

## District Heating and Cooling Development: Kent County, Michigan

District heating and cooling systems can save substantial amounts of energy on a community-wide basis. When combined with a waste-to-energy facility, district heating has the added advantage of helping to solve one of the nation's most serious environmental problems—disposal of municipal solid waste.

In 1986, DOE provided Kent County, Michigan, with \$50,000 to assess the feasibility of a district heating/cogeneration system. As a result of this study, Kent County constructed a 625 ton-per-day waste-to-energy cogeneration facility at a cost of about \$62 million. Kent County's state-of-the-art air pollution control system contains scrubbers and a baghouse. These bags trap particles and prevent them from being emitted into the atmosphere. Their use is expected to remove 99.8% of total particulate mass and more than 99% of the smaller particles.

The facility will serve six communities with a total population of approximately 320,000, including Grand Rapids, Michigan. The system will deliver approximately 115,000 pounds of steam per hour to the county-owned district heating loop and generate 14 megawatts of electricity to be sold to a local power company. Revenue from tipping fees is estimated at approximately \$38 per ton. The project serves as an example of how a community government can develop a community energy system to provide an alternative to the use of oil or gas.

## Acoustic Leak Detection System

Many industries use pipelines to carry steam, water, gas, and oil. The costs for detection and repair of leaks in these pipelines are high in terms of lost productivity and repair time. The District Heating and Cooling Leak Detection Research program, cofunded by Consolidated Edison and the Fluid Conservation Systems Corporation, allowed scientists at the Argonne National Laboratory to develop a computer-based acoustic monitoring system that can accurately locate underground pipe leaks. The detector records sounds created when pressurized gas or liquid escapes from a damaged pipe. The data are fed into a computer that provides information on the location, size, and type of the leaks. Experiments on district heating pipes demonstrated that water leaks can be detected at a distance of 500 feet and escaping

steam at 1500 feet. Utility companies may be able to save thousands of dollars per week by using the acoustic leak detector system for location and repair work.

## Infiltration Model

Infiltration, the uncontrolled flow of air through a building's shell, is responsible for one-third to one-half of residential and commercial building energy requirements. Before 1980, no adequate method existed to predict energy losses owing to infiltration. To meet this need, DOE sponsored the development of an infiltration model that provides simplified techniques for estimating infiltration rates in residential buildings based on building-envelope parameters and climatic conditions.

To predict the performance of air infiltration in the building shell, the model uses the leakage properties of the building envelope and site weather data. The model may be used with a hand calculator and is usually accurate to within 20% of actual figures.

Described in detail in the ASHRAE *Handbook of Fundamentals*, the infiltration model is currently being used throughout the professional design community and has been incorporated into major energy performance computational programs (CIRA, DOE-2, BLAST, and TRNSYS). Residential building designs that incorporate the results of the infiltration model are typically 10% to 15% more energy efficient. The residential infiltration model is currently being extended to analyze infiltration in commercial buildings.

## DOE-2

The DOE-2 building energy simulation program was developed as an unbiased analytical tool to assist in designing buildings and evaluating building performance from the perspective of energy use, efficiency, comfort, and cost. Operating on a wide variety of computers ranging from personal computers to mainframes, DOE-2 has become the standard by which similar commercially developed programs are evaluated. DOE-2 has been used in developing building industry standards, such as the ASHRAE Standard 90, the California Building Code, and the ASHRAE *Handbook of Fundamentals*; as an aid in developing simplified analytical tools (ADM-2, Trackload, ASEAM [A Simplified Energy Analysis Method], BLAST, and PEAR); and as an educational tool to train engineers, designers, and architects. Since its release in 1977,