uest Editorial: Energy Analysis and the Dynamic Steady State

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The growth in the production of net useful energy in the United States and much of the industrial world has almost stopped. Consequently, economic growth has also leveled off. Since 1973 the American economy has produced enough to maintain national assets and to exchange money and goods for energy imports but not enough for significant further growth. U.S. natural gas and older oil reserves were yielding about 10 units of useful energy for each unit used in processing until the gas crisis of the winter of 1977. Now most energy sources yield 6 units of useful energy for each unit put directly and indirectly into the work of acquisition (either through foreign exchange or through exploration and processing). Nuclear energy yields only 3 to 4 units of net useful energy for each unit of useful energy put into the system. The net useful energy that can be obtained by importing fuels depends on the availability of fuel reserves in the United States to keep the prices of foreign fuels down. As yield ratios for the primary energy sources of America fall below 6 to 1, the net useful energy drops, and with it drops the amount of useful work that can be accomplished (the real GNP). The average standard of living may hold steady for a while as emphasis shifts to eliminating waste, but eventually it may drop as net useful energy yields decline (Figure 13–11). Here are some suggestions for adaptation to these new times.

1. A 10 percent cut in salary for everyone in the United States may be needed so that unemployment can be reduced without a change in GNP, net energy use, or inflation. This action will allow each American to eliminate what is less essential or less productive. Unions might take the lead, emphasizing employment for all instead of high wages for the few.

2. If U.S. money flow can be adjusted to energy flow each year (annual use of fossil fuels plus renewable productivities), the buying power of the dollar in real value will hold constant and the dollar will then be on an energy standard. This protects the individual and prevents unwise attempts to expand the economy when such attempts will fail. This is the reverse of the deficit financing that is used in growth times.

3. It is useful to use energy costs to estimate net energy value. The unit of measure is kilocalories of solar energy to develop a kilocalorie of useful energy. Good energetics suggest items should not be used for less effect than their energy cost. Because they are at the end of a chain of energy transformations, wildlife, people, and information have high energy costs and thus are valued.

4. In planning and judging what energy alternatives and uses will be economical, purchased energy should be matched with the free resources of the sun, rain, and land. The national ratio of matching is about 2.5 kilocalories purchased to 1 supplied free (both measures in solar equivalents). The basis for money flow is 38 million kilocalories of solar equivalents per dollar (1975 dollars).

5. In all considerations of the realm of environment, economics, and energy, a basic energy analysis is needed to show the interactions of money, energy, materials, and information. Drawing and numerically evaluating energy analysis diagrams, as discussed in more detail in Odum (1971a) and Odum and Odum (1976), is a starting procedure that can be understood from the grammar school to the graduate school. Rather than being interdisciplinary, energy analysis is a new discipline that realigns knowledge and principles. We may need to institutionalize courses and degrees using energetic holism as a key to understanding the systems of humans and nature.

Guest Editorial Discussion

1. Explain how overall energy use continues to rise whereas the growth in net useful energy has leveled off in most industrial nations and may begin to decline.
2. What are the advantages and disadvantages of relating energy flow in a society to dollar flow?
3. Explain how unemployment could be reduced without a change in GNP, energy use, or inflation if everyone in the United States took a 10 percent cut in salary. Debate the pros and cons of this suggestion.

[Di]scussion Topics

[1.] What is an energy crisis? What are the four energy crises [de]scribed in this chapter? Do you agree or disagree with this [cla]ssification? Defend your answer.

[2.] Trace your own direct and indirect energy consumption [ea]ch day and show how it could average 250,000 kilocalories per day. Contrast your total with that of a Mississippi farm laborer, an Indian peasant, and a Chicago slum dweller.

3. Why has the United States in recent years shifted from coal to natural gas and oil, even though coal is the nation's most abundant fossil fuel?

4. List the following forms of energy in order of increasing energy quality: heat from nuclear fission, normal sunlight, oil shale, air at 500°C.

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