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THE GEOTHERMAL HEAT PUMP CONSORTIUM'S NATIONAL EARTH COMFORT PROGRAM

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PROJECT BACKGROUND AND STATUS

In 1990, DOE identified Geothermal Heat Pumps (GHPs) as a major renewable energy technology which offered the nation significant energy savings. In 1993, the U.S. Environmental Protection Agency concluded that geothermal heating and cooling technologies represented a major opportunity to reduce air pollution through use of renewable energy. EPA also found that geothermal technology was becoming increasingly competitive and provided excellent comfort, reliability and aesthetic amenities. EPA recommended the formation of a national, utility-based consortium to take advantage of this opportunity for cost-effective pollution prevention.

The U.S. Department of Energy immediately began laying the groundwork for such a market mobilization as part of Action 26 of President Clinton's Climate Change Action Plan of October 1993. DOE worked with the Edison Electric Institute, EPA, the Electric Power Research Institute (EPRI), International Ground Source Heat Pump Association, the National Rural Electric Cooperative Association and industry to incorporate the Geothermal Heat Pump Consortium (GHPC) in late 1994 to implement the National Earth Comfort Program.

The GHPC recruited 119 utilities as dues-paying members in 1995. In addition, well over 100 manufacturer and trade allies were recruited as well. From these organizations, officers and members of GHPC's Operating Committees were recruited, and strategic planning was begun in each Operating Committee. Meanwhile, GHPC completed its staffing, and provided sufficient definitization of its project priorities to receive assistance funding from both DOE and EPA.

PROJECT OBJECTIVES

Geothermal heat pumps substantially reduce heating, cooling and water heating bills, and cause less pollution than other available heating and cooling technologies. However, geothermal systems usually have higher capital costs than conventional technologies, consumers and commercial facility managers know little about them, and contractors generally do not actively promote them. The Geothermal Heat Pump Consortium is a partnership of utilities, geothermal manufacturers, HVAC vendors and public agencies whose objective is to overcome these market

barriers and increase market penetration of geothermal heat pumps tenfold to 400,000 per year by 2001.

Technical Objectives

- Reduce cost of loop installation by 25-50% by the end of this decade through development of new loop, drilling and trenching technologies.
- Develop advanced design tools and substantially increase number of architects, engineers, HVAC contractors and builders that are trained in the design and installation of geothermal systems.
- Effectively demonstrate and document the economic, environmental, comfort and reliability benefits of geothermal systems for consumers, commercial facility managers, building owners and public officials.
- Develop and implement "technology transfer" mechanisms to be employed by GHPC-member utilities, manufacturers and vendors.

Expected Outcomes

- Advance current loop designs or develop new loop systems that reduce installation time and cost and perform as well or better than today's prevalent loop configurations.
- Develop improved loop installation procedures, drilling and trenching equipment that reduce installation time and cost.
- Develop equipment performance ratings that accurately reflect the performance benefits of integrated functions (i.e., explicitly taking water heating benefits into account).
- Successfully demonstrate and document geothermal system reliability and energy performance in a variety of residential, commercial and public-sector applications.
- Develop 6 to 8 regional training centers that utilize the most up-to-date training facilities and curricula, and successfully train thousands of technicians in the effective sale and installation of geothermal systems.
- Improve and update residential and commercial geothermal system design tools.
- Demonstrate and transfer effective market-pull technologies and strategies to GHPC members through Model Utility Geothermal Program demonstrations.

Expected Outcomes (continued)

- Achieve widespread recognition of geothermal as a viable, desired heating and cooling technology among homeowners, landlords and facility managers.
- Substantially increase employment opportunities in the drilling and excavating industries.

APPROACH

Analysis of the HVAC market identified three major types of barriers to the increased market penetration of geothermal heating and cooling systems in the U.S. As a result, three Operating Committees were formed within GHPC to formulate, coordinate and implement aggressive responses to each of these areas.

First Cost Competitiveness

Geothermal systems cost as much as $2000-$5000 more than conventional heating and cooling systems in a typical residential application. However, for some commercial sized buildings geothermal systems have the lowest first cost. Even though their energy efficiency and maintenance savings leads to lower overall *life cycle* cost compared to conventional technologies, their first cost premium constitutes a significant market barrier for most systems. The First Cost Competitiveness (FCC) Committee's approach to reducing the capital cost of geothermal systems involves investigation of new, improved loop configurations, installation techniques, drilling/trenching equipment and developing innovative financing packages. It also is supporting technical work to improve the understanding of soil conductivity, grout performance, and advanced (hybrid and integrated) system design and performance.

Infrastructure Strengthening

Today there are insufficient numbers of distributors, contractors, architects, engineers, builders developers and realtors who know and recommend or install geothermal systems. The Infrastructure Strengthening (IS) Committee's goal is to create a market infrastructure of trained and experienced contractors, developers, architects and engineers sufficient to achieve GHPC's annual sales goal of 400,000 units by 2001 with advanced residential and commerical design tools, competitive pricing, a high degree of installation quality and reliability, and support from a rational framework of environmental, licensing, building code and other regulations.

Technology Confidence Building

A key barrier to geothermal technology is the fact that, even though it has been technically proven through the installation of over 250,000 systems to date, it is still unknown and unproven to end users in many markets. The goal of GHPC's Technology Confidence Building (TCB) Committee is to help build a self-sustaining market for geothermal by effectively communicating

their benefits to all important market stakeholders. TCB's approach is to provide cofunding for Model Utility Geothermal Program Demonstrations and Pilots. Through support for innovative utility program design, demonstration and transfer, GHPC will help its member utilities learn which program designs, communication and public education strategies are most effective in yielding demand for geothermal systems. In return, cofunded utilities will provide their own significant resources to the effort, and share program designs, deliverables and lessons learned. GHPC will complement this with a national effort to increase awareness about geothermal among key market influences, commerical building developers, realtors, national home builders, appraisers contractors, builders, architects and engineers.

RESEARCH RESULTS

During 1995, GHPC went through the process of member recruitment, organization building, staffing and strategic planning, leading to launch of the National Earth Comfort Program during the second half of the year. The following tasks were carried out:

Benchmarking Studies

To ensure effective program launch, GHPC performed several benchmarking studies to study present market conditions and formulate recommendations for overcoming key market barriers. Benchmarking studies on utility HVAC programs and financing alternatives to rebates provide timely insight on cost-effective utility program designs and public education strategies. Comprehensive research on the dynamics of the space conditioning market was carried out, providing recommendations about what awareness and education activities will be most effective for key market stakeholder groups. Similarly, benchmarking studies on existing technical training programs and geothermal design tools are providing a solid foundation for infrastructure strengthening efforts to begin in 1996. All of GHPC's benchmarking studies produced draft reports in 1995, with final reports to be completed in January 1996.

Projects Selected and Initiated

GHPC's early planning process led to identification of several projects that could be started up immediately. Contracts were successfully awarded for the following projects:

Field Demonstration of New Loop Technology

During 1995, GHPC initiated a field demonstration of a patented, "multiple parallel" loop configuration technology for both vertical and horizontal ground loops. Developed by ClimateMaster, this technology has the potential for reducing loop installation costs by 25% or more without compromising performance, while taking much of the responsibility for on-site design and fabrication from the installation contractor.

Grout Research

GHPC is supporting research at South Dakota State University on the performance and environmental impact of cement as an alternative grouting material. This is in response to interest by some state water protection agencies in requiring cement grout in lieu of bentonite.

ASHRAE Study on Antifreezes

During 1995, GHPC initiated cofunding for an important ASHRAE study on the environmental impacts of loop antifreeze materials. The study's findings, expected in 1996, will provide guidance to water protection regulators and the loop industry.

Compilation of State and Local Codes and Regulations

In 1994 the National Rural Electric Cooperatives Association (NRECA) initiated research at University of Idaho to compile and analyze state drilling regulations, and develop model regulations. GHPC is expanding this effort by extending the research to include local jurisdiction regulations and open-loop borehole regulations; and by compiling and analyzing state and local building codes for their treatment (if any) of geothermal systems.

Research on Pumping Pressure and Head Loss

Lack of information on the pressure drop associated with geothermal loop components (the pipe, pipe joints, and fittings, such as U-bends and Tees) can lead to oversizing of circulating pumps, thereby increasing capital cost and reducing operating efficiency. GHPC and Phillips Driscopipe, a manufacturer of geothermal loop pipes, are cofunding work at University of Alabama that will lead to publication in late 1996 of head loss tables for geothermal systems.

Duke Power Residential New Construction Pilot

GHPC selected Duke Power for a cofunded Model Utility Program pilot that combines several elements to build market infrastructure, increase public awareness, and reduce the first cost of geothermal in the single-family home market. Duke Power's contractor, the Alternative Energy Corporation of North Carolina, will train builders and HVAC contractors to build efficient and healthy homes utilizing geothermal systems. Duke will also evaluate and verify geothermal performance in its territory through monitoring, and will provide public education.

Minnesota Power Demonstration of Integrated Gas Station/Retail/Car Wash System

GHPC is cofunding a demonstration of a geothermal installation at a combination gas station/convenience store/car wash. The geothermal design, unprecedented in this climate, will provide space conditioning, refrigeration, hot water, and radiant slab heating and deicing for the car wash. Minnesota Power will produce an installation video, performance data, and a case study.

Plumas Sierra Rural Electric Cooperative Retrofit Pilot

Plumas Sierra serves many planned recreational communities in California that are experiencing a rise in full-year residency, and which get heating from electric resistance, air source heat pumps, propane and wood. GHPC will assist Plumas Sierra in implementing a unique, community-based awareness and education effort. A number of homes that convert to geothermal will be monitored for energy savings. Plumas Sierra will also analyze the degree to which recent revisions in local regulations is causing a rise in the cost of loops.

FUTURE PLANS

During FY96, GHPC will complete or make substantial progress in all of the above projects. Benchmarking reports and research findings will be reported fully to all GHPC members, and summaries will be made available through GHPC's National Information Resource Center and Web Site. In addition, the Operating Committees plan to initiate the following projects:

First Cost Competitiveness

- Field test innovative loop designs in addition to project already underway;
- Acquire residential and commercial field data and prepare case studies;
- Identify data gaps and monitor several commercial facilities to overcome them;
- Evaluate opportunities for reducing drilling costs;
- Analyze long-term heat build-up effects on system performance and the environment, leading to improved system designs;
- Develop low-cost ways to determine thermal conductivity of soils;
- Design commercialization project for drilling rigs and/or associated equipment that enhance vertical drilling productivity by 25-50%;
- Assess potential for loops that are integrated with other building components; and
- Improve understanding of heat transfer in hybrid commercial systems.

Infrastructure Strengthening Committee

- Establish 3-4 regional, state-of-the-art technician training centers;
- Develop and update training curriculum materials;
- Augment or update residential and commercial design tools; and

- Initiate process at Air Conditioning and Refrigeration Institute (ARI) to produce certification procedures and ratings for integrated geothermal systems.

Technology Confidence Building Committee

- Initiate 2-4 major Model Utility Geothermal Program Demonstrations;
- Initiate 3-5 smaller Utility Geothermal Program Pilots; and
- Report on the load shape benefits of geothermal for electric utilities.

INDUSTRY INTEREST AND TECHNOLOGY TRANSFER

Organizations	Type and Extent of Interest
119 Electric or Dual Utilities	Dues-paying members in 1995
150 Manufactures and Trade Allies	GHPC non-dues paying members
International Ground Source Heat Pump Association (IGSHPA)	Board member; provides advice and guidance from perspective of research community and industry
Electric Power Research Institute (EPRI)	Tailored collaboration arrangement for members; cofunding of research efforts; Board Member
Edison Electric Institute (EEI)	Support for GHPC start-up; Board Member
National Rural Electric Cooperative Association	Resources for various R&D projects; Board Member
ASHRAE	75% cost share of antifreeze environmental study
ClimateMaster	Greater than 75% cofunding of new loop technology commercialization
Phillips Driscopipe	60% cost share of head loss algorithm study
Duke Power	70% cost share of pilot
Minnesota Power	50% cost share of installation monitoring demonstration and case study
Plumas Sierra Rural Electric Cooperative	60% cost share of retrofit and loop costing pilot
Philadelphia Electric Company	Cofunding for monitoring and case study for geothermal redevelopment project

REFERENCES

Geothermal Heat Pump Consortium, "National Earth Comfort Program: A Proposal for an Industry-Government Collaborative, GHPC, Washington, DC, September 1994.

Geothermal Heat Pump Consortium, "1996 Business Plan," GHPC, Washington, DC, December 1995.

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