

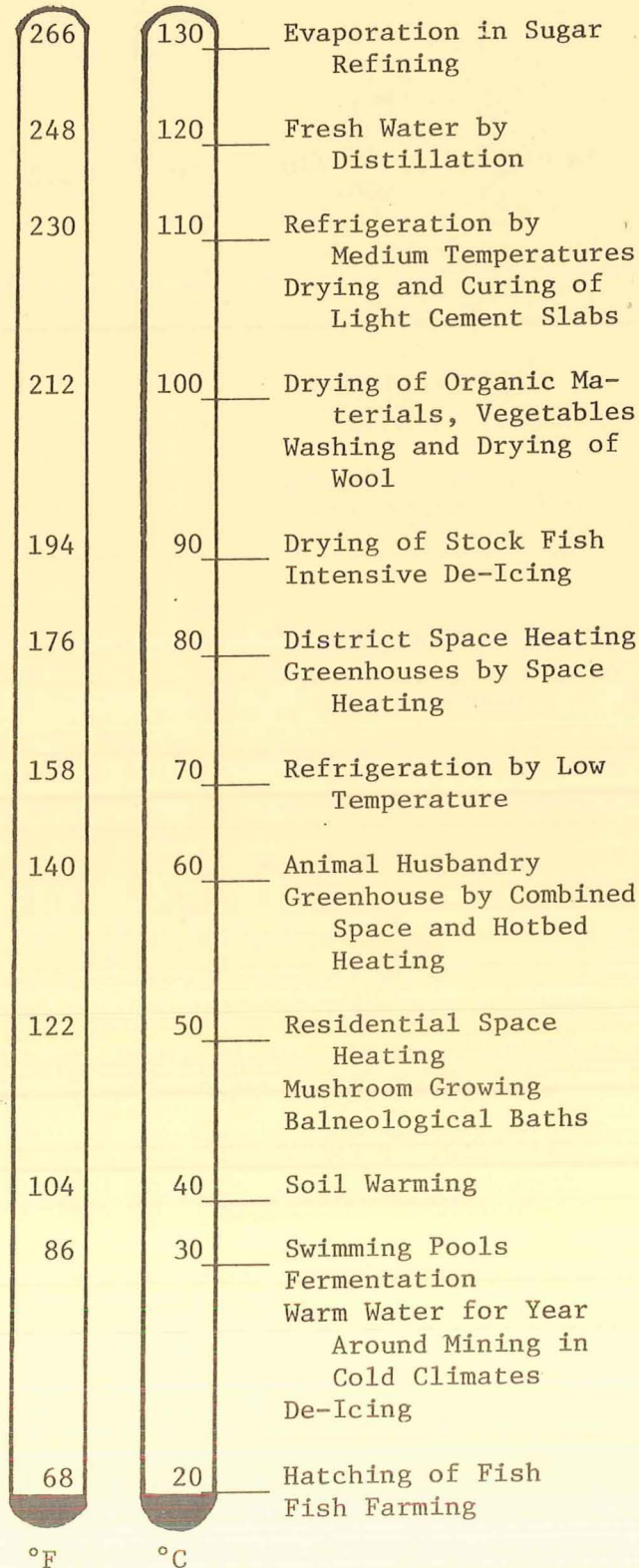


GEO THERMAL NEWS

P.O. Box 4096, University Station, Laramie, WY 82071
 (307)766-4820 Toll-free in Wyoming 1-800-442-8334

Vol. I, No. 1

May 1980



The Wyoming Geothermal Commercialization Office was established in December 1978 on the campus of the University of Wyoming, and is a project funded jointly by the Department of Energy and the University of Wyoming. The purpose of GCO is to catalog geothermal resources within the state of Wyoming and to assist individuals, businesses, and governmental offices in the evaluation and use of specific geothermal sites.

Geothermal energy is energy that is produced from the heat in the ground. It takes the form of steam in high temperature areas, while it is very hot water in low temperature areas. With the expected shortage of fossil fuels in the future, geothermal energy has become a very important resource in energy-rich Wyoming.

There are three main types of geothermal systems in Wyoming: (1) volcanic systems such as those found in Yellowstone National Park; (2) hydrothermal systems manifesting themselves in hot springs and wells, such as those in the Thermopolis area; and (3) deep sedimentary basins producing unusually hot temperatures at depth, a system which underlies much of Converse and Natrona Counties.

The chart to the left indicates some potential uses of geothermal energy in Wyoming. The upper range of temperatures are not shown, as they are not known to exist in the state outside of Yellowstone National Park. Many resources currently in use in Wyoming are swimming pools and hot baths in the Thermopolis, Saratoga, and Jackson areas; space heating near Lander and Thermopolis; a trout hatchery near Jackson; and bridge de-icing in Sybille Canyon between Laramie and Wheatland.

The Wyoming Geothermal Commercialization Office is currently working on a wide variety of projects. Site specific studies are being done to determine the feasibility of district heating systems for the Midwest/Edgerton and Thermopolis areas. A broader study of the geothermal potentials of the Converse and Natrona County region is nearing completion.

Many individuals around the state are also proposing geothermal resources and development.

- new greenhouse for commercial tomatoes near Thermopolis
- possible aquaculture application near Midwest
- greenhouse for raising Forest Service pine seedlings near Midwest
- existing greenhouse for commercial tomatoes being expanded near Lander
- possible greenhouse or aquaculture application near Powell

GCO Personnel

Program Director Rick James
 Research Associate . . Karen Marcotte
 Graduate Research Assistant
 John MacDonald
 Research Aide Carole Aspinwall
 Work Study Student Keith Bray
 Senior Secretary Nancy Nelms

Commercial use of geothermal heat has been in existence in the Midwest/Edgerton area for years in oil field production. The Amoco waterflood system injects hot water into the earth to maximize oil recovery.

GEO THERMAL NEWS is a quarterly publication of the Wyoming Geothermal Commercialization Office. This and future issues are suitable for filing in a three-ring binder for easy reference.



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GEOHERMAL NEWS

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Vol. 1, No. 2

July, 1980

USER-COUPLED CONFIRMATION DRILLING PROGRAM ANNOUNCED BY DEPT. OF ENERGY

The U.S. Department of Energy has announced the User-Coupled Drilling Program to help share in the economic risks of geothermal exploration. DOE will share the costs of all aspects of exploration including: feasibility studies, exploration for drill hole sites, drilling, flow testing, reservoir engineering and injection well drilling. DOE's percentage of participation on any one project will depend upon the degree of project success. DOE will pay approximately 90% of incurred costs for a totally unsuccessful drill hole, and about 20% for a completely successful hole. A percentage between 20% and 90% will be paid for partially successful projects. The new program has been announced through a Solicitation for Cooperative Agreement Proposals. A 90 day submission period is included in these proposals. For more information on submitting a proposal and what it should include, please contact this office or the DOE Idaho Operations Office at 550 Second Street, Idaho Falls, ID 83401, (208) 526-1668.

Wyoming Outdoor Council Meeting

Carole Aspinwall represented the GCO at the Wyoming Outdoor Council meeting in Casper on May 24, 1980. Ms. Aspinwall gave a slide show on existing and potential geothermal projects in Wyoming. She also appeared as one of the speakers for a panel discussion at the meeting.

TOP 20 INDUSTRIAL PROCESS HEAT USERS DIRECTLY MATCHED (1) FOR GEOHERMAL ENERGY REPLACEMENT IN THE ROCKY MOUNTAIN BASIN AND RANGE REGION (x10¹² BTU/HR)

| <u>INDUSTRY</u> | <u>MATCHED 1975 ENERGY USE (2)</u> |
|--------------------------------|--|
| Dehydrated Fruits & Vegetables | 11.80 |
| Concrete Block | 7.10 |
| Frozen Fruits & Vegetables | 5.24 |
| Poultry Dressing | 4.82 |
| Meat Packing | 4.45 |
| Prepared Feeds | 3.65 |
| Plastic Materials | 3.63 |
| Dairy Industry | 3.24 |
| Soft Drinks | 2.91 |
| Soaps | 1.24 |
| Inorganic Chemicals | 1.06 |
| Ready-Mix Concrete | .98 |
| Gypsum | .97 |
| Canned Fruits & Vegetables | .97 |
| Beet Sugar | .82 |
| Treated Minerals | .69 |
| Cotton Seed Oil Mills | .34 |
| Prepared Meats | .34 |
| Pharmaceuticals | .25 |
| Furniture | .21 |

(1) Industries matched by co-location with resources and compatible process temperatures in those counties having hydrothermal resources.

(2) Regional consumption of direct heat energy in 1975 replaceable by hydrothermal energy from co-located and temperature matched resources. Energy use totals are for a 10 state region.

* All of the industries listed above presently exist in, or could be located in Wyoming.

Source: Adapted from original table taken from EG&G of Idaho, Inc.

PLANNING AND REPORTING MEETING HELD

The Region VIII, tri-annual planning and reporting meeting was held by the U.S. Department of Energy in Santa Fe, N.M. on May 21-23. Geothermal commercialization teams from six western states received direction from the DOE and reported on state activities. Wyoming's team presented information on the use of geothermal energy in secondary oil recovery techniques. Rick James and Karen Marcotte represented Wyoming at this meeting.

The New Mexico Energy Institute also held a meeting for state commercialization teams. This meeting took place at the New Mexico State University in Las Cruces, on May 19 and 20. NMEI staff members presented information on computer modelling for geothermal commercialization. Site specific data from Wyoming, in conjunction with the various computer models at NMEI, will assist in economic planning for geothermal development in our state. Rick James and Karen Marcotte attended this meeting also.

This is the second issue of the Geothermal News. It was originally planned as a quarterly publication, but due to additional funding from the Wyoming State DEPAD Office, it will now be published on a monthly basis. This and future issues are suitable for filing in a three-ring binder for easy reference.

GCO PERSONNEL

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Research Associate.....Karen Marcotte
Temporary Secretary.....Robin Bomke

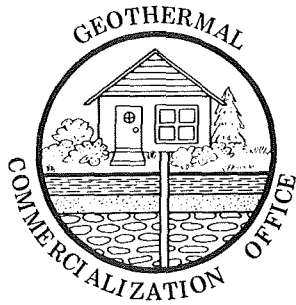
Due to the termination of the spring semester of the University of Wyoming, our office staff has been reduced for the summer. Our Graduate Research Assistant, John MacDonald, is now working as a mine reclamationist in southwestern Wyoming. Carole Aspinwall, our Research Aide, has left our office to finish writing her thesis. She will be graduating with a Master's degree in Planning at the end of this summer. Our Work Study Student, Keith Bray, has left for full time work this summer in Casper. Keith will be returning to this office in the fall. Finally, Nancy Nelms, our Senior Secretary, has taken a position in another department of the University. Robin Bomke has been helping us out in the office until a permanent secretary can be hired.



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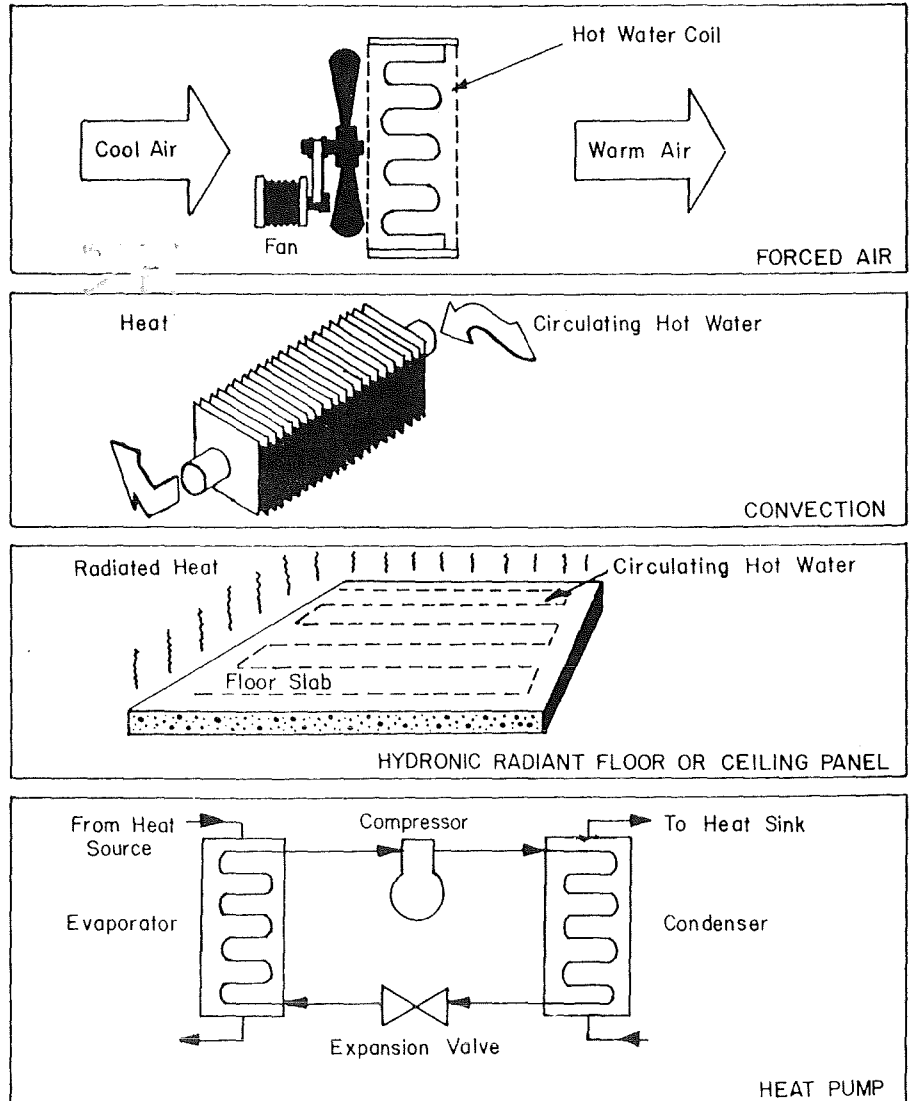
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August, 1980

GEO THERMAL SPACE HEATING

Most areas of Wyoming require significant amounts of energy for space heating. The most widely used residential space heating systems are forced air, circulating water and radiant electric resistance. More recently, the use of heat pumps has become popular. A heat pump is an off-the-shelf device allowing for the economic utilization of the marginal geothermal resource down to temperatures as low as 55-60°F (13-16°C). The heat-pump application adapts well to the forced air system in retrofit situations and has the added benefit of providing cooling in the summer months with no additional equipment cost. Between 60°F and 90°F (16-32°C), standard heat pumps will have Coefficients of Performance (COP) of about 3 when used to provide space and low temperature process heat. This means the heat output will be about three times the electrical input.



The figure above illustrates commonly used heating systems, all of which are adaptable to using geothermal energy as the fuel supply. (Source: EG&G)

WYOMING GEO THERMAL INSTITUTIONAL HANDBOOKS AVAILABLE

Geothermal handbooks covering the legal, permitting and institutional process for development in the state of Wyoming have been written by GCO staff members and recently published by the Department of Energy. These handbooks would be an invaluable tool to anyone considering geothermal development in the state of Wyoming. Copies of the Institutional Handbook can be sent upon request. There is no charge for this publication, but supplies are limited. Please request a copy only if you are planning on developing a geothermal project in the state of Wyoming.

AGRICULTURAL GROWTH APPLICATIONS

The use of geothermal resources is especially appropriate for agricultural growth applications because they require heating at the lower end of the temperature spectrum where there is an abundance of resources available. The following agricultural growth applications are adaptable to using a geothermal fuel supply: greenhousing, animal husbandry, aquaculture, soil warming, mushroom raising, and biogas generation. Within the previously indicated agricultural processes, there is potential for thermal cascading of the heat-bearing fluid. For example, the highest temperature water could be used for geothermal space heating. After the greenhouse has utilized some of the heat, the water would still be hot enough to enable the growing of mushrooms. When still more heat is extracted, the fluid could be used for biogas generation. Finally, even water that has cooled to below 90°F (32°C) could be used for aquacultural activities. Cascading systems, such as the one described above, can provide significant economic advantages as compared to single-purpose applications.

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GEOTHERMAL LEGISLATION DISCUSSED

On July 15 in Casper the Joint Mines, Minerals and Industrial Development Interim Committee of the Wyoming Legislature held a hearing on potential geothermal legislation.

Presentations were made by Sherri Valentine of the National Conference of State Legislatures (NCSL); Dan Miller, State Geologist; Ken Wostolen (NCSL), water law; Dick Stockdale, State Engineers Office; Chuck Farmer, Wyoming Oil & Gas Commission; Hank Heasler, Geology Department, U.W. and Rick James, G.C.O. Additionally, Dr. Jay Kunge, Energy Services Inc., made a presentation of low temperature economics to the committee. He mentioned one water to water heat pump application in Idaho where the resource temperature is 42°F and the project is feasible!

Significant attention in the hearing was given to the definition of geothermal resources. The Wyoming Statutes describe the resource as "underground water" under the regulatory authority of the state engineer. The state board of Land Commissioners leases geothermal as a "mineral" on state lands. The federal government defines geothermal energy as a mineral. Therefore great conflicts could occur between state and federal definitions.



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GEOTHERMAL COMMERCIALIZATION OFFICE

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September, 1980

Geothermal Loan Guaranty Program

The Geothermal Loan Guaranty Program (GLGP) is sponsored by the U.S. Government to stimulate the commercialization of geothermal resources. This stimulation consists of loan repayment guaranties to development capital lenders. Under the GLCP the U.S. Government guarantees the repayment of the principal and interest on loans made to businesses whose planned use of geothermal energy will advance the development of geothermal resources. The GLCP reduces capital risk to lenders during the early, high risk stages of geothermal commercial development. It is hoped that this financial incentive will accelerate geothermal development by promoting capital availability to potential borrowers.

GLGP is applicable to a very broad range of projects. Any project that falls into at least one of the following categories is eligible for a loan guaranty. A project feasible for Wyoming would be:

- Determining and evaluating the commercial potential of geothermal resources
- Researching and developing geothermal extraction and utilization technologies
- Obtaining rights to geothermal resources

Any organization, public or private can be granted a geothermal loan guaranty. First priority is considered for projects having a plan of prompt development and use of energy from undeveloped geothermal areas; second priority for projects designed to demonstrate or use new technological advances; and third priority for projects that use the commercial potential of partially developed geo-

thermal areas. Preference is also given to projects that a) need a guaranty for only a portion of the loan, b) are to be carried out by small public and private utilities or small businesses, and c) will yield royalty payments to the Federal Government.

• Loan guaranties of up to 75% of the estimated aggregate cost of a project may be granted for up to 30 years. At least 25% of the project cost must be provided by the borrower. The maximum loan guaranty for a single project is \$100 million.

Application for a geothermal loan guaranty is made to:

Geothermal Loan Guaranty Office
DOE-San Francisco
1333 Broadway
Oakland, California 94612
415/273-7151

Usually, a total of no more than 6 months is required by DOE to evaluate and approve a loan guaranty.

Utilizing Geothermal Energy

Direct utilization of geothermal energy for space and process heating usually requires only application of existing technology. The utilization of geothermal energy requires only common engineering progress rather than revolutionary advances and major scientific discoveries.

The main advantages of direct utilization of geothermal energy are:
--high conversion efficiency (80-90%)
--use of low-temperature resources
--use of many off the shelf items for exploitation
--short development time

Typically, agricultural uses utilize the lowest temperatures, with values generally ranging from 80° to 100°F. Use of wastewater has wide applications here, although the amount

A cooperative program between the U.S. Department of Energy and the University of Wyoming to further public awareness and commercialization of geothermal energy.





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GEO THERMAL HEAT PIPES USED TO DE-ICE BRIDGES

A new system using geothermal heat to de-ice bridges is going to be used in Wyoming. The system designed and developed by Dr. Kynric Pell, Dr. John Nydahl of the University of Wyoming, and the Wyoming State Bridge Engineers Office, is the first of its kind. The project was funded by the Federal Highway Administration and the State of Wyoming.

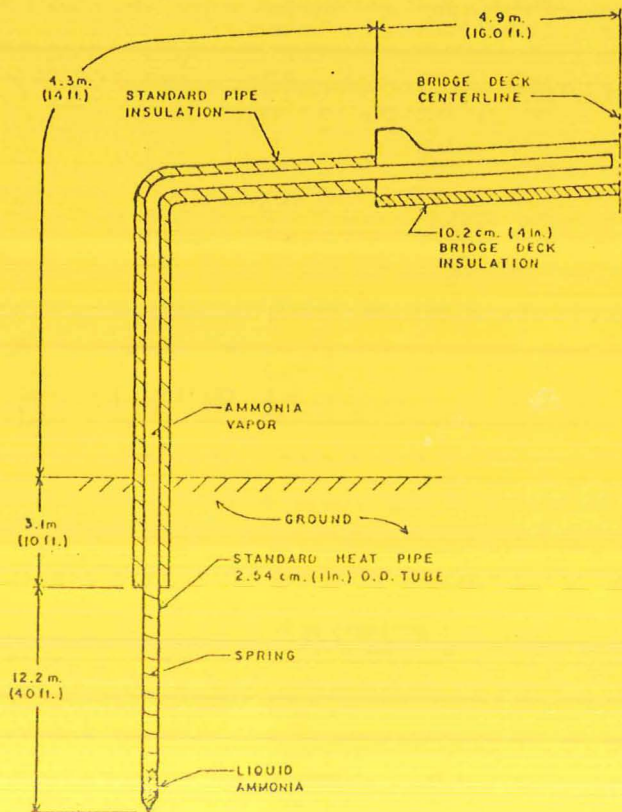
The purpose of the de-icing system, according to Dr. Pell is to "...increase safety by always keeping the bridge in as good a shape as the highway". Dr. Pell also anticipates that the bridges installed with these units will last longer than conventional bridges because the salt used to de-ice bridges causes deterioration of the rebar. This would be eliminated with the geothermally heated bridge.

A network of 60 pipes is placed under the pavement with the reinforcing steel before the concrete is poured, and these are connected with pipes which are placed 100 feet deep in the ground. The 60 pipes are arranged in a manifold system with 15 pipes in each corner sunk to a 100 foot depth. The pipes inside the bridge deck are two feet and four feet long. Each pipe is two-inch diameter steel, coated with epoxy and foam insulation wherever they appear outside of the bridge deck.

The heat of the earth, a constant 43°F at a depth of 100 feet, causes the liquid ammonia to vaporize and rise up the heat pipe system to the pavement surface where the heat is released because of the 32°F or lower surface temperature. The inside wall of each evaporator pipe in the ground will be lined with a spring to cause the condensate to spiral down the pipe rather than run down one side in the form of a rivulet. This wets the wall more effectively, allowing for more efficient and uniform vaporization.

The prototype of this bridge was built into a bridge at North Sybille Canyon on Wyoming Highway 34 located between Wheatland and Bosler Jct. The ten foot section which was geothermally heated was snow covered for 116 hours. The rest of the bridge was snow covered for 331 hours. The new bridge now under construction on Grand Avenue in Laramie will be the first completely geothermally heated bridge.

The diagram shown to the left illustrates the conceptual design of a heat pipe bridge. The new bridge being installed in Laramie will vary slightly from this standardized design.



The GCO wishes to express their thanks to Mr. Keith Bray who authored and researched the heat pipe article for us.

Thermopolis SSDA

The Site Specific Development Analysis for the Thermopolis/East Thermopolis region will be completed by the GCO early in November. This SSDA will include sections of another report entitled, The Thermopolis Hydrothermal System. The hydrothermal report is still in rough draft form, but contains useful information on the Thermopolis system. This report was written under a Department of Energy contract and authored by three geologists at the University of Wyoming. The authors are: J.K. King, H.P. Heasler and E.R. Decker.

The GCO will be scheduling a trip to Thermopolis during November to present information on the geothermal potential of that region. Data gathered by the GCO for this SSDA is public information and can be obtained by attending the presentation in Thermopolis or by writing or calling this office.

GCO Personnel

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Senior Secretary.....Mary Weber

The preparation of this newsletter was aided by a grant from the Old West Regional Commission authorized under the Public Investment Program.



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Cody Geothermal Report Release

A report entitled, Preliminary Data from Six Temperature Gradient Holes near Cody, Wyoming will be available through the GCO. November 7, 1980 is the tentative release date for this report. This paper was authored by H.P. Heasler and E.R. Decker of the Geology Department at the University of Wyoming. It is a report on data gathered from six temperature gradient holes drilled by the authors during the winter of 1980. This report is public information and a copy may be obtained by writing or calling this office.

Geothermal Consultants File

The GCO has been gathering information on geothermal consultants for the Rocky Mountain Region. This data is intended for use by potential geothermal developers in need of some developmental expertise. Information on areas of geothermal developmental interest has been gathered for individual firms in the form of a questionnaire. If you are interested in obtaining a copy of the consultants file, please write or call the GCO. In addition, if you would like your firm to be included in the consultants file and have not received a questionnaire to date, please contact Karen Marcotte at the GCO address.



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GEOHERMAL NEWS

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Industrial Workshops

The GCO will be sponsoring three workshops this winter that will address possible industrial and commercial uses of Wyoming's geothermal resource. These workshops will address a number of development related issues such as: the geothermal resource in Wyoming, some possible uses of the resource, the economics of direct use applications, water rights, leasing and permitting procedures, and the developmental process.

The first workshop will be held on January 23, 1981 at the Hitching Post Inn, in Cheyenne, Wyoming. The workshop is scheduled to last a full day; in addition a guest speaker will conduct a short session that evening. Guest speakers at the first workshop will be: Hank Heasler, Geology Department at the University of Wyoming; Bruce Amsterdam of the National Water Well Association, and Chuck Higbee of the Oregon Institute of Technology. Governor Ed Herschler has been invited to speak during the conference luncheon.

A \$25.00 registration fee will be required of workshop attendees. The registration includes lunch, a geothermal informational booklet and a full day of discussion with the geothermal experts.

Additional workshops will be held in Casper during the month of February and in Riverton during March. Place and time details of these two conferences will be forthcoming in future issues of the Geothermal News.

Registration forms will be sent out to many businesses and industries during the month of December. If you would like to make sure that you receive a registration form, or if you have any questions on the workshops, please call us toll free in Wyoming at 1-800-442-8334.

Geothermal Greenhouses

The greenhouse industry in the western portion of the United States has utilized geothermal energy as a heat source for many years. Geothermal greenhouses are now in existence and being proposed for installation in many areas of Wyoming as well.

The main objective in heating a greenhouse is maintaining the environment at an optimum day temperature (60°-75°F, 16°-24°C) and an optimum night temperature (50°-65°F, 10°-18°C) for the particular plants being grown. The more critical of the two is maintaining a minimum night temperature. Only a limited amount of heat would be needed during the day, even on a cloudy day, because of solar radiation.

The basic elements of a geothermal heating system for a greenhouse involve: adequate supply of hot water, heat exchangers, and a method of heat distribution by forced air where natural convection is inadequate. These elements vary in sophistication from a simple on/off thermostat that is changed manually for day and night operations to a multimode controller with programmed changes in temperature from day to night.

Geothermal energy has been utilized in greenhouses to grow commercial vegetable crops, commercial flowers such as carnations and roses, and for the growth of tree seedlings. A geothermal greenhouse has been in existence near Lander, Wyoming for several years. The heat is supplied by hot water flowing from the Countryman Well, which was originally drilled for oil in the late 1800's. Additional greenhouses have been proposed for the Thermopolis and Midwest regions.

Thermopolis Geothermal Potential

The Thermopolis/East Thermopolis SSDA had been completed in unpublished form by GCO staff members. This SSDA will eventually be published by the U.S. Department of Energy.

Some of the topics included in the SSDA are: socio-economic data for the region, known information on the resource itself and the total potential of the geothermal reservoir, possible uses of the heat produced, marketing of the final "products", possible sources of financial assistance to potential developers, legal aspects of development and possible barriers and constraints to geothermal development.

Karen Marcotte and Patti Burgess gave four formal presentations on the SSDA to residents of Thermopolis during the week of November 17-21, 1980. These meetings were well attended and the audiences seemed interested and enthusiastic about the geothermal potential of their community.

Data gathered by the GCO for this SSDA is public information. A copy of this report may be obtained by writing or calling this office.

District Heating Program Announced

The U.S. Department of Housing and Urban Development has announced solicitation for proposals for technical assistance to develop district heating systems. The proposals must involve Community Development Block Grant eligible communities. The closing date for proposals is January 5, 1981. More information is available by writing to: Christopher Lee, HUD Office of Procurement and Contracts, Room B-133 (711 Bldg.) (ACC-CL), 451 7th Street S.W., Washington, D.C. 20410.

Source: Utah Water/Geothermal Report

The preparation of this newsletter was aided by a grant from the Old West Regional Commission authorized under the Public Investment Program.

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