

DISTRICT HEATING

The History of District Heating

District heating is the method by which thermal energy in the form of steam or hot water is distributed to various users from a central source through a series of underground pipes. District heating is not a new concept. It began nearly 2,000 years ago when the Romans constructed underground pipe systems to heat dwellings as well as baths.³⁰⁵ District heating received its start in the United States in 1748, when Benjamin Franklin built an iron stove type furnace in an underground chamber and used it to heat several row homes.³⁰⁶ The first commercial use of a district heating system was pioneered by Birdsell Holly in 1877 in Lockport, New York. Using a boiler in his home as the central heat source, Holly developed a steam loop which provided heat to his and his neighbors' homes.³⁰⁷

In the following decades, Pennsylvania's district heating systems began to develop rapidly. By 1900, there were 33 systems of various sizes and configurations throughout the Commonwealth.³⁰⁸ The majority of these systems were operated by small, locally owned utility companies, and provided thermal energy to the local community. These systems were generally not very large and served mostly residential buildings. A few of these systems served larger metropolitan areas and were commonly a division of the local electric utility which utilized the exhaust steam from power generation to fuel the district heating system. The components of a typical district heating system are diagramed in Figure 51.

In the 1940s, the district heating industry entered a period of decline with the development of larger and less centrally located electric generating facilities and the advent of closed cycle turbine generators which lacked exhaust steam. Generating steam separately (instead of having it as a byproduct from generating electricity) greatly increased costs and district heating systems were forced to raise rates.³⁰⁹ During the years after World War II, many of the systems began to fail for a variety of reasons including prices of competing fuels, piping deterioration, higher insulation cost associated with steam systems, heat load problems, the non-replacement of lost customers and a lack of interest on the part of the host electric utility.³¹⁰

During the last five years, district heating has experienced a resurgence throughout the United States. Cities such as Jamestown, New York, Provo, Utah, and Trenton, New Jersey have built district heating systems in an effort to lower energy costs and provide an economic incentive for urban revitalization. Utilizing new technological improvements such as hot water as the heat medium, improved insulated piping systems with built in electronic leak detection systems and fault indicators, district heating systems are now in a position to compete with other forms of delivered energy.

Commercial District Heating Systems in Pennsylvania

Today there are seven urban district heating systems operating in Pennsylvania. Figure 52 lists these systems.

During the summer of 1986, the PEO commissioned a study to assess the current state of district heating in Pennsylvania and the potential for further development of such systems. The *District Heating Assessment Survey for the Commonwealth of Pennsylvania* studied the characteristics and operation of the current systems, the reasons for abandonment of the district heat systems, and potential areas for future district heating sites. A total of 39 municipalities across Pennsylvania were identified as having the basic characteristics necessary to support a viable district heating system.

Figure 52

District Heating Systems in Pennsylvania

<u>System</u>	<u>Heat Capacity (lb/hr.)</u>	<u>Age</u>	<u>Fuel Type</u>	<u>Total Length (miles)</u>
Erie	400,000	87	coal	6.6
Harrisburg	500,000	98	oil	6.8
Philadelphia	2,000,000	82	oil	32.0
Pittsburgh (1)	240,000	19	gas/oil	1.5
Pittsburgh (2)	500,000	57	gas/oil	5.6
Scranton	368,000	95	gas/oil	18.5
Wilkes-Barre	321,000	80	coal/oil	4.7

(1) Equitable Gas

(2) Pittsburgh Allegheny County Thermal

Source: PEO, *District Heating Assessment Survey for the Commonwealth of PA*, 1986.

These characteristics include an adequate heat load density,³¹¹ a heat source, reasonable distance between the heat source and load and possible system expansion opportunities.

As a result of the assessment, the PEO sponsored a program to determine the feasibility of implementing new systems or expanding current district heating systems. A total of 13 studies have been co-funded with local governments. These are listed in Figure 53. The results of these studies indicate that there is a potential for expansion or implementation in a majority of the sites.

Small Scale District Heating Systems

In addition to the large urban systems, many small district heating systems are located throughout the Commonwealth. Many college and university campuses and industrial parks have systems which provide heat to the buildings and facilities on the campus or in the park. At the Pennsylvania State University in State College, a system provides heat to over 160 buildings with 11 million square feet of space. The Indiana University of Pennsylvania has a campus system which distributes heat from a gas-fired facility which also cogenerates electricity.

District heating system applications in industrial parks can provide a strong economic development benefit by providing low cost energy services. At an Ebensburg industrial park currently under development, the district heating system will be supplied by a facility which burns bituminous waste coal. The facility will provide steam to the occupants of the park and a nearby Commonwealth facility (the Ebensburg Center) and electricity will be sold to the local utility.

District Heating System Development

The successful development of district heating systems depends on overcoming problems with market entry, financing, and certain legal, regulatory and environmental issues. Market entry requires overcoming the initial lack of general knowledge about district heating and obtaining initial institutional and financial support for such things as feasibility studies. Financing issues primarily surround the high capital cost and long construction time of the systems, further complicated by uncertain future energy prices. Legal and regulatory issues affect system development in terms of pricing of energy services, allocating benefits, and ownership arrangements. The key environmental issues are air emissions and other environmental impacts of the boiler plant which provides the thermal energy for the system.

The PEO, as part of its 1986 district heating survey, developed a Planning Guidebook for local officials which outlines the basic steps municipalities should take when contemplating a district heating system.³¹² The PEO should build on the guidebook concept and develop a comprehensive district heating technology transfer and information program. The PEO should develop and organize specific informational pieces on district heating, the issues involved in system development, and methods to achieve community support for these systems. This program should also include a database of the latest technologies and current regulations affecting district heating development. In addition, a system of tracking district heating projects across the country should be included to assist developers and communities in learning about the successes and failures of other systems. The PEO should host regular meetings of current district heating operators as a means of sharing information and developing solutions to common problems.

Figure 53

District Heating Preliminary Feasibility Studies Funded by the PEO

<u>Organization</u>	<u>Objective</u>
Chambersburg	System Implementation
Chester	System Implementation
Chester County	System Implementation
Easton	System Implementation
Erie	System Expansion/Ownership
Harrisburg	System Expansion
Kutztown	System Implementation
Mercer County	System Implementation
Montgomery County	System Implementation
Philadelphia	System Expansion
Pittsburgh (PACT)	System Expansion
Scranton	System Expansion
Wilkes-Barre	System Expansion

RECOMMENDATION 76. The Pennsylvania Energy Office should expand its district heating technology transfer and information programs. The office should develop a database with information on current projects, new technologies, vendors, etc., as well as plans to make this information available to cities, developers and other interested parties. The office should also serve as a facilitator and trouble-shooter for communities interested in developing or expanding district heating systems.

Residential Customer Arrearages of PUC Regulated Utilities in 1987

	Arrearages of Customers with Current Payment Plans <u>(Mo. average)</u>	Arrearages of Customers w/o Current Payment Plans <u>(Mo. average)</u>	Write-off <u>(Annual Total)</u>
Gas	\$30,800,000	\$23,300,000	\$16,938,000
Electric	\$83,200,000	\$79,634,000	\$48,959,000

Source: Data from utility filings submitted to the PA PUC pursuant to 56 Pa. Code Section 231.