Solid Wastes, Geothermal Conversion Provide Alternative Electric Power Sources

The growth rates of converting municipal solid waste to energy and of geothermal energy may well exceed that of nuclear power generating capacity, observes this engineer, who sees serious drawbacks to both nuclear and fossil fuel energy production. The technology exists today for transforming the municipal headache of solid waste disposal into an economically feasible source of energy and materials.

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Among the most significant techniques for meeting this country's growing demand for electric power—while eliminating dependence on fossil fuels—are nuclear reactors, the conversion of solid wastes, and use of geothermal sources. But debates continue to rage about the safety of nuclear reactors, and disposing of the nuclear waste materials is a growing problem. Fusion reactors, which don't produce nuclear waste materials, will not be developed and ready for use until around the year 2000.

Other methods including coal gasification and the conversion of the sun's energy are also under study, but most will not become economically feasible for large-scale applications within the next decade. That leaves solid waste conversion and geothermal sources as two of the most important proven means of satisfying this nation's almost insatiable thirst for electric power.

The enormity of the problem we face is clear when one looks at some of the facts. In the last 15 years, the total electric generating capacity in the U.S. has more than tripled, and the demand grows at an ever-increasing rate. We use about one-third of the total amount of energy consumed by the entire world and more than twice as much as is used in Russia—even though that country has about 50 million more people than the U.S. does.

In spite of the problems, much of the power in the future will very likely come from nuclear generators. The Atomic Energy Commission (AEC) has projected that in 1990, the total generating capacity in this country will be about 1.1 million megawatts, and the AEC predicts that nearly half the total will come from nuclear power plants.

Yet it seems highly probable that such techniques as solid waste conversion and geothermal energy, though perhaps not accounting for a major portion of the total, will be very important. Their growth rates may very well exceed that of nuclear power generating capacity with the added benefit that present-day technology is available to develop both. This belief is based in part on the continued advances being made in the application of those techniques. Both methods are already in use in various parts of the country, and, only recently, San Diego Gas and Electric announced completion of a fifth geothermal well in California's Imperial Valley; the firm indicated it would build a geothermal power generating station at the site.

One distinct advantage of both techniques is that the fuel sources are free—unlike nuclear fission reactors or conventional power stations using fossil fuels. The fuel source for hydroelectric plants is also free, but those only account for about 15 percent of the total.

According to a survey made last year by the U.S. Conference of Mayors, almost half of our cities will be running out of current solid waste disposal capacity in five years. Second, the municipal governments when forced to use disposal sites farther away than current sites will be faced with an increase of cost per ton in transportation costs due to the longer distance traveled by disposal trucks.

Finally, the amount of solid waste per capita has increased dramatically in the last 50 years and will continue to increase, therefore resulting in larger costs per capita. According to data from a national solid wastes survey, the average amount of solid waste collected in the U.S. is over 5.3 pounds per person per day. This is equivalent to 380 billion pounds per year with energy potential equal to 250 million barrels of oil.

Organic solid waste can be transformed into oil or gas by pyrolysis, and the inorganic portion is a source of metals and glass which are of considerable marketable value. The technology exists today to transform this municipal headache to an economically feasible source of energy and materials, and Envirodyne feels that those who utilize this wasted resource will benefit now and even more so as the availability of energy and materials decreases.

The major tasks necessary to finding the best solutions to solid waste conversion to fuel and materials resources are:

1. Evaluation and optimization of advanced waste disposal systems now being developed or refined. The functions these various systems perform are separation, shredding, pelletizing, recycling, pyrolysis, and combustion.

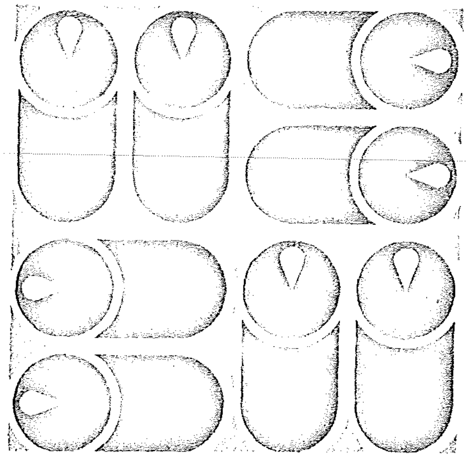
2. Study of the by-products available from processing solid wastes. These include the quantity and quality of fuel, metals, glasses, and the like.

3. Development of markets that can utilize these by-products.

4. Continued study of forthcoming developments that will optimize and refine the recovery and utilization of the energy and material potential of solid waste conversion to energy. With current shortages of energy and predictions of more shortages, other fuel sources must be found and implemented. Some companies, including Envirodyne Energy Services, are prepared and have the ability to work with any governmental agency to do the necessary research, implementation, and operation of a complete waste disposal and resource conversion facility.

What then is the current "state of the art" in regard to power generation from trash? There are presently two methods available—pyrolysis or the burning of trash as a solid fuel. Pyrolysis, or destructive distillation, is an old process that has received much interest of late because of the shortage of natural gas. Furthermore, there is renewed interest in making fuel gas from coal which was widespread prior to World War II. There are, in fact, some similarities between the production of a gaseous fuel from coal and from trash.

Basically, pyrolysis is achieved by bringing the long-chain cellulosic waste materials to a temperature above 1200°F in the absence of oxygen. The net result is a breakdown of the long hydrocarbon chains into shorter links which are liquid and gaseous fuels. There are several techniques for accomplishing the end result.



The most obvious competition for pyrolysis is to burn trash as a solid fuel. This provides a greater heat recovery at lower capital costs. This is the way St. Louis and Union Electric Company have chosen to solve their problem. The trash is fed into two coal-burning furnaces to generate steam.

The approach is being used in Chicago to handle 2000 tons of trash per day. Here again, the trash will be mixed with coal. The light paper-like fuel from trash has one major drawback. It tends to air lift out of the bed of coal and may coat the inside of the furnace thus cutting down on the heat transfer rate.

One solution to this is to pelletize the paper-like trash so as to keep it from being air lifted. Shredding to a smaller particle size is another way of solving this problem. The basic furnace design may also be tailored to meet this problem. For example, the use of a cyclonic vortex motion within the combustor is a way of ensuring adequate residence time of the burning particles. This has been working successfully with powdered coal and lignite, and General Electric Company has been developing a Vortex Incinerator at Shelbyville, Indiana, to incinerate up to 95 tons per day of shredded combustibles from trash.

The other source of free fuel available with today's technology is from geothermal resources. The earth is an immense reservoir of energy, but most of this energy is contained in the earth's core and mantle at depths unlikely ever to be tapped by any foreseeable drilling technology. Within the earth at depths potentially accessible to drilling (about six miles) are stored approximately 10^{24} Btu's of heat, enough energy to maintain the United States at its present level of energy consumption for almost 14 million years. Most of this heat is far too diffuse to be considered as a potential resource.

However, economically significant concentrations of geothermal energy do occur in local hot spots where high temperatures (150° to 650°F) are found in porous rocks containing liquid water and/or steam. Such concentrations of extractable heat are known as geothermal reservoirs. The reservoirs are found in regions of recent volcanism and mountain building and in the deep parts of many sedimentary basins.

The energy in a geothermal reservoir consists of heat, largely stored in rocks and, to a lesser extent, in liquid water or steam-filling pores and fractures. The water and steam provide the means by which heat from deep sources is transferred by convection to depths shallow enough to be tapped by drilling. The fluid in most geothermal reservoirs is liquid water that is held at temperatures above surface boiling by the confining pressure. Decrease in pressure upon withdrawal of the liquid water causes steam and water at the surface.

According to the United States Geological Survey, for a geothermal reservoir to have appreciable potential for exploitation it must meet the following requirements: 1. relatively high temperature (greater than 150° to 400°F, depending on processing technology); 2. a depth shallow enough to permit drilling (currently 10,000 feet or less); 3. sufficient rock permeability to allow the heat transfer agent (water and/or steam) to flow continuously at a high rate; and 4. sufficient water recharge to maintain production over many years.

Limited exploitation of geothermal resources has occurred since the turn of the century, primarily to generate electric power. Geothermal resources also have been used for space heating, product processing, and agricultural heating, and, in addition, some geothermal fluids contain chemicals and metals of potentially great commercial value. Furthermore, geothermal energy appears to have an important potential use in desalination, either of the geothermal fluid itself or of other saline waters that may occur near a source of geothermal energy.

Estimates of the ultimate electrical generation potential of the Imperial Valley range up to 25,000 megawatts. By comparison, the most optimistic projections of the ultimate capacity of the geysers geothermal area in Northern California peak at 4800 megawatts. In yet another light, the geothermal electric generating capability of the Salton Sea area could itself provide almost 75 percent of Southern California Edison's projected load for the year 1995, according to one projection.

To date, very little available technology has been applied to the development of our geothermal resources. It is common to header several geothermal wells together, thereby being subject to the temperature limitations of the worst producing well. The separation of the dissolved solids, while presently treated as a liability, could offer possibilities for commercial extraction of sodium chloride (table salt), calcium chloride, potassium chloride (potash), and lithium chloride in parallel with the generation of electricity. Geothermal fields have been abandoned because the total dissolved solids were thought to be too high to produce electricity. Why not use these hot brines for water desalination? The technology and the need both exist today.

Because of the simplicity of the geothermal technique, the fact that solid waste conversion eliminates disposal problems of the waste materials, and the proven feasibility of these approaches, both systems are expected to be rapidly adopted around the country. pe