Teaching Guide

Energy Conversions

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ENERGY CONVERSIONS

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ENERGY CONVERSIONS

A Microcomputer Program for the
Apple and TRS-80 Model III and Model IV Computers

Foreword

Energy Conversions is one of a series of programs developed during the summer of 1981 in a project coordinated by the National Science Teachers Association, Project for an Energy Enriched Curriculum (PEEC) and Technical Education Research Centers (TERC), with funding from the U.S. Department of Energy. The project involved teachers and student programmers. The goal of the project was to develop sophisticated software dealing with various topics in energy studies. The pilot programs were widely tested in schools across the country and revised in the spring of 1983. This software is designed to be used in school curricula in a variety of applications. Some of the programs are best used in the classroom, while others may be used in resource rooms, computer rooms, and possibly in the home. These materials are particularly appropriate for grades 9 through 12, though they may be used with older and younger students. The activities can last for a number of weeks or class periods depending on the teacher.

Other programs in this series are these:

Temperature Grapher	This program utilizes two temperature probes connected to the Apple computer game-paddle input. It is an excellent addition to a science laboratory.
Home Energy Savings	This is a game that illustrates the economics of various energy-conserving home improvements.
Power Grid	This is a game in which the student has responsibility for the operation of a mix of power-generating facilities. The object is to meet consumer demand as efficiently as possible.
Personal Energy Inventory	This program allows for a wide range of data analysis of students' personal energy use.
Electric Bill	This program introduces and teaches the calculation of an electric bill with text and graphics.

All programs are available for Apple* and TRS-80* Model III and Model IV computers with the exception of Temperature Grapher, which is available only for the Apple.

* Apple and TRS-80 are registered trademarks, respectively, of Apple Computer Co. and Tandy Corp.

Summary of Energy Conversions

This program serves two functions. First, it is a resource to convert from one energy unit to another (e.g., cords of wood to gallons of oil). Second, it is an exercise in solving problems using dimensional analysis. The problems in the second part are related to the energy units in the conversion section.

In the energy conversion part of the program, students will select from a Main Menu one of the following areas: Petroleum, LNG (Liquid Natural Gas), Gases, Coal, Alcohol, Uranium, Wood, or Energy. They will then select a more specific area (e.g., maple wood or hard coal), a specific unit (e.g., cords or tons), and an amount. To convert to another specific unit, they will go through the selection process a second time (e.g., gases . . . methane . . . cubic feet). An equivalency will be stated relating the two sets of units (e.g., 2 cords maple wood = 42,289 cubic feet methane).

In the problem-solving part of the program, the students will be given a computer-generated problem and a choice of formulas. When the appropriate formula is selected, the students will be asked to supply the quantities required for the formula. The program will supply the numbers, but the students will indicate the appropriate quantities for each part of the formula.

Objectives of Energy Conversions

Upon completion of this program, the student should--

1. Know the general areas of energy units.
2. Know specific energy units.
3. Know how to convert from one energy unit to another energy unit.
4. Understand the process of dimensional analysis as used in solving problems.
5. Calculate the solutions to problems using energy units.

Background Information

Part I: Energy Conversion Portion of Program

Energy is consumed in many different processes, in amounts that vary from grams to tons. In this part of the program, equivalencies can be found between different energy forms. Some of the energy forms will be familiar to the students, while others are very obscure. Before using this program, a background of energy sources and uses would be helpful. A discussion of the common energy units and their applications can be found in Energy Environment Source Book, John Fowler, National Science Teachers Association, Washington, DC 20009.

This part of the program will allow for the conversion of grams of uranium to kilowatt hours; or tons of coal to Btus; or cords of maple wood to liters of methanol; or many, many others. All of the options are best found by running the program.

Part II: Problem-solving Portion of Energy Conversions

This section teaches the process of dimensional analysis to students by presenting a problem and having students choose the formula and the correct amounts to fill into the formula. These problems deal with the efficiency of different energy-using processes (e.g., efficiency of wood stoves). The problems are randomly generated by the program to give as much variety as possible. The formula that all of the problems are based on is--

ENERGY = (AMOUNT) x (ENERGY/UNIT) x (EFFICIENCY)

For example: what is the total amount of useful energy (in calories) produced by the burning of 1.5 gallons of heating oil in a 40% efficient furnace?

ENERGY = (1.5 gallons) x (3.48022E + 07 CAL./GAL.) x (.40)

Teaching Strategies

Both parts of Energy Conversions can be used in a large number of teaching applications. Below are some suggestions.

Part I: Conversions

1. Have the students compare the fuels used in heating homes.
2. Compare and contrast different methods of power generation.
3. Use with a laboratory exercise on heat to determine equivalent amounts of fuel to produce one calorie.
4. Use information obtained from the program to develop bar graphs comparing fuels.
5. Have students work on sample problems or other teacher-developed problems.

Part II: Problem-solving

1. Use as a follow-up to dimensional analysis.
2. Have students work some of the problems in the program and then make up their own problems.

Time Required

This will vary greatly depending on the specific use of the program.

Extending the Lesson

1. Include cost per unit in the problems.
2. Use up-to-date prices.

Problems and Questions

Using Part I of the program, solve the following sample problems:

1. What amount (cords) of maple wood is equivalent to the following?
    a. 25.0 liters methane
    b. 2050 cubic feet methane
    c. 690 pounds anthracite
    d. 16.0 gallons distillate fuel oil
    e. 25.0 gallons gasoline

2. Calculate the amount of energy in calories that each of the following will produce:
    a. 2.0 grams uranium oxide
    b. 1.5 cubic meters beech wood
    c. 3.0 liters ethanol
    d. 1.2 barrels kerosene

3. A 1000-watt hair dryer is used for 1 hour per week. This is equivalent to 52 kilowatt-hours of electricity each year. Calculate the amount of fuel needed to produce the electricity for the hair dryer annually. Choose appropriate units.
    a. uranium oxide
    b. residual fuel oil
    c. anthracite coal
    d. ash wood
    e. natural gas

Answer the following questions:

4. What are the three highest energy-producing woods?

5. Which liquid petroleum product provides the highest energy per liter?

6. What is meant by the efficiency of a certain energy-using process?

7. List all the factors you can think of that must be considered in choosing a fuel for a particular use.

Starting the Program

This program is available for use with Apple II, II+, IIe, and Radio Shack TRS-80 Model III and Model IV computers. Write HRM Software regarding availability of the TRS-80 Model I version. Be sure that you have the correct version of the program for the computer you are using. Follow the directions below to begin the program.

For all Apple II computers

1. Insert the disk into the disk drive. If you have two drives, use Drive 1.
2. Turn on the video screen and the computer.
3. Wait for the program to load, and as soon as directions appear on the screen, start the program as directed.
4. If you have any problems starting the program, check with a qualified person.

For TRS-80 Model III and Model IV computers

1. Insert the disk into the lower disk drive, close the drive door, and turn on the computer.
2. Wait for the program to load, and as soon as directions appear on the screen, start the program as directed.
3. If you have any problems starting the program, check with a qualified person.