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The energy hypothesis

In Chapter 21 the following hypothesis was introduced:

"The forces that motivate and strengthen the monetary economics of a society are diametrically opposed to the conservation of energy resources."

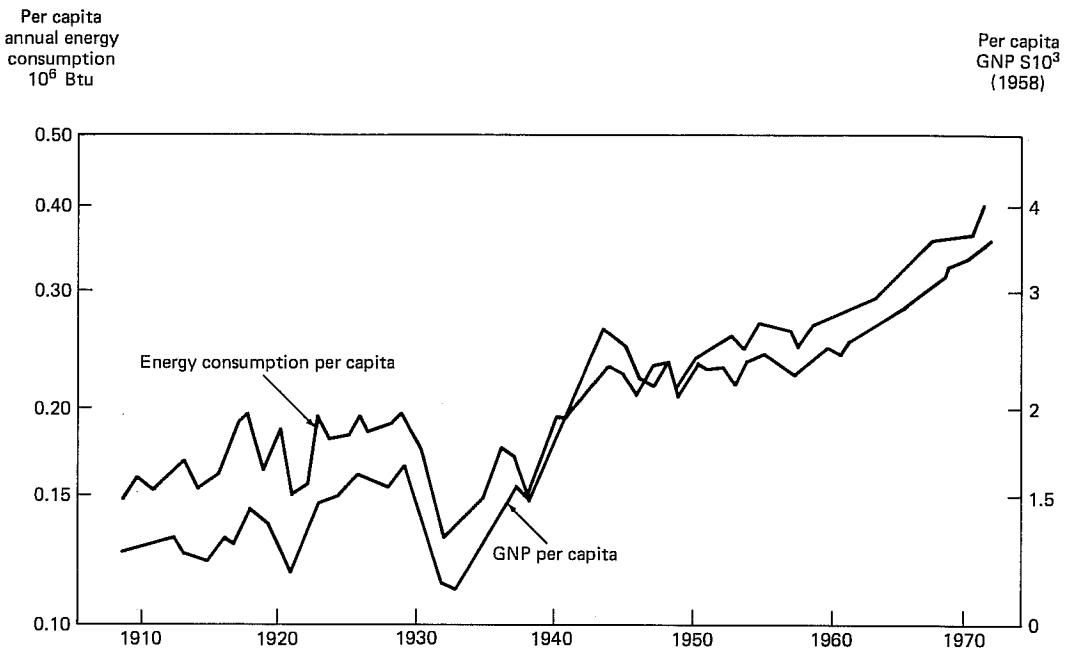
This chapter discusses the significance of this hypothesis as it relates to the energy economics efforts of the engineering community and governmental policies.

The statement was called a hypothesis, not a law, on the basis of the definition of a hypothesis: an interpretation of a practical situation or condition taken as the ground for action.

Examples that justify the hypothesis are endless. To state a few:

- The monetary economics of the energy industries are such that retardation of ever-increasing energy use could financially destroy them. Consider the commonplace utility rate structures that penalize a consumer for not using more hours (energy) of demand (power); or the rates for either fossil fuels or electric energy, which reduce the unit cost and consequently the *average cost per energy unit as consumption increases.*
- Examples in transportation are numerous. Consider the complex interrelations of the automotive industry, the highway systems, and the building industry. Development of interstate highways into and around major metropolitan areas spurred development of suburban or satellite business communities such as office and industrial parks as well as housing communities and associated commercial developments. The only links between the housing communities, suburban business communities, and "downtown" areas are the superhighways. The required use of the family car for transportation to a daily place of work not only increased the per capita gasoline consumption significantly, but also increased demand for the second car, which was now sorely needed for visits to the doctor, trips to the store, and shuttling the kids to their extracurricular activities. We became a nation on wheels with no alternative. Yet, no one lost in this conversion: the building industry boomed; the automobile business boomed; and the energy business boomed.
- An example that presents an overview of the hypothesis is shown in Fig. 22-1. Against the time span of 1909 to 1973 is plotted gross national product per capita in units of thousands of dollars; superimposed is the annual energy consumption per capita in units of billions of Btus. It is immediately evident that the two curves are very nearly congruent. This phenomenon tends to prove the legitimacy of the hypothesis.

Several conclusions could conceivably be drawn from the above examples, particularly the one illustrated by the graph, and some of these conclusions are most distressing. For example, one might conclude that the two phenomena are so closely interrelated that by some law of economics a downward slope in one would dictate a downward slope in the other, and vice versa. This conclusion could likely be justified by the current situation in the United States. We have been effectively reducing our energy consumption by various external and internal pressures; and concurrently, we are in the midst of one of the most complex monetary crises of modern times—



Source: Institute of Gas Technology

Fig. 22-1. Trends of per capita GNP and annual per capital energy consumption in the U.S. 1909–1973.

unemployment is high, inflation is rampant, shortages prevail, and many of our largest business institutions are in serious financial difficulty.

Another interesting observation is that previously all discontinuities or changes in direction of the curves were caused by other forces affecting GNP, with the energy curve following. But this time, the energy curve is the controlling parameter, and the GNP curve is doing the following. This simple observation, if studied in more depth, could go a long way toward explaining the current economic situation.

But in the study of economics, the laws are not as clearly defined or as hard and fast as the laws of the natural sciences; and in most cases, the recognition of a phenomenon as stated in the hypothesis can provide guidance for intelligent solutions to seemingly overwhelming problems. If, for example, in the development of national energy policies, every effort is made to defy the hypothesis, to separate the two curves—bending the energy curve horizontally if not downward while forcing the GNP curve upward—further crises can be avoided.

There is no question but that this can be achieved, and this is the goal of energy economics. In the design of any energy conversion system or the conception of any alternatives to existing methods, the use of energy economics should include the identification of the "energy product" requirement. This identification should start with the concept and be carried through the entire design development of each and every energy related component.

For example, in transportation the "energy product" is simply the theoretical units of energy required to move an individual or given cargo from Point A to Point B in a given time. From this point, the burdens of the practical systems such as vehicles are considered. The phase-by-phase degradation continues until we have achieved a method of providing for the "energy product" in the most effective manner. The final measure is to compare the resource utilized to achieve the product requirement. This evaluation parameter is commonly identified in the automotive area as miles per gallon or in public transportation as passenger miles per gallon.

The same approach can be validly applied to building systems, industrial processes, etc. In Section 12 of ASHRAE Standard 90, this

concept is applied to a degree to building systems.

In the development of energy policies, whether they be national, international, or regional, consideration must be given to the energy hypothesis. The question must be answered: Will the policy reduce energy use while not adversely affecting the monetary economic situation? There are numerous ways of achieving this goal either totally or in part. Lack of recognition of this interplay has plagued us so far.