DISTRICT ENERGY

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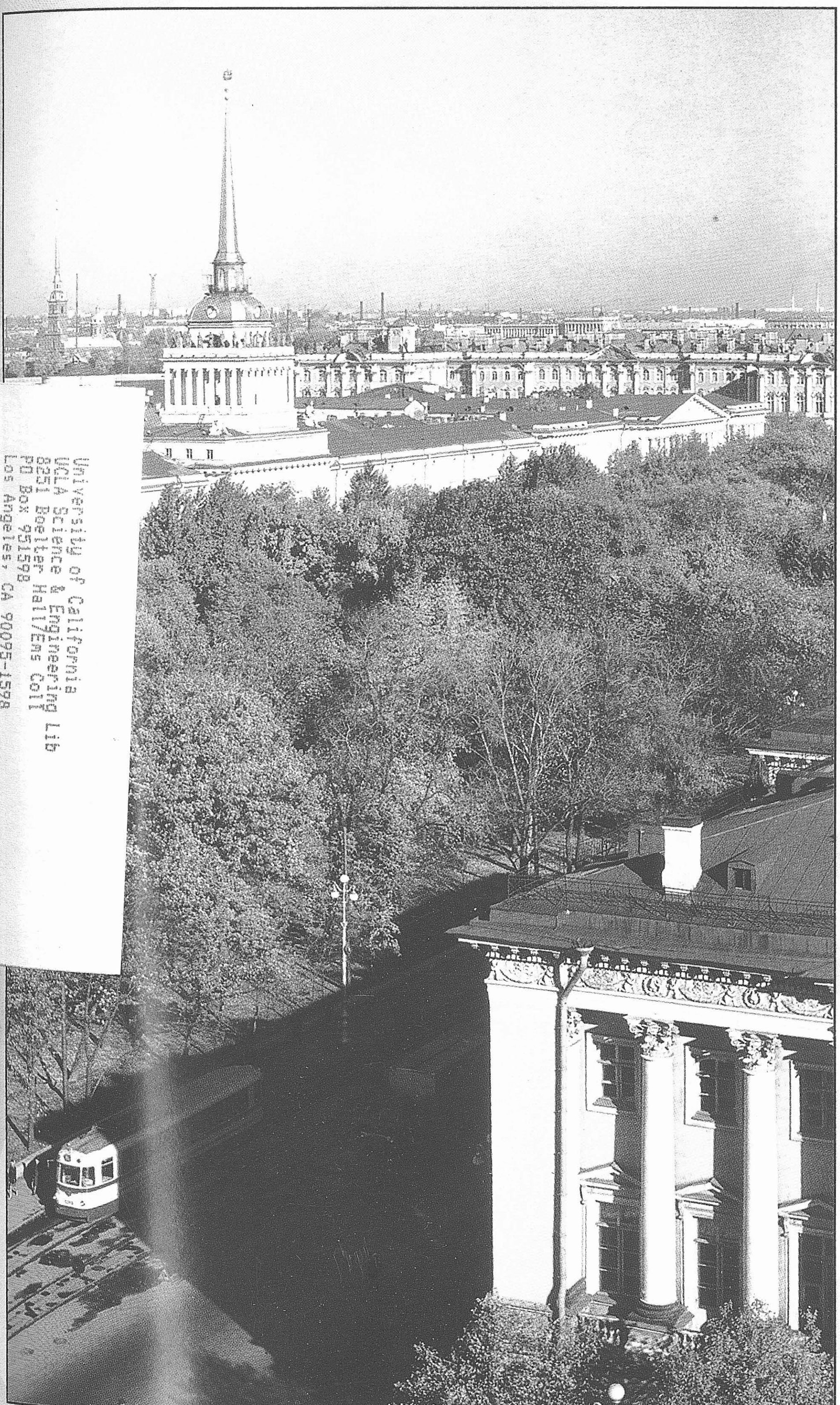

Russia Rebuilds With Eye on Energy-Efficiency

Featuring

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Volume 81 Number 4 Second Quarter 1996

DISTRICT ENERGY

COVER STORY

Dr. Ishai Oliker, P.E., Principal, Joseph Technology Corporation Inc.

Russia's critically important district heating systems provide almost 70 percent of the nation's heat, giving district energy an important political and economic role. Nationwide rehabilitation strategies for district energy must consider a diverse set of concerns: unusually large-scale systems, wide-spread pipe corrosion, poorly insulated buildings, a relatively short remaining service life of 35 percent of installed capacity, and the close link between development of district heating and the tremendous ongoing changes throughout Russia's infrastructure. Despite these challenges, Russia will certainly continue to demonstrate the social, economic and environmental advantages of district heating as the industry works to raise energy-efficiency.

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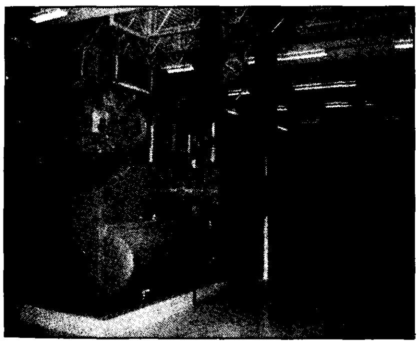
FEATURES

Morris A. Pierce, Energy Manager, University of Rochester

Community heat-supply plans focus on energy-efficiency, safety, environment and consumer choice and often result in the construction of new or expanded district energy systems. The U.S. district energy industry can benefit from modeling this European practice which has played a significant role in earning the European district energy industry a much larger marketshare than its U.S. counterpart.



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Andree D. Keneau, Communications/Marketing Specialist, Holland Board of Public Works

An average snowfall of 100 inches each year in Holland, Mich., was threatening its downtown economy as shoppers moved to outer fringe malls with easy parking. Replicating a snow-melt practice common in Sweden, a grid of plastic hot-water pipes was laid beneath the street's surface. The installation of this underground system labeled Snowmelt has kept downtown free of snow and ice, revitalizing the commercial and retail area.

Susan Odiseos, Director of Corporate Communications, Trigen Energy Corporation; Peter Laliberte, Communications/Development Associate, Trigen Energy Corporation

Brewers have more time for producing and marketing beer when they turn to Trigen Energy Corporation as their steam source. From microbreweries to the largest single-site brewery in the world, Coors Brewing Company, more brewers are relying on the benefits of district energy to brew their malted beverages.

David W. Wade, President RDA Engineering Inc.

New and long-standing district heating and cooling systems will provide indoor comfort, hot water and process cooling to Olympic athletes and spectators in Atlanta this summer. Olympic-related dormitory construction at Georgia Tech resulted in a new 3,000-ton satellite chilled-water plant. Other Olympic locales served by district energy will include Atlanta University, Georgia World Congress Center, Hartsfield International Airport and the University of Georgia.

DEPARTMENTS

On the Cover: Once known as Leningrad, St. Petersburg is home to Russia's first district heating system. *Courtesy of Novosti Press Agency, Moscow.*

F E A T U R E

Heat-Supply Planning: A Practice Worth Importing

Morris A. Pierce, Energy Manager, University of Rochester

"If district energy is such a good idea, why doesn't everyone use it?" This is an easy question to ask but a difficult one to answer. According to the United States Census Bureau, there are more than 23,000 communities in this country. In a perfect district energy world, there would also be at least as many district energy systems — one serving each community. In fact, the U.S. Department of Energy estimates that more than 30,000 such systems currently exist in the United States. While this figure might seem to indicate that the district energy industry has exceeded its marketshare goals, it cannot be considered a great achievement.

Only about 100 of these 30,000 district energy systems — just 0.3 percent — provide general service to the communities in which they operate. The rest heat and/or cool a single facility, such as a college campus, hospital or factory. Only a few of these systems, including those in Virginia and Hibbing, Minn., provide more than 50 percent of the heating supply in their respective communities. Moreover, most new and proposed district energy systems will actually compete with these existing systems.

Overall, U.S. district energy systems supply about 0.6 quads (0.7 x 10^{15} Btu) of heating and cooling energy to the commercial and residential market, or about 6 percent of the 10-quad heating and 1.3-quad cooling market. Of this total, commercial systems deliver only about 0.1 quad, or perhaps 1 percent, of all commercial and residential heating in the country. (One-third of this total is delivered by one system in New York City.)

This situation can be contrasted with Europe, where commercial district energy systems account for a much higher percentage of the heating market. The development of district energy in western Europe, which has been accomplished under a wide variety of political and economic conditions, has occurred mostly since the early 1970s. One important factor that has contributed to this growth is heat-supply planning, commonly practiced in most European communities but not in the United States. (This is also true of cooling-supply planning, to which the following discussion also applies.)

> ***One important factor that has contributed to [western Europe's district energy growth] is heat-supply planning, commonly practiced in most European communities but not in the United States.***

Heat-Supply Planning in Europe

Since the 1920s, heat-supply planning has been employed in the centrally planned or "command" economies of the former Soviet Union and its allies. It has also been used in western European countries since the end of World War I. As the oil shocks of the 1970s revealed many weaknesses in European energy markets, several countries adopted laws requiring municipalities to prepare heat-supply plans.

Although the details of these plans differ from country to country, the fundamental goals have been the same: reduce energy use through conservation, ensure long-term and safe supplies of heat, reduce fuel imports by using existing local heat sources and indigenous fuels, improve environmental quality and retain the consumer's choice in the energy market.

A typical plan first identifies the quantity and nature of heating used in each community as well as existing and potential heat and fuel sources. It then evaluates the various economic and environmental effects of the alternatives. Since planning periods have generally been defined in terms of decades, it is not surprising that district energy has often been the preferred solution despite the large capital investment required. With financing made available through loans and grants, a very large number of heat-supply plans have been implemented across Europe using a wide variety of fuels and energy sources.

Heat-Supply Planning in the United States

Although communities in the United States typically do not prepare heat-supply plans, it should not seem particularly radical to suggest that they begin doing so. Few people would find it unusual to plan for water supply, sewage treatment or a host of other elements of the modern infrastructure. And virtually every residential and commercial building in this country has some need for space and domestic water heating. In fact, many northern communities simply could not exist without artificial heating systems.

Heat-supply planning may confirm that a community's existing heating infrastructure is adequate to meet future needs. More than likely, however, it will disclose many shortcomings in existing heat-supply apparatus — some of which may only cause discomfort but others, such as carbon monoxide poisoning, that can be deadly.

Developing a Community Energy Profile

The first step in heat-supply planning is to determine the size and basic characteristics of a community's heating supply.

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Many statistics can be found in documents published by the Bureau of the Census and the Energy Information Administration (EIA). These documents are available not only in many local libraries but also on the Internet. Census data provides housing unit counts and heating fuel type for each of the 23,000 communities in the country. The EIA's residential building consumption data include average space and water-heating fuel consumption and costs for each census region. Together these data give a fairly detailed picture of a community's residential heating market, which can be verified and updated with a sample of utility bills for typical households.

Although the energy profiles of commercial buildings will require more legwork to develop, several good sources of information exist. The EIA's commercial building publications contain some useful benchmark data. A community's large energy users are also usually willing to share data on their energy use and costs. Larger commercial and industrial customers should be audited carefully not only to determine consumption profiles, but to uncover potential sources of heat (such as excess boiler capacity or manufacturing-waste heat) that may be incor-

Table 1
Percentage of heating market supplied by commercial district heating.

Iceland	85%
Russia	80%
Denmark	50%
Finland	44%
Sweden	33%
Austria	9%
Germany	6%
France	4%
Netherlands	3%
Switzerland	3%
Norway	2%
United States	0.1%

Source: Euroheat & Power, 1992 National Census of District Heating and Cooling.

porated into a communitywide heating plan.

In assembling a community energy profile, it is also essential to enlist the cooperation of government authorities and utilities. This may in some instances severely test the diplomatic skills of the heat-supply planner. Wherever possible, cooling data should be obtained along with heating information.

Evaluating Heating Alternatives

After determining the basic characteristics of a community's heating supply, the next step is to evaluate various heating technologies. Single-family residences on large lots, for instance, may best be served by ground-source heat pumps, which are becoming popular in certain areas. Commercial, industrial and dense residential locations might well be candidates for a new district energy system or an extension of an existing system. New construction areas where new buildings are just being erected are almost always the easiest district energy prospects.

Potential fuel and heating sources should be considered carefully. Local power plants, refineries or manufacturing facilities may be willing to provide low-grade heat at a reasonable cost. Local geothermal potential, a resource often ignored for heating purposes, should also be explored. If no heat sources are available, biomass fuels might be evaluated, including wood, crop residues and dedicated energy crops. These can produce a significant environmental advantage while contributing to the local economy. Local agricultural agencies can be very helpful in this evaluation.

In many cases, it is not possible to obtain heat from a geothermal, industrial or other existing source. In such instances, a heating plant will be necessary to burn the selected fuels to generate heat for distribution. With appropriate fuel handling and storage facilities provided at the plant site, thermal storage can be incorporated to meet peak loads and take advantage of time-sensitive fuel prices. Thermal storage also permits batch combustion of bulk fuels, such as

Table 2
U.S. residential heating fuels.

Natural Gas	50.9%
Electricity	25.8%
Oil	12.2%
Bottled gas	5.7%
Wood	3.9%
Other or none	1.5%

Source: 1990 U.S. Census.

biomass, during a single shift.

The potential for cogeneration should also be evaluated, since power can often be generated at a very low incremental cost as a byproduct of heat production. Cogeneration with solid fuels will generally require the use of steam turbines, while gasification, landfill methane, natural gas, oil, ethanol or other similar fuels permit consideration of reciprocating engines, gas turbines or even fuel cells.

Cogeneration can often be coupled with thermal storage by operating the plant as a batch process during peak-rate periods (or as dispatched by the electric utility) for a period sufficient to charge the thermal storage tank. In some arrangements, the electric utility provides inexpensive off-peak electric heat to charge the storage tank when the plant's electric capacity is not needed. Heating storage tanks are widely used with cogeneration in Europe to enhance electric network flexibility.

Determining Ownership Arrangements

The various technical options in a heat-supply plan have different tax and financial ramifications that must be considered in determining a system's organizational structure and ownership. The tension between public and private ownership options has often been resolved in Europe by sharing ownership among the municipality and private investors. While not a common arrangement in the United States, such a structure could be explored for district energy systems in this country as well. If a heat-supply plan shows definite economic and environmental advantages for a community, the issue of ownership should, in theory, not be a difficult problem to solve.

Conclusion

Heat-supply planning has been successful in Europe, often resulting in the construction of new or expanded district energy systems. Since several other components of the U.S. infrastructure already involve extensive planning, it would be reasonable to introduce heat-supply planning here as well as at the local level, and perhaps under broad criteria also at the state and federal level. However implemented, heat-supply plans should encompass and provide advantages for the entire community.

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