

## SECTION VIII

# Energy source systems

The energy source or sources for a building can be thought of as meaning one of two things: either an initial source in its form as found in nature, or the form in which a central conversion plant in the building, or remote from the building, delivers it to the use system or some intermediate transport system. In the final analysis, studies of the building source system must include consideration of both the initial natural resource which is employed and the method in which that resource is converted to the ultimate building use form. Lack of recognition of this fundamental principle has led to misdirected source selection in a significant percentage of the buildings constructed during the period commencing about 1945, and if not recognized in the future, will continue to plague efforts to address the energy source selection intelligently.

In the era of aggressive energy marketing during the 1950s and 1960s, little attention was given to the initial resource from which the energy was obtained or the method or efficiency of converting it. The primary consideration was monetary economics which themselves were often misapplied. This situation was primarily existent in North America where the energy supply industries had been geared up for the needed production of World War II and were seeking new markets, supported by a combination of available resources, technology, and capital. It has only been since the mid-1970s when the age-old economics law of supply and demand started exerting pressure in the marketplace that both the owners of buildings and the designers of the energy systems have become concerned about energy on other than a present-day economics basis.

Unfortunately, when a particular parameter becomes a popular issue, it tends to be applied out of proportion to its true relationship to the other parameters. The first chapter in this section is simply a checklist aimed at keeping the energy source/system selection in perspective. The chapter on the "Myth of Free Steam," illustrates by simple but hopefully valid arithmetic the error of not considering the time-integrated nature of energy consumption and the error of not reexamining yesterday's technology today. In an earlier era, when alternative energy sources were not available to serve relatively large loads, the builders of these large facilities found it necessary to construct their own conversion plants. It was thus that many institutions and large buildings contained electrical generating plants. Since state of the art at that time was primarily turbine-Rankine plants, the concept of utilizing turbine exhaust for building heat was a viable method of increasing the effectiveness of energy utilization during some months of the year.

We now live in a different era and must reevaluate these prior decisions in view of new technologies and economic structures. In the combined power-heat cycle of the steam Rankine system, the steam is first expanded through the turbine, then condensed in either a heating system or for some beneficial process heat. Conceptually, this source cycle can be shown to have a design value (power) "efficiency" of 70 to 80 percent. It can also be shown that *each* of the products produced (electricity and heat) is produced at the combined cycle efficiency. This appears to be the only way to provide shaft power from heat at higher than the Carnot efficiency. Thus the reason for all the attention to the so-called cogeneration concept in the late 1970s.

The shortcoming with most applications of the cogeneration concept is that the whole problem has not been addressed—some of the ingredients of which are the identification of valid thermal loads, the load balance between shaft and thermal needs versus the machinery balance between shaft and thermal capability, and the time-integrated variations in both the absolute quantities of the loads and the balances. Only when these other parameters are properly analyzed, can the true wisdom of specific cogeneration selections be determined.

There was a considerable amount of activity in the decade of the 1960s in what is now called cogeneration. The popular thrust at that time utilized internal combustion (Otto or Diesel) cycles. Chapter 44, "An Oil-Fired Integrated Plant Design" is a step-by-step discussion on the design approach for such a facility. Although we are currently reconsidering the wisdom of utilizing oil for building systems, most of the materials in that chapter are also applicable to the design of natural gas fired plants. The final chapter in this section reflects upon the status of this internal combustion cogeneration activity (called total energy) at the time of its original publication in May 1978.

One statement in the first chapter might be discussed in more detail, as it is probably the single most important consideration in the selection of a building's energy source. That statement is as follows:

Reliability of the source, however, is an often overlooked parameter. If there is any question of future availability or future stabilized cost, the system should provide for conversion to an alternate source.

In designing the source system, this simple statement should never be overlooked—doing so could destine the building to an early and unanticipated obsolescence. This is particularly true if the resource source is not readily identified as is the case when the building receives a preconverted form such as electricity or district steam.