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**SOLAR-HEATED MUNICIPAL SWIMMING POOLS,
A CASE STUDY: DADE COUNTY, FLORIDA**

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SOLAR-HEATED MUNICIPAL SWIMMING POOLS

A Case Study: Dade County, Florida

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A CASE STUDY: DADE COUNTY, FLORIDA

Introduction

Many cities and counties own and operate public swimming pools as a service to their communities. In fact, there are more than 53,000* local government-operated swimming pools in the United States. A swimming pool is a major part of a municipal recreation program; it means good times, healthful exercise, keeping cool in the summer's heat, and is a service residents appreciate. These benefits are not without a price, in terms of not only the initial capital investment, but operation and maintenance costs.

How much a pool is used is one of the best measures of the value of investing public funds in its construction and operation. The more the pool is used, the more valuable the investment. To increase pool use, many communities are considering heating their pools to extend their useful

period by months or even throughout the year. The expense of pool heating can be reduced or eliminated by using the sun to heat the pool.

Solar energy can heat swimming pools satisfactorily in almost any location. Solar panels can generate sufficient heat for a pool whenever the temperature is 50°F or higher with the sun shining. At higher outdoor temperatures, solar systems can heat a pool on even hazy or overcast days. In warm climates, the pool season can often be extended to twelve months a year, and, in northern latitudes, from two to four months, depending on collector area and use of pool covers.

In December 1978, Dade County, Florida, installed a solar energy system to heat the water in the swimming pool of one of its major parks. This report describes Dade County's successful experience and explains the mechanics of solar-heated swimming pools.

DADE COUNTY'S SOLAR SWIMMING POOL EXPERIENCE

Background

During the winter of 1973-74, Metropolitan Dade County experienced a severe shortage of petroleum products, mostly gasoline. At times, it seemed

doubtful whether emergency vehicles, such as those of the police, fire, and sanitation departments, would remain in operation. In December 1973, the County Manager directed the county government to immediately begin a program of fuel

*1981 Swimming Pool Institute Market Report

conservation in all departments. An energy coordinator was appointed and an energy office established within the General Services Administration.

The County Manager's action originally addressed motor fuel contingency measures to counter the gasoline supply disruption. After the shortages had ended, prices continued to escalate rapidly, leading the energy office and other Dade County departments to continue their energy management efforts.

In May 1980, because of the increasing need for energy conservation in Dade County, the county commissioners established the Office of Energy Management and placed it under the Office of the County Manager. The Office of Energy Management is responsible for coordinating all energy-related activities of Metro-Dade.

Dade County energy goals are to improve the energy efficiency of operations, provide for the economic stability and growth of the total community, and promote efforts to free the United States from its dependence on foreign sources of energy. This is accomplished through improved management of nonrenewable energy resources and promotion of cost-effective renewable resources. To date, energy management efforts carried out with the support of the County Commission and County Manager include over 70 programs, which Dade County officials estimate have saved the community a significant amount of tax dollars.

One of Dade County's more prominent energy management activities has been the installation of a solar energy system to heat an existing county-operated swimming pool. In 1974, Dade County officials began initial research into developing year-round swim programs for the general public, area

Dade County's Tamiami Park Pool

high schools, junior highs, several AAU teams, and the senior adult swimming team. After examining other solar-heated swimming pools, the County Commission, upon recommendation of the County Manager and the Director of the Parks and Recreation Department, decided to install a solar energy system at Tamiami Park's swimming pool. Tamiami Park was selected because it was the only olympic-size pool in the county and because it is used for competitive swimming as well as leisure activities. It is probably the largest solar-heated pool in the United States.

How It Was Done

A Parks and Recreation Department engineer with no previous experience in

solar designed the pool-heating system. Several solar-heated pools were examined before design work began, and technical assistance was sought and provided at no cost by the Florida Solar Energy Center. The Center is a part of the Florida State University System and serves as the "focal point for coordination and promulgation of research, demonstrations, and dissemination of information on solar energy of importance to Floridians." No other outside assistance was provided during the design phase.

Description of the Solar Energy System

The Tamiami Park pool, now affectionately called the "sun pool," contains 500,000 gallons of water, which

Solar panels, which collect the sun's free energy

maintains temperatures between 76° and 82°. The solar energy system consists of 216 collectors, each 4 feet wide by 10 feet in length. The panels are made of polypropylene and are unglazed and uninsulated. Solar pool collectors are typically unglazed and uninsulated because pool heating is a low-temperature application, where heat loss is not a major concern and does not warrant the costs associated with glazing and insulating the panel.

There are 104 parallel plastic tubes within each panel, through which the pool water is channeled and heated. The system is controlled through sensors and a differential thermostat. When a water sensor indicates the water temperature has fallen below the desired comfort level and a solar sensor determines that there is

sufficient solar energy available to add heat to the pool, the differential thermostat system activates the necessary controls to channel the pool water through the solar energy collector panels until the desired pool temperature is reached. The 216 panels are arranged in 24 banks, which are protected from wind by shrubs and earth berming and from vandalism by a chain link fence. For additional descriptive information refer to Chart 1.

Installation

The installation of all of the solar system equipment, as well as the landscaping and fencing, was handled by Dade County Parks and Recreation personnel. The manufacturer of the solar panels provided limited guidance during installation. Additional assistance was

CHART 1

Dade County Solar Energy System
Manufactured by Solar Industries, Inc.
Model #10001-2

Overall Dimensions (each panel)

Size (feet)	4 x 10
Length	120 in.
Effective Width - Absorber Plate	47 in.
Overall Width - Manifold Length	51 in.
Manifold Diameter	1.9 in.
Gross Area Sq. Ft.	38.80
Weight - empty	17.1 lbs.
Collector Fluid Capacity	24.5 lbs.
Total Panel Weight - Wet	41.6 lbs.
Weight per Sq. Ft. - Wet	1.06 lbs.
Absorber Material - Stabilized Polypropylene	
Flow Pattern - Parallel	

Total Collector Area	8,640 Sq. Ft.
Number of Collectors	216

provided by an outside contracting plumber (Al Hill Plumbing, Inc.) to help make the proper connections in the mechanical room. The Dade County employees had no previous experience installing a solar system but sought professional plumbing assistance.

Because of specific site constraints, the panels could not be placed on the roof of the office/bathhouse building. A ground site was prepared just south of the pool. The desired slope of the site was attained by landscaping. A concrete slab was poured for the base of the panels and a chain link fence with barbed wire was erected. Shrubs were planted for wind protection.

The County built its own pool cover to reduce the heat loss from the water during the night. To keep expenses down, the Florida Solar Energy Center suggested a cover made of PVC pipe frames covered by four-mil plastic. This "homemade" cover worked well, but the stress of constantly taking it in and putting it out caused it to tear. After using the cover for one year, the County discarded it and purchased a manufactured one from Imperial Wax and Chemical Company of California.

Performance

The solar system was installed in December 1978, a month when the average air temperature in Miami is 68°F. The sun provided water at the desired temperature of 76° to 82°F. The entire system has performed satisfactorily since it was installed in 1978, and no conventional back-up system has been required. On one occasion, the County had to dismantle and take in the panels to protect them from an anticipated hurricane.

During periods of consistently hot weather (above 95°), the temperature of the water in the pool can rise up to 90°F, and steps must be taken to lower the temperature of the water. At first, Dade County dealt with this situation by circulating pool water through the solar panels during the night to cool the water. However, this action caused a major increase in energy consumption by the circulation pumps. The County is now working on a simple system of aeration that requires a low-horsepower sump pump and perforated PVC piping. For additional performance information refer to Chart 2.

CHART 2

Performance Test Results*

Intercept	.78
Slope Btu/hr-Ft ² -°F	2.75
Thermal Performance	
Low Temperature	
Rating - Btu/Day	35,100
Rating/Ft ² - Btu/Ft ² /Day	905
Intermediate Temperature	
Rating - Btu/Day	16,000
Rating/Ft ² - Btu/Ft ² /Day	412

*Independent tests conducted by the Florida Solar Energy Center

Cost of Solar Pool Heating System

The solar energy system was purchased through the County's low-bid procedure. The County received a price quote of \$81 per panel from Solar Industries, Incorporated of New Jersey. The total cost of the solar equipment, not installed, was approximately \$17,500. All installation and landscaping was handled by County employees. Funding for the solar project came from normal county resources, specifically the capital outlay reserve account.

Savings

When Dade County decided to install the solar energy system on the pool, the cost savings in heating with solar versus fossil fuels was estimated to be \$22,000 annually. Operation and maintenance of the solar system costs approximately one fourth of that of a comparable fossil fuel system. In addition, the County is receiving greater revenues from admission charges as a result of the increased usage. When these savings are combined, the County expects the entire solar system

and installation to pay for itself within four years.

The increase in facility usage before and after the solar system was installed is indicated in Chart 3. The pool is now being used by approximately 60,000 people per year for competitive swimming as well as leisure activities.

Future Solar Pool Plans

The County Commission and County Manager are convinced that solar-heated pools make sense and are very pleased with the results of their decision. Public reaction and acceptance has been enthusiastic, and pool users are grateful for the additional service the County is providing. To publicize the pool, the County held a "warm-up" celebration dedicating the new solar system on February 16, 1979, which was attended by local and state officials. The program included swimming program demonstrations and a tour of the solar energy installation.

The Dade County Parks and Recreation Department has conducted a preliminary

CHART 3

Tamiami Park Pool-Usage*
1977-1980

MONTH	1977/78	1978/79	1979/80	1980/81
October	1,304	1,845	5,781	3,780
November	606	closed for solar system installation	1,063	2,914
December	139		571	1,839
January	0	1,311	2,993	2,516
February	0	1,891	1,656	2,458
March	0	2,557	3,194	4,573

*Figures reflect the number of people using the pool per month.

study of the feasibility of solar heat for a smaller, 100,000-gallon pool. The study indicates that solar heating is less expensive than other forms of available energy and that it would be cost effective for the pool.

At Tamiami Park Pool, County officials are considering using solar energy to heat the shower water in the bathhouse facility that is part of the pool complex. The County estimates that it would pay for itself in a very short time and would then save the County approximately \$7,000 annually (at 1981 utility prices).

Summary

Solar pool heating seems to be a cost-effective option for local governments. It expands the pool's period of usefulness and therefore serves the needs of the community. Additional pool usage increases revenues from admissions, and substantial fuel cost savings are realized at the same time.

Dade County heats its pool for about a fourth of what it would cost if conventional fuels were used as well as receiving additional revenues from increased pool usage. Officials estimate that these combined should pay for the entire solar system and installation within four years. Dade County officials feel their efforts have been successful because the County Commission and the County Manager were committed to carrying the idea of solar pool heating through to completion.

Climates and building configurations will vary with location, and each local government will need to conduct its own research, design evaluation, and sizing for its particular needs. Dade County's experience, combined with specific technical review, can serve as a guide to

local governments interested in using solar systems in public facilities.

For Further Information

Additional information on Dade County's solar-heated swimming pool can be obtained from:

Bill Bird, Director
Metro-Dade County Park and Recreation
Department
50 SW 32nd Road
Miami, FL 33129
(305) 579-2562

A Compendium of Energy Management Activities has been published by the Dade County Office of Energy Management. A copy of the compendium can be obtained from:

Metro-Dade Office of Energy
Management
44 W. Flagler Street
Suite 2302
Miami, FL 33130
(305) 579-2887

Other Local Government Solar-Heated Pools

Local governments throughout the nation are turning to the sun to heat their pools and their experiences can provide a wealth of information to local government officials. Listed below are a few of the cities and counties that either have installed or are in the process of installing solar energy systems on their public swimming pools.

City of Rockville, Maryland
City of Miamisburg, Ohio
City of Largo, Florida
Richmond County, Georgia
City of Gainesville, Georgia
Montgomery County, Maryland
Arlington County, Maryland
Chapel Hill, North Carolina

THE MECHANICS OF SOLAR HEATING

Active Method

An active solar pool-heating system consists of four basic components: collectors, a swimming pool, a distribution system, and controls.

Collector

The most common collector for a solar pool-heating system consists of one broad, flat absorbing surface with several parallel fluid tubes running lengthwise through it. Liquid is pumped through the tubes. Sunlight heats the collector and in turn raises the temperature of the flowing water inside it. Solar collectors are usually installed on a south-facing surface apart from the pool, on the roof of an adjacent bathhouse, or on a specially built structure.

Storage

Heated water is stored in a tank. In a solar pool-heating system, the pool itself serves as the storage tank.

Distribution System

The distribution system moves the warmed water from the collector to storage. When the filter and pump are running, a pool system accomplishes this by simply circulating the water from the collectors to the filter and back to the pool.

Controls

Thermostats activate mechanisms that cause water to flow from the pool to the collector and back to the pool.

Passive or Non-Mechanical Methods

Fresh water flows into the pool at a temperature generally determined by the ground temperature. It acquires a few degrees of additional warmth directly from the sun and from the air if it is warmer than the water. There are several ways to keep the pool water warm without using an active heating system. The most effective way is to prevent heat loss by installing a pool cover. Pool covers virtually eliminate evaporation and reduce convective and radiative heat loss by insulating the surface of the pool, which is the major source of heat loss. Besides maintaining the water temperature, a properly used cover keeps the pool cleaner and reduces the consumption of pool chemicals.

Other passive methods that can be used to conserve heat include:

- placement of wind barriers, such as hedges and fences; and
- trimming or removing trees around the pool to allow direct rays of the sun to add warmth to the water.

Solar Swimming Pool Publications

A Guide to Collector Sizing and System Design Considerations for Solar Pool Heating in Florida, R. Talwar; Florida Solar Energy Center, Document Sales, 300 State Road 401, Cape Canaveral, FL 32920, 1977

How to Design and Build a Solar Swimming Pool Heater, F. DeWinter; Copper Development Association, 405 Lexington Avenue, New York, NY 10017, 1975

"Design Considerations in Solar Heating Large Swimming Pools," N. Davis; Solar Engineering Magazine 3(10):20-21+, October, 1978

"Solar Takes on Olympic Proportions," Solar Engineering Magazine 3(10):26-31, October 1978

Additional publications and information can be obtained from the Conservation and Renewable Energy Information and Referral Service. Their toll-free telephone number is 1-800-523-2929.

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