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Infinite sink?

Chapter 19, entitled "Infinite Source" addressed the concepts of *infinite source* and *infinite sink* as they relate to energy economics. Following introductory discussion, that chapter concentrated on the source issue. This chapter will consider the receiving end of the energy flow path, the sink.

One interesting aspect of energy, in any form or forms, is that it has a tendency always to degrade itself to a lower "level." The earlier discussion discussed the sun as the only true infinite source, and even that source in its relative infinity is continually transferring its energy in astronomical quantities to the space surrounding it. A ball at the top of a hill will always roll down, converting some of its potential energy to velocity, which will ultimately degrade to a low form of heat.

Whenever this direction of energy flow is reversed—that is, when some force outside the natural order attempts to move the energy from a lower to a higher "level"—a quantity of energy is required that exceeds the increase. The option available, then, is to sacrifice a larger quantity of one form of energy to provide a smaller quantity of a more desired form.

Another fundamental concept that must be recognized is the fourth dimension aspect of energy: it is as time related as life itself. Starting with the sun, the energy emanates from the sun in the form of thermal radiation in dimensions of energy per unit time. Whenever we "consume" energy here on earth, supposedly for the benefit of mankind, we consume it in the power dimension—energy per unit time.

Prior to the advent of man on earth, the energy cycle achieved natural balances, which ultimately resulted in storing some energy within the earth. It was when man discovered the fossil energy stored in the earth that dependence on a finite source commenced.

Fossil energy is depleting

The time required for the formation of fossil energy resources is many orders of magnitude in excess of the time rate of consumption, to the extent that the former is irrelevant. It can thus be reasoned that fossil energy is totally depleting!

As energy degrades (considered as a source in its initial form), it can be thought of as simply taking a useful path toward a lower level region called a sink. And since man generates the need for the flow, it can be reasoned that man creates the sink. As an example, if man creates a need for energy in the form of electricity, he has dictated a need for energy in a higher form than the stored fossil resources. Thus, for each unit of electricity required, three to four units of fossil energy will move from the fossil storage form to ambient temperature form (the ambient temperature being the ultimate sink for earth-bound processes).

Time-integrated loads are sinks

In the science of building technology, the time-integrated loads can be thought of as being intermediate energy sinks. The amount of energy available to serve these loads was relatively well matched to the true need when energy was not readily available and when the monetary cost of purchasing and converting it was relatively high. As the immediate availability became less of a problem, however, and the unit cost reduced, a mismatch of the consumption and the need started to develop.

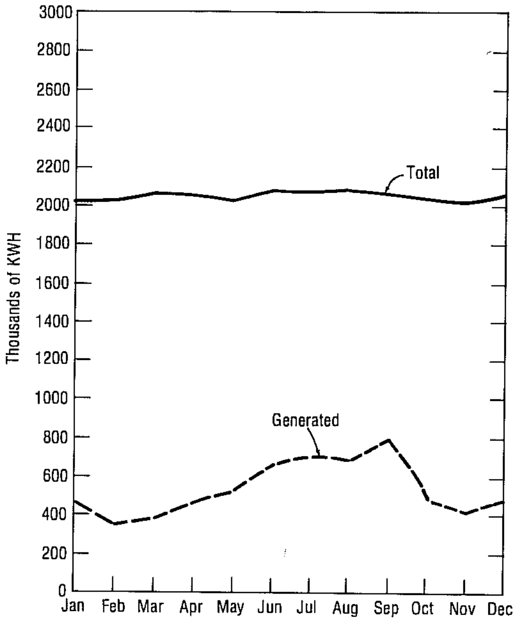

Fig. 26-1. Monthly consumption of electricity at educational institution.

Indeed, in many cases the true need was forgotten, and the problem of converting energy in ample quantities to serve *any* need became the underlying motivation. In engineering technology, efficiency of conversion became the goal, *not* efficiency in ultimate utilization.

Figure 26-1 is an example of the creation of an energy sink on the campus of a relatively large educational institution in the Midwest. This is a graph of monthly electrical energy consumption in kW-hr for a calendar year. It is most interesting to note that the consumption is essentially independent of those parameters that would normally be expected to affect it—outdoor temperature, hours of daylight, student population, etc. *On this campus was created the ideal electrical profile from the standpoint of the energy conversion system!*

Figure 26-2 is the fuel consumption graph for the same campus for the same year. Although there is a bit more shape to this curve than to that in Fig. 26-1, obviously relating to weather, the base is extremely high (minimum monthly consumption is 57 percent of maximum) and is totally independent of campus population!

The staff responsible for the energy systems on the campus historically concentrated all their efforts on the efficiency of the conversion at the campus power plant. (The plant was an integrated energy plant that produced both electrical and thermal energy. The electric loads were shared with the electric utility company in such a way that the plant efficiency could further be optimized.) In these efforts, the staff was extremely successful; the plant was highly efficient.

In retrospect, however, the method utilized to accomplish the high degree of efficiency was one of building the loads to match the availability of a given form of energy. Though there may have been some validity to this concept in isolated instances, it was when it became the underlying philosophy upon which policies were based that reason lost control.

This case history is not unique. The concept of "building the load" is fundamental to our entire current-day economic system. Once a pipeline company invests in running a line across the nation, it is to its overwhelming

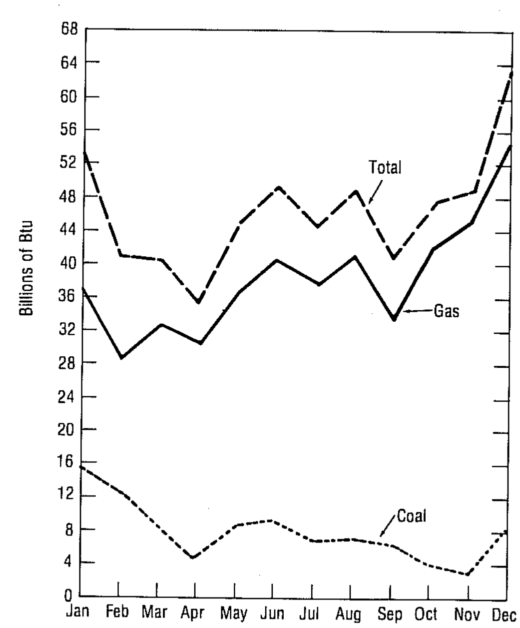

Fig. 26-2. Monthly consumption of fuels for same campus as in Fig. 26-1.

advantage to deliver all the fuel it possibly can through the pipe. Once an electric utility company invests millions of dollars in a generating plant, its economic survival depends on maximum utilization of that plant. If, as on the campus, the load does not exist in the natural order of things, the utility must create a market by building a load to support the investment in plant.

Thus it is that society continues without policy or plan to create an infinite sink into which we degrade our finite quantity of fossil energy reserves at an ever-increasing rate in a highly efficient manner!