



Project Summary

Alternative Energy Sources for Wastewater Treatment Plants

This technology assessment provides an introduction to the use of several alternative energy sources at wastewater treatment plants. This document assumes that the reader has little or no knowledge of the technologies presented. The report contains fact sheets (technical descriptions) and data sheets (cost and design information) for the technologies. Cost figures and schematic diagrams of the technologies are included. Case histories of seven treatment plants that have used one or more of the alternative technologies are presented.

Based on this assessment the following alternative energy technologies appear to be potentially cost effective:

1. Heat pumps which use influent or effluent wastewater as their heat source, for supplying process or building heat.
2. Geothermal direct-use systems for large energy loads when geothermal source is adequate.
3. Wind power systems for large electrical loads when annual wind flux is adequate.
4. Passive solar systems where they can be cost-effectively integrated into the overall architectural design of a facility.
5. Low-head hydro systems may be appropriate for smaller plants which have an available head greater than three meters.

This Project Summary was developed by EPA's Water Engineering

Research Laboratory, Cincinnati, OH to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This technology assessment provides an introduction to the use of several alternative energy sources at wastewater treatment plants. This document assumes that the reader has little or no knowledge of the following technologies:

1. Heat pumps,
2. Active solar systems for heating and cooling,
3. Photovoltaic systems,
4. Geothermal--direct-use systems,
5. Wind power systems,
6. Low-head hydro systems,
7. Passive solar systems,
8. Geothermal--power generation systems,
9. Fuel cells, and
10. Active solar systems for power generation.

For each of these technologies, the report presents a "fact sheet" that contains a description of the technology (including schematic diagrams), the current status of development and applications, design considerations, performance and reliability information, and a reference list. For the first six technologies listed above, simplified design and cost-estimating information is presented in "data sheets". Data collection for the report was done in 1982, therefore, the costs presented

should only be used to gauge the relative costs of the various technologies. Current cost information should be obtained from equipment vendors or other current sources for actual cost estimating.

1. Wilton, ME (active solar for process heating, passive solar, and heat pumps),
2. Lake Tapps (Bonney Lake, WA) sewerage project (Low-head hydro),
3. Newport, VT (active solar for process heating),
4. Hillsborough, NH (passive solar),
5. Livingston, MT (wind power),
6. Woodlawn, NY (Southtown plant) (wind power), and
7. Waynesburg-Magnolia, OH (photovoltaic).

Of the seven case histories, only Wilton, ME had been on-line long enough at the time the report was written to have meaningful operating data.

Conclusions

Heat Pumps

Heat pumps are commercially available. The temperature of the alternative energy source is the principal potential technical limitation on the application of these systems in POTW's; however, the use of the wastewater itself as the alternative energy source minimizes the impact of this limitation. The use of influent or effluent wastewater heat pumps is generally cost-effective in comparison to distilled oil, residual oil, and natural gas for supplying process or building heat to the POTW.

Active Solar Heating and Cooling Systems

Active solar heating and cooling systems are commercially available. The available solar insolation rate and system cost are the principal limitations on the application of these systems in POTW's. Active solar heating and cooling systems are not cost-effective alternatives to the use of conventional energy supplies in POTW's due to the high capital investment.

Photovoltaic Systems

Photovoltaic systems are commercially available. The available solar insolation rate, system energy conversion efficiency, and system cost are the principal limitations on the application of these systems in POTW's. Because of the high initial capital investment, photovoltaic systems are not cost-effective alterna-

tives to the use of conventional electrical energy supplies in POTW's.

Geothermal -- Direct Use Systems

Geothermal direct use systems are commercially available. Geographical limitations associated with the geothermal temperature gradient and available well flow as well as site investigation and well construction costs, are the principal limitations on the application of these systems in POTW's. Geothermal direct use systems appear to be cost-effective in comparison with the use of conventional fuels for satisfying thermal energy loads greater than 10⁸ kJ/d when the geothermal temperature gradient is approximately 45°C/km or greater, and when well flows are of a sufficient magnitude. Locations with geothermal gradients in excess of 45°C/km are predominantly limited to the Rocky Mountain states.

Wind Power Systems

Wind power systems are commercially available. Geographical limitations associated with the available wind flux regimes as well as overall system costs are the principal limitations on the application of these systems. Wind power systems appear to be cost-effective in comparison with the use of conventional fuels for satisfying energy loads greater than 1,000 kWh/d, when the annual wind flux is approximately 4,000 kWh/yr-m² or greater.

Locations with annual wind flux greater than 4,000 kWh/yr-m² are predominantly limited to areas in the following states:

- | | |
|------------------|--------------|
| • Maine | • Colorado |
| • Vermont | • Wyoming |
| • New Hampshire | • Montana |
| • New York | • Idaho |
| • Virginia | • Utah |
| • North Carolina | • Nevada |
| • Kansas | • Washington |
| • Oklahoma | • California |

Low-Head Hydro Systems

Low-head hydro systems are commercially available. Geographical limitations associated with the available head for these systems and the fraction of the total POTW energy requirements satisfied are the principal limitations on the application of these systems in

POTW's. From the standpoint of satisfying a significant portion of POTW's electrical requirement, the systems appear to be more appropriate for smaller POTW's. The use of the systems should be seriously considered in any application that has an available head greater than 3 m.

Passive Solar Systems

Passive solar systems are commercially available. These systems have been used previously to reduce the consumption of conventional heating fuels in POTW's, as well as many other architectural applications. The principal technical limitations of passive solar systems are possible site-specific limitations on available solar insolation and the integration of the passive system into the overall architectural plan. Potential economic limitations are primarily associated with the incremental costs for construction of the passive solar system instead of a conventional architectural design. These incremental costs must be considered, along with the amount of alternative energy supplied, on a case-by-case basis to potential justify the use of a passive solar system in specific applications. In light of the rising costs for conventional fuels, these systems should be seriously considered in future construction at POTW's throughout the United States.

Geothermal -- Power System

Geothermal power systems are commercially available, however, current technological limitations on minimum system size, as well as the limited availability of acceptable sites exhibiting the necessary geothermal characteristics will likely prevent the use of these systems in POTW's.

Fuel Cells

Fuel cells are not expected to be commercially available until approximately the year 2000.

Active Solar Systems for Power Generation

Active solar systems for power generation are not expected to be commercially available until the mid 1990's. In addition, these systems can only use direct sunlight, and, therefore, their applications would be primarily limited to arid regions of the southwest.

The full report was submitted in fulfillment of Contract No. 68-03-305 by Roy F. Weston, Inc., under the sponsorship of the U.S. Environmental Protection Agency.

This Project Summary was prepared by staff of Roy F. Weston, Inc., West Chester, PA 19380.

Francis L. Evans was the EPA Project Officer (see below for present contact).

The complete report, entitled "Alternative Energy Sources for Wastewater Treatment Plants," (Order No. PB 88-239 090/AS; Cost: \$21.95, subject to change) will be available only from:

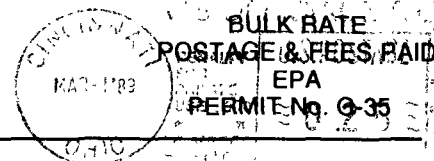
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