areas which can be used for a structured course or workshop, individual self-study or as independent reference materials.

Computer-Based Methods for Educational Decision Making: An Introduction and Guide for School Administrators

This guide acquaints decision makers with the practical application of operations research in management and administration.

Computer Applications in Instruction: A Teacher's Guide to Selection and Use

This guide acquaints the teacher with the rudiments of computer hardware, programming languages, different roles the computer plays in instruction and how to evaluate and select appropriate computer application materials for classroom use.

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*For descriptions, prices and ordering source, contact:

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