GL01369

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell International

MAY 22 1981

May 15, 1981

81ETEC-DRF-2029

Multiple Addressess.
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team

Reference: 81ETEC-DRF-1284, Budney to Technical Assistance Team, Geothermal District Heating Team, Final Roster, March 26, 1981

Dear Team Member:

Enclosed is a copy of the HUD News Release, dated May 5, 1981, announcing the names of the communities selected to perform district heating and cooling system feasibility studies. Of the 28 communities selected, nine are considering geothermal energy as a possible energy source.

HUD/DOE is in the process of negotiating contracts with the various grant winners. Therefore Technical Assistance Team members are asked not to initiate any contacts with the winners at this time. However, the locations are listed here so that Team members may provide ETEC with site-specific references. ETEC will compile the site-specific references from all team members for the use of the various communities. Please review your literature sources and send to ETEC a listing of specific references for each of the nine locations listed below. Please provide this information by June 1, 1981.

Locations for which site-specific references are needed are:

- Campbellsville, Kentucky
- Berlin, Maryland
- Springfield, Massachusetts
- Missoula, Montana
- Santa Ana Pueblo, New Mexico
- Union County, Oregon
- Provo, Utah
- Bellows Falls/Rockingham, Vermont
- Thermopolis, Wyoming

Thank you for your cooperation. If you need further information, please call me at extension 6474, or Bob Eichelberger at extension 6165.

Sincerely yours,

G S Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosure: as noted

U.S. Department of Housing and Urban Development
Office of Public Affairs
Washington, D.C. 20410

# News Release

HUD-No. 81-97
Jackie Conn (202) 755-5284
Leonard Burchman (202) 755-6980

FOR RELEASE:
Tuesday
May 5, 1981

## HUD/DOE TO ASSESS OLD ENERGY SOURCE

Twenty eight American communities will test the possibility of heating and cooling buildings by a low cost, energy efficient system invented in this country over a hundred years ago.

U.S. Department of Housing and Urban Development Secretary Samuel R. Pierce, Jr. today announced that HUD and the Department of Energy will jointly fund a $1.5 million district heating and cooling program to help communities find alternative approaches to meeting their energy demands.

The communities selected today represent a cross section of the Nation, ranging from Santa Ana Pueblo, an Indian tribe in New Mexico, to New York City.

District heating and cooling systems capture heat normally wasted in burning trash, generating electricity, manufacturing and other processes. At a central location this captured energy is used to heat water or create steam which is then pumped out over a network of pipes to heat apartments, offices, schools, hospitals, homes and factories. These same buildings can be cooled by captured energy when it is processed into cold water.

-more-

District heating, a 19th century development in the Northeast and Midwest, almost disappeared in the United States when gas, oil and electricity became cheap commodities after World War II.

Today district heating is widely used throughout Europe in Scandanavia, Germany and Russia. In Sweden, for example, approximately three million people live or work in buildings served by district heating and cooling. In the United States, New York City and Philadelphia, along with a few other major cities, have been using these systems for many years in some high density areas.

In announcing the program, Secretary Pierce noted there is a renewed and intense interest in district heating and cooling. "With today's sharply rising fuel prices, local governments are looking for ways to drastically cut energy costs and, at the same time, revitalize their communities.

"Some cities are interested in rejuvenating existing unused systems while other cities are interested in building new ones," Secretary Pierce said. All of them are aware that district heating and cooling has the potential for lowering energy costs of the businesses that drive their economies."

The selected cities are: Albany, NY, Allentown, PA, Atlanta, GA, Atlantic City, NJ, Baltimore, MD, Bellows Falls/ Rockingham, VT, Berlin, MD, Cambridge, MA, Campbellsville, KY, Columbus, OH, Dayton, OH, Devils Lake, ND, Ecorse, MI, Fort Wayne, IN, Galax, VA, Gary, IN, Holland, MI, Lawrence, MA, Lewiston, ME, Missoula, MT, New York, NY, Norwalk, CT, Provo, UT, Richmond, IN, Santa Ana Pueblo, NM, Springfield, MA, Thermopolis, WY, Union County, OR.

Over six hundred cities were interested in participating in this program. Final selection was made from the one hundred and eleven cities which submitted full applications.

"At HUD we are looking forward to working cooperatively with DOE in helping these twenty-eight communities assess their ability to use district heating," Secretary Pierce said.

-more-

The cities will spend the next six to twelve months examining the most effective ways of connecting local heat suppliers with consumers. With the help of a local advisory committee, representing the varied interests of the community, they will study the financial and technical feasibility of the best systems. The committees will also help make the final selection of the district heating systems that have the best potential for fostering economic development and community revitalization through reduced energy costs.

Secretary Pierce expects many of the cities to be able to carry their analysis far enough, through this program, to get local financial and institutional support to further develop their projects.

Additional information is available from Wyndham Clarke, Office of Environmental Quality, U.S. Department of Housing and Urban Development, Area Code 202-755-6290.

# # #

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

JUN 0 1 1981

May 27, 1981

81ETEC-DRF-2174

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team
HUD's District Heating Project Winners

Reference: 81ETEC-DRF-2029, Budney to Technical Assistance Team, May 15, 1981

Dear Team Member:

Enclosed is a copy of HUD's list of District Heating Project Winners and Applicants. The list identifies winners considering geothermal energy.

DOE will be contacting the winners considering geothermal energy and advising them of the technical assistance program. Copies of the Geothermal District Heating Technical Assistance Team Information Resources document will be forwarded to these winners.

The winners are being asked to express their interest in attending a workshop or seminar on the technical assistance program and application of geothermal energy for district heating and cooling. If sufficient interest is expressed, ETEC will organize the workshop or seminar and invite your participation.

ETEC proposes to compile and transmit the site-specific references requested in the Reference letter to the Project Winners. Please forward this information to ETEC as soon as possible.

If you need further information, please call me at extension 6474, or Bob Eichelberger at extension 6165.

Sincerely yours,

G. S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosures: as noted

cc w/o encl: J. K. Hartman, ETEC PO

May 27, 1981

MAILING LIST

GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

DOE and Technical Assistance Management

Hilary Sullivan
Program Coordinator, Geothermal Energy
Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal
Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Roald Bendixen
U. S. Department of Energy Region X
1992 Federal Building
915 Second Avenue
Seattle, Washington 98174
Telephone: (206) 442-2820

## Participating Organizations

Mr. George Lawson
Oak Ridge National Laboratory
Building 3550
Oak Ridge, Tennessee 37830
Telephone: (615) 574-5210

Jess Pascual
Building 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Telephone: (312) 972-5249

Ms. Ann W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. New York 11973
Telephone: (516) 345-2666

Dr. Ishai Oliker
Project Manager, District Heating Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, New Jersey 07649
Telephone: (201) 265-2000, Ext. 2702

Ms. Susan Brown
California State Commercialization Team
California Energy Commission
1111 Howe Avenue
Sacramento, California 95825
Telephone: (916) 924-2499

J. C. Austin
$CH_2M$ Hill, Boise Office
P. O. Box 8748
Boise, Idaho 83707
Telephone: (208) 345-5310

Richard E. Pearl, Project Coordinator
Geothermal Commercialization and Planning Project
Colorado Geological Survey
715 State Centennial Building
1313 Sherman Street
Denver, Colorado
Telephone: (303) 866-2611

Mr. Robert Van Horn, Executive Director
GRIPS Commission
2628 Mendocino Avenue
Santa Rose, California 95401
Telephone: (707) 527-2025

William Toth
Hydrothermal Energy Commercialization Division
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83401
Telephone: (208) 526-9217

Mr. Alex Sifford
Eliot Allen & Associates, Inc.
5006 Commercial Street, S.E.
Salem, Oregon 97302
Telephone: (503) 371-4561

Mr. Bill Eastlake
Office of Energy
Statehouse
Boise, Idaho 83720
Telephone: (208) 334-3721

Dr. Fletcher C. Paddison
Johns Hopkins University -
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Telephone: (301) 953-7100

Participants Organizations

Mr. Michael Chapman
Energy Planning Division
Montana Department of Natural Resources
32 South Ewing
Helena, Montana 59620
Telephone: (406) 449-4624

Doug Sacarto
National Council of State Legislatures
1125 - 17th Street, Suite 1500
Denver, Colorado 80202
Telephone: (303) 623-6600

Mr. Noel Clark, Director
Nevada Department of Energy
1050 East Williams, Suite 405
Carson City, Nevada 89710
Telephone: (702) 885-5157

Dr. Larry Iceman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico 88003
Telephone: (505) 646-1745

Mr. Bruce Gaugler
State Energy Office
State Capitol
Bismarck, North Dakota 58501
Telephone: (701) 224-2107

William Sidle
Geothermal Project Director
Oregon Department of Energy
Labor and Industry Building
Salem, Oregon 97310
Telephone: (503) 378-5981

Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch Post Office
Klamath Falls, Oregon 97601
Telephone: (503) 882-6321

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, Oregon 97331
Telephone: (503) 754-2575, Ext. 3441

C. H. Bloomster, Linda Fassbender
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352
Telephone: (509) 376-4357, 376-4361

Marshall Conover
Radian Corporation
P. O. Box 9948
Austin, Texas 78766
Telephone: (512) 454-4797

N. Richard Friedman
Resource Dynamics Corporation
1340 Old Chain Bridge Road
McLean, Virginia 22101
Telephone: (703) 356-1300

Phil Lidel, Director
Geothermal Program
Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501
Telephone: (605) 773-3603

Phillip M. Wright, Debra Struhsacker
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Telephone: (801) 581-5283

Participants Organizations

William Isherwood
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025
Telephone: (415) 323-8111, Ext. 2841

Dr. R. Gordon Bloomquist
Washington State Energy Office
400 East Union Street
Olympia, Washington 98504
Telephone: (206) 754-0774

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 South Ivanhoe, Suite 4
Denver, Colorado 80222
Telephone: (303) 758-8206

Dr. Gary Tuttle
Western Energy Planners, Ltd.
12305 Eastridge Dr., N.E.
Alberquerque, N.M. 87112
Telephone: (505) 292-4070

Rick James
Geothermal Commercialization Office
P. O. Box 4096
University Station
Laramie, Wyoming 82071
Telephone: (307) 766-4820

Stanley Green
Utah Department of Natural Resources
Division of Water Rights
200 Empire Building
231 East 400 South
Salt Lake City, Utah 84111
Telephone: (801) 533-6071

Enclosure to 81ETEC-DRF-2174

HUD's District Heating Project Winners

1. Paul D. Ammerman
City of Albany, City Hall
Albany, NY 12207
(518) 462-2141

2. Donald M. Bernhard
Community Development Department
435 Hamilton Street
Allentown, PA 18101
(215) 437-7761

3. Angie Jones
City of Atlanta
Department of Budget and Planning
68 Mitchell Street, S.W.
Atlanta, GA 30303
(404) 658-7284

4. Matthew J. McCool
City of Atlantic City
Energy Office
303 City Hall
Tennessee and Bacarach Boulevard
Atlantic City, NJ
(609) 347-5522

5. Sheldon Lynn
Department of Planning
222 E. Saratoga Street
Baltimore, MD 21202
(301) 396-4330

6. David Rassmann
Rockingham Community Development Heat Pump
P.O. Box 370
Bellows Falls, VT 05101
(802) 463-3456

7. Ronald L. Bireley Geothermal
Town of Berlin
10 Williams Street
Berlin, MD 21811
(301) 641-2770

8. Richard L. Fahlander
Community Development Department
57 Inman Street
Cambridge, MA 02137
(502) 465-3576

9. C.F. Bright
Department of Housing and
Community Development
P.O. Box 459
Campbellsville, KY 42718 *Heat Pump*
(502) 465-3576

10. Anne C. Meier
Department of Energy and
Telecommunications
50 West Gay Street
Columbus, OH 43215
(614) 222-7750

11. Michael Schierloh
City of Dayton
101 Third Street
Dayton, OH 45402
(513) 255-5067

12. J.E. Mahoney
City Commission
P.O. Box 773
Devils Lake, ND 58301
(701) 662-4005

13. Mary Jane Hock
Downriver Community Conserence
3131 Biddle Avenue
Wyandotte, MI 48192
(313) 282-1300

14. Abe Farkas
Department of Community Development
and Planning
800 City-County Building
One Maine Street
Fort Wayne, IN 46802
(219) 423-7708

15. W. Harold Sneed
City of Galax
City Hass
Galax, VA 24333
(703) 236-3441

16. Gail H. Pugh
City of Gary
401 Broadway
Gary, IN 46402
(219) 944-6471

17. Tim Morawski
City of Holland
Board of Public Works
270 River Avenue
Holland, MI 49423
(616)396-4628

18. Kevin P. Clement
City of Lawrence
Community Development Department
200 Common Street
Lawrence, MA 08140
(617)685-5764

19. Robert Faunce
City of Lewiston
Department of Development
Pine Street
Lewiston, ME 04240
(207)784-2951

20. Michael Barton
City of Missoula
Planning Office
301 West Alder
Missoula, MT 59801 Geothermal with others
(406)721-5700

21. Richard P. Kuo
New York City Energy Office
49 Chambers Street, Room 720
New York, NY 10007
(212(566-3880

22. Roderick C. Johnson
City of Norwalk
41 Main Street
Norwalk, CT 06854
(203)838-7531

23. Garth Limburg
Provo City Corporation geothermal possible
P.O. Box 1849
Provo, UT 84601
(801)375-1822, Ext. 289

24. James Mays
City of Richmond
Richmond Power and Light
Box 908-2000, US27 South
Richmond, IN 47374
(317)935-3131

25. Erma J. Lopez
Santa Ana Pueblo
Indian Tribe
Star Route Box 37
Bernalillo, NM 87004
(505) 867-3301

geothermal

26. Joseph Superneau
City of Springfield
Department of Public Works
1600 E. Columbus Avenue
Springfield, MA 01103
(413) 787-6260

Heat pump and others

27. Lee Nellis
Town of Termopolis
P.O. Box 603
Thermopolis, Wyoming 82443
(307) 864-2732

geothermal

28. Hanley Jenkins, II
Union County Planning Department
Union County Courthouse
La Grande, OR 97850
(503) 963-8686, Ext. 227

geothermal

Applicants to HUD District Heating Solicitation
for Geothermal - Non Winners

Billings Yellowstone 87-
George S. Freeman
Planning Director
Billings-Yellowstone City County Planning Board
510 North 28 Street
Billings, Montana 59101
(406) 254-8989 ext. 246

Heber Public Utility District 77-
P.O. Box H
1085 Igram Ave.
Heber, California 92249
Salvador Lopez
President

City of Yakima
Dept. of Community Development
City Hall
Yakima, Washington 98901
David L. Wright
Planning Manager
(509) 575-6113

Stamford, Connecticut
Nancy L. Mitchell/Ft. Soldano Energy Dir.
Director Community Development
City of Stamford, Connecticut 06901

City of Ouray
P.O. Box 468
Ouray, Colorado 81427
George H. Gault
(303) 874-4848

City of Las Cruces
P.O. Drawer CLC
Las Cruces, NM 88001
James N. Allen
(505) 526-0436

City of Brawley 47-
City Hall
400 Main Street
Brawley, California 92227
Walker Ritter
(714) 344-1550

City of Alamosa
City Managers Office
P.O. Box 419
Alamosa, Colorado 81101
Gary T. Suiter
(303) 589-2593

City of Auburn
Office of City Manager
24 South Street
Auburn, New York 13021
Bruce L. Clifford
(315) 252-9531

City of Calipatria
Planning Dept.
101 N. Lake Street
Calipatria, California 92233
W. H. Sorensen
(714) 348-2246

City of Philip
DHC Assessment Work Group
Haakon County Courthouse
Philip, South Dakota 57567

Ft. Peck Assiniboine & Sioux Tribe
Ft. Peck Planning District
P.O. Box 115
Poplar, Montana 59255
Roy LaFromboise
(406) 768-3690

Mammoth County Water District
Special Purpose District
P.O. Box 597
Mammoth Lakes Village, California 93546
Gerry Baldwin
General Manager
(714) 934-2596

City of Caliente
P.O. Box 158
Caliente, Nevada 89009
Keith Larson
Mayor
(702) 726-3132

City of Reno, Nevada
Community Development Dept.
P.O. Box 1900
Reno, Nevada 89505
Pamela Luhrs
Acting Dir.
(702) 785-2040

Village of Milan, Ohio
Town Hall
Milan, Ohio 44846
Allen Appleton
(419) 668-2911

City of Oakridge, Oregon
City Administrator
P.O. Box 385
Oakridge, Oregon 97463
David Waffle
(503) 782-2258

Fort Collins, Colorado
City of Ft. Collins Municiple Gov
P.O. Box 580
Fort Collins, Colorado 80522
Barry Selbert
(303) 484-4220

Salt Lake City Corp.
Redevelopment Agency
351 South State Street
Salt Lake City, Utah 84111
Dick Turpin
(801) 328-3211

**Proposal #**

60 Marlin, Texas
P.O. Drawer 980
Marlin, Texas 76661
A. C. Johnson
(817) 833-5542

74 City of Preston, Idaho
70 West Oneida
Preston, Idaho 83263
Seth J. Butterfield
(801) 621-7351

52 City of Jamestown, New York
Dept. of Development
Municipal Bldg.
Jamestown, New York 14701
Douglas V. Champ
(716) 661-2241

16 Washoe County, Nevada
Gerlach, Nevada
P.O. Box 11130
Reno, Nevada 89520
Thomas Purkey

Town of Framingham, Mass.
Framingham Planning Dept.
Room 132 Memorial Bldg.
Framingham, Mass.
Mr. Christy Maltas
(617) 879-8571

County of San Diego
1600 Pacific Highway
San Diego, California 92101
Erick Pullion
(714) 236-2293

Forty Fort Borough, Pennsylvania
1271 Wyoming Ave.
Forty Fort, Pennsylvania 18704
Robert Walters or Carl Scarantino
(717) 287-3762

List of District/Heating-Cooling Applications
Solicitation No. 6500, January 1981

110 ALAMOSA, NEW MEXICO
84 ALBANY, N.Y.
39 ALLENTOWN, PA
45 ATLANTA, GA.
41 ATLANTIC CITY, N.J.
88 AUBURN, NY
91 AUGUSTA, MAINE

37 BALTIMORE, MD
87 BANGOR, PA
85 BATTLECREEK, MI
28 BELFAST, ME
58 BELLOWS FALLS, VT
11 BERLIN, MD
80 BERNALILLO, NEW MEX. (SANTA ANA PEUBLO)
100 BILLINGS, MONTANA
98 BLOOMINGTON, MINNESOTA
86 BOSTON, MASS.
63 BRAWLEY, CA
18 BRISTOL, VA.
1 BUFFALO (LACKAWANNA), NY
57 BUFFALO, NY

76 CALIENTE, NEV.
105 CALIPATRIA, CA
30 CAMBRIDGE, MA
4 CAMDEN, NJ
61 CAMPBELLSVILLE, KY
19 CARRBORO, NC
10 CHICAGO, ILL.
20 COLUMBUS, OH

46 DAYTON, OH (CITY)
81 DAYTON, OH (SHAILWOOD. ASSOC)
103 DENTON, TEXAS
108 DES MOINES, IOWA
106 DEVIL'S LAKE, ND

17 ECORSE, MICHIGAN
21 ERIE, PA
22 EXETER, NH

89 FLINT, MICHIGAN
97 FORT COLLINS, COLORADO
62 FORT PECT (POPLAR) MT.

47 FORT WAYNE, INDIANA
34 FORTY FORT, PA.
14 FRAMINGHAM, MA
70 FRESNO, CA

59 GALAX, VA
27 GARDNER, MA
93 GARY, INDIANA
8 GRAND HAVEN, MICH
54 GRANTIE FALLS, MINN

51 HARTFORD, CT
95 HEBER, CA
53 HOLLAND, MICHIGAN
68 HOLYOKE, MA

5 INKSTER, MICH.
66 Ithaca, NY

52 JAMESTOWN, NY
50 JERSEY CITY, NJ
102 JOHNSON CITY, NY

111 KOTZEBUE, ALASKA

82 LAS CRUCES, NEW MEXICO
40 LAWRENCE, MA
73 LEWISTON, ME

109 MADISON, WI.
101 MANKATO, MINNESOTA
75 MAMMOTH LAKES, CA
60 MARLIN, TEXAS
29 MAYNARD, MA
71 MILAN, OHIO
23 MILWAUKEE, WI
24 MINNEAPOLIS, MINN.
104 MISSOLIA, MONTANA

107 NEW ORLEANS, LOUISIANA
42 NEW YORK, NY
78 NORTH ADAMS, MA
77 NORWALK, CT

36 OAKRIDGE, OREGON
32 OURAY, COLORADO

3

13 PAINESVILLE, OH
12 PHILIP, SOUTH DAKOTA
74 PRESTON, IDAHO
92 PROVO, UTAH

48 RAHWAY, NJ
49 RED BANK, NJ
3 REDMOND, WASHINGTON
2 RENO, NEVADA
7 RICHMOND, INDIANA
9 ROCHESTER, MINN.
94 ROCHESTER, NY

99 ST. LOUIS PARK, MINNESOTA
26 ST. PAUL, MINN.
38 SALT LAKE CITY, UTAH
96 SAN FRANCISCO, CA
33 SAN DIEGO, CA
83 SCHENECTADY, NY
35 SKOWHEGAN, ME
69 SPRINGFIELD, MA
72 STAMPFORD, CONN.

43 TAMPA, FLORIDA
44 TAUTON, MA
65 THERMOPOLIS, WYOMING

56 UNION COUNTY, OREGON

90 VIRGINIA, MINNESOTA

6 WASH., D.C.
16 WASHOE COUNTY, NEVADA
67 WATERTOWN, NY
64 WILMAR, MINN.
79 WILKES-BARRE, PA.
25 WINOOSKE, VERMONT
55 WORTHINGTON, MINN.

15 YAKIMA, WASHINGTON
31 YPSILANTI, MICH.

April 1981

Geothermal H.Q. Quarterly Newsletter

As you may remember, I started a Geothermal Monthly Newsletter in December. I have been distracted so I have retitled the newsletter a Quarterly.

Eric Peterson

Attachment

Table of Contents

## Status of Federal District Heating Initiatives

### HUD

Over 110 proposals were received to the HUD solicitation for Assessing District Heating/Cooling Systems. Of these thirty-five communities wanted to address geothermal systems including heat pump systems. The majority of geothermal proposals came from states with a large known geothermal potential, however, there were also proposals from such non-traditional states as Vermont, Maryland and Kentucky. Attached is a list of the HUD awardees. All communities that submitted proposals, even though not winners, will have priority in obtaining Engineering, Resources and Institutional Technical Assistance from the Technical Assistance Centers.

### DOE

The DOE phase II solicitation for a more detailed analysis of an identified district heating project has been delayed. The funds are presently being considered as part of the recision of the funding for conservation's buildings and community systems.

## Interagency District Heating Coordinating Group

The Executive Policy Option Paper has been prepared by the IDHCG and is awaiting signature of the Secretaries for HUD and DOE. After approval by the Secretaries for consideration by the White House Domestic Policy Staff, copies will be available. The initial lower level readings at HUD are favorable.

# DOE Federal Buildings Program

The Geothermal Federal Buildings Program is designed to implement Section 642, Subtitle D of the Energy Security Act (Public Law 96-294). This requires the Federal Government to consider the option of using geothermal energy or resources in any new Federal buildings located where there are geothermal resources.

The plan prepared to achieve implementation will take advantage of technical expertise of existing programs. Its goal is to focus at sites where replacement with geothermal energy is economically advantageous.

High potential resource cities will be identified and matched with Federal buildings. Contacts will be made with Federal agencies to explain the program and offer assistance. Technical/economic scoping studies will be performed, to evaluate use of geothermal energy at each site selected. Results will be presented to the Federal agencies with suggestions as to further work needed, sources of assistance, possible scenarios for development, and further assistance available.

Since it is anticipated that at most sites the Federal Buildings will not provide sufficient heating load for an economical project, we will encourage a broader community base approach.

IRS

The Internal Revenue Service has published final regulations implementing energy credit provisions of The Energy Tax Act of 1978 in the Federal Register Vol. 46, No. 15, Friday January 23, 1981 (see attached copy). Tax credits for geothermal resources are provided under regulations for the Residential Energy Credit and the Investment Credit for Energy Property. The residential tax credit is intended for owners or renters who invest in certain energy conservation measures or alternative energy sources for their residential properties. The investment credit is for businesses investing in certain types of energy property. In either case, geothermal fluids must have wellhead temperatures exceeding 50°C (122°F) to qualify. No energy tax credits are available for equipment utilizing geothermal resources of lower temperature.

The credit for residential geothermal systems is 40 percent of the system cost, to a maximum credit of $4,000. The eligible costs include labor as well as equipment including back-up equipment. Heating/cooling systems that supplement geothermal systems are excluded. All heat pump equipment is excluded.

The business investment credit is 15 percent of the cost of "equipment used to produce, distribute or use energy derived from a geothermal deposit..." "Exploration and development" equipment does not qualify. The existence of backup equipment to protect against a failure in the geothermal system will not disqualify the system. Equipment that uses both geothermal energy and energy derived from other sources is not eligible.

For geothermal electric power plants, equipment through the turbine/generator stage is eligible for the credit. For geothermal district heating the equipment from the well to the heat distribution system is eligible.

## Proposed Federal Legislation

### Federal Tax Bill

It is expected that a congressman from Ohio will introduce at this session of Congress a bill to override regulations limiting geothermal residential and business tax credits to systems that use resources at temperatures greater than 50°C and to allow the tax credit for systems that use peaking for part of the year when the load is highest.

## National Conference of Mayors

Mayor Hatcher of Gary, Indiana sent a leter to the Secretary of HUD strongly supporting District Heating as a development tool for cities and the HUD district heating solicitation. The National Conference of Mayors has made a policy decision strongly supporting district heating.

## International District Heating Association

The Annual Meeting for the IDHA will be held in Cooperstown, NY June 14-17. No geothermal session is planned however representatives of the industry generally turn out in force.

## Am. Society of Heating Refrigeration and Air Conditioning Engineers

The Annual ASHRAE meeting will be held in Cincinnati, Ohio June 28 thru July 2. The Geothermal Committee TC 6.8 will sponsor a seminar "Large-Scale Geothermal Space Heating Systems. The DOE District Heating Team will hold an organizational meeting in conjunction with the ASHRAE meeting.

## American Society of Testing Material

The Semi-Annual ASTM meeting will be held in Phoenix, Arizona May 13 & 14. The Geothermal Resource and Energy Committee E-44 will be considering standards for geothermal wells. The subcommittee on energy utilization is interested in input on the need for standards on health safety or performance.

*Example (3)* of § 1.401 (j)-1 (g)). Thus, the plan would satisfy section 401(j) if it provided A with a $24,[illegible] normal retirement benefit instead of the $25,000 benefit determined under the plan formula without regard to this section.

**§ 1.401(j)-6 Effective dates and transitional rules.**

(a) *Effective dates.* Section 401(j) and the regulations thereunder apply to taxable years of an employer beginning after December 31, 1975, and to any plan year beginning with or within such taxable years.

(b) *Transitional rule.* (1) A plan will be treated as satisfying the requirements of section 401(j) for plan years beginning prior to January 23, 1982 if, for such years, any excess of the benefit accruing under the plan over the maximum benefit permitted for a participant under section 401(j) for such years is used, to the extent reasonably possible, to reduce the maximum benefit permitted under section 401(j) for plan years beginning on or after such date. This subparagraph will apply to a plan only if it is amended to satisfy the requirements of this subparagraph by the beginning of the first plan year beginning on or after January 23, 1982.

(2) A plan other than a plan described in section 412(i) will satisfy subparagraph (1) of this paragraph only if it is amended to provide that a participant who has accrued an excess benefit will reduce the accruals in each subsequent year by the remaining amount of such excess, until the excess is completely eliminated. An amendment required by this subparagraph shall not be considered a change in benefit accruals requiring the adjustments described in §§ 1.401(j)-3 or 1.401(j)-5(c).

(3) A plan described in section 412 (i) will satisfy subparagraph (1) if a new level premium is established based on a targeted cash surrender value at or below the limits described in § 1.401(j)-4(a).

(4) The rules of this paragraph may be illustrated by the following examples:

*Example (1).* (i) A, a partner in the X partnership, becomes a participant in the X Plan, a career average defined benefit plan, in 1977 at age 32. A accrues a basic benefit of 6.5% of compensation up to $50,000 for each year of service. A earns $20,000 in 1977, $30,000 in 1978, $40,000 in 1979, and $50,000 or more in 1980 and all subsequent years. In 1977, A accrues a basic benefit of $1,300 (6.5% of $20,000); in 1978, $1,950 (6.5% of $30,000); in 1979, $2,600 (6.5% of $40,000); and in 1980, $3,250 (6.5% of $50,000), for a total of $9,100. The plan otherwise complies with the requirements of section 401 and is not a plan described in section 412(i).

(ii) Under § 1.401(j)-1(c)(1) A's applicable percentage is 6.0% and A's maximum benefit accrual is $1,200 (6% of $20,000) for 1977; $1,800 (6% of $30,000) for 1978; $2,400 (6% of $40,000) for 1979; and $3,000 (6% of $50,000) for 1980, for a total maximum benefit of $8,400. Thus, A accrued an excess benefit of $700 in 1977-80. In 1980, the plan is amended effective January 1, 1981, the beginning of the plan year, to provide A with a benefit accrual in 1981 of $2,300 (6% of $50,000, or $3,000, minus $700) and 6% of compensation up to $50,000 thereafter.

(iii) Under subparagraphs (1) and (2), the plan will continue to be qualified because the amendment to reduce future accruals to the extent of past excess accruals was adopted before [one year after publication of this Treasury decision in the Federal Register]. A's applicable percentage remains 6.0% because the amendment required by this section does not begin a new period of participation.

*Example (2).* (i) A, a self-employed individual, begins participation in Plan X, a career average defined benefit plan, in 1976 at age 32. The plan is not a plan described in section 412(i). Each year A accrues a basic benefit of 6.5% of compensation up to $50,000. On May 1, 1980, A ceases to be covered by the plan.

(ii) Under § 1.401(j)-1(b) (1) A's maximum benefit for each plan year is 6.0% (the applicable percentage for age 32) of compensation up to $50,000. Therefore A has accrued a benefit in excess of the maximum benefit permitted under section 401(j). The plan will satisfy the requirements of section 401(j) if it is amended to provide that A's future benefit accruals will be reduced to zero until A's accrued benefit equals the sum of A's maximum benefits for all plan years in which A is or was subject to the section 401(j) limitations. The plan, so amended, will satisfy the requirements of this section even though A never again participates in the plan.

*Example (3).* (i) Employee A, a shareholder-employee, became a participant in a defined benefit plan in 1976 at age 45. The plan is a plan described in section 412(i) and the insurance company uses sex base tables to determine its premiums. A is male. A's compensation each year from 1976 through 1980 was $20,000. The plan year begins on January 1. In 1981, A's compensation was again $20,000. Under the terms of the plan in effect through 1980 and the terms of the insurance contract purchased to fund A's benefit, A's targeted cash surrender value was $150,000. However, under § 1.401(j)-4(a) the maximum targeted cash surrender value for A at age 65 is $133,488 (3.6% (A's applicable percentage) times 20 (A's years of possible participation to retirement) times $20,000 (A's compensation for each year) times 9.27 (Table A)).

(ii) The plan is amended in December 1980, effective January 1, 1981, to conform to these regulations. A lower annual premium is established to reflect the new targeted cash surrender value of $133,488. Under subparagraph (3), the plan will continue to be qualified because the plan has been amended to conform to these regulations prior to January 23, 1982.

*Example (4).* (i) Employee B, a shareholder-employee, became a participant in a defined benefit plan in 1979 at age 50. The plan is a plan described in section 412(i) and the insurance company uses sex-based tables to determine the premiums. B is female. B's compensation was $30,000 in 1979 and 1980 and increased to $40,000 in 1981. The plan year begins January 1. Under the terms of the plan in effect through 1980 and the terms of the insurance contract purchased to fund B's benefit, B's targeted cash surrender value was $185,000. However, under § 1.401(j)-4(a) the maximum targeted cash surrender value for B at age 65 was $146,880 (3% (B's applicable percentage) times 15 (B's years of possible participation to retirement) times $30,000 (B's compensation for each year) times 10.88 (Table A)).

(ii) The plan is amended in December 1980, effective January 1, 1981, to conform to these regulations. Because B's compensation increased and because the plan was amended, B's targeted cash surrender value at age 65 under the terms of the plan and insurance contracts purchased to fund B's benefits is $188,000. Under § 1.401(j)-4(a) the maximum targeted cash surrender value for B at age 65 is $189,312 (3% times $30,000 times 10.88 for each of the first two plan years plus 3% times 13 (B's years of possible plan participation from age 52 to retirement) times $40,000 (B's compensation) times 10.88). No adjustment in B's targeted cash surrender value need be made, even though B's targeted cash surrender value under the plan exceeded the maximum targeted cash surrender value for years prior to 1981.

(c) *Subchapter S plan in existence before December 31, 1975.* If a defined benefit plan covered a shareholder-employee in a plan year beginning before December 31, 1975, the pre-401(j) part of the plan is subject to the rules on taxability of shareholder-employees set forth in section 1379(b). The pre-401(j) part of the plan is the part attributable to benefits accrued for plan years beginning prior to December 31, 1975, in which the plan covered a shareholder-employee.

(Secs. 401(j), 7805, Internal Revenue Code of 1954 (88 Stat. 953, 68A Stat. 917 (26 U.S.C. 401(j), 7805)))

Jerome Kurtz,

*Commissioner of Internal Revenue.*

Approved: January 12, 1981.

Donald C. Lubick,

*Assistant Secretary of the Treasury.*

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BILLING CODE 4830-01-M

## 26 CFR Part 1

[T.D. 7765]

## Investment Credit for Energy Property

AGENCY: Internal Revenue Service, Treasury.

ACTION: Final regulations.

SUMMARY: This document contains final regulations relating to the business investment credit for energy property. Changes in the applicable tax law were made by the Energy Tax Act of 1978. These regulations will provide the public with the guidance needed to comply with the law.

**DATES:** These regulations are effective, in general, for the period beginning on October 1, 1978, and ending December 31, 1982.

**FOR FURTHER INFORMATION CONTACT:** Mary Frances Pearson of the Legislation and Regulations Division, Office of the Chief Counsel, Internal Revenue Service, 1111 Constitution Avenue, NW., Washington, D.C. 20224, Attention: CC:LR:T (202-566-3458, not a toll-free number).

**SUPPLEMENTARY INFORMATION:**

### Background

This document contains amendments to the Income Tax Regulations (26 CFR Part 1) under section 48 of the Internal Revenue Code of 1954. These amendments were proposed in the Federal Register for September 19, 1980 (45 FR 62496). A public hearing concerning the proposed amendments was held on December 4, 1980. These amendments conform the regulations to certain changes made by section 301(b) of the Energy Tax Act of 1978 (Pub. L. 95-618, 92 Stat. 3174) and are issued under the authority contained in Code sections 7805 (68A Stat. 917, 26 U.S.C. 7805) and 38(b) (76 Stat. 962, 26 U.S.C. 38).

After careful consideration of the comments submitted in response to the notice of proposed rulemaking, and after consultation with the Department of Energy, the proposed rules are adopted as revised by this Treasury Decision.

### Windfall Profit Tax Legislation

This regulation does not reflect any amendments under sections 221-223 of the Crude Oil Windfall Profit Tax Act of 1980 (Pub. L. 96-223, 94 Stat. 229). Under that Act, certain categories of energy property have been expanded and effective dates for certain energy property have been extended. A subsequent notice of proposed rulemaking will cover those amendments.

### In General

In general, a taxpayer may claim a 10-percent investment credit (regular credit) for certain tangible business property. The taxpayer may apply the regular credit against a portion of its tax liability. Unused credits may be carried forward or carried back. If property for which the regular credit was claimed is disposed of before the end of its estimated useful life, the credit must be recomputed on the basis of its actual life.

For the period beginning October 1, 1978, and ending December 31, 1982, section 301(b) of the Energy Tax Act of 1978 adds a 10 percent credit for energy property (energy credit). The rules for the regular credit apply, in general, to the energy credit. However, the energy credit may offset 100 percent of the tax liability remaining after applying the regular credit.

Energy property is defined as alternative energy property, solar or wind energy property, specially defined energy property, recycling equipment, shale oil equipment, and equipment used to produce natural gas from geopressured brine. Energy property must be new section 38 property. For the energy credit only, building and structural components of buildings and property used in lodging facilities (to the extent qualified, *e.g.*, solar or geothermal equipment) are treated as section 38 property. However, since this type of property, in general, is not otherwise section 38 property, the property does not qualify for the regular credit. Public utility property generally does not qualify as energy property. To be eligible, the original use of acquired property must begin after September 30, 1978, and before January 1, 1983. Property constructed by the taxpayer is eligible only to the extent of basis attributable to construction for the period beginning on October 1, 1978, and ending on December 31, 1982.

### Recapture

If energy property is sold or otherwise disposed of, the recapture rules of section 47 apply to both the regular credit and energy credit. In response to public comments, the application of the section 47 recapture rules to the energy credit was clarified to emphasize that the recapture determination is based upon the estimated useful life of the property which was taken into account in computing qualified investment. Thus, the principles of recapture for the energy credit are the same as for the regular credit.

### Alternative Energy Property

Alternative energy property includes (1) equipment which uses an alternate substance as a fuel, and (2) equipment which produces a snythetic fuel from an alternate substance. An alternate substance is a substance other than oil or natural gas or any product of oil or natural gas. Various comments suggested that the definition of alternate substance in the proposed regulations should be expanded to include the synthetic fuels produced from an alternate substance, oil shale, and tar sands. These suggestions were not adopted.

Congress provided a subsidy for direct use of alternate substances as a fuel as well as for producing synthetic fuels from the alternate substance. The commentators would disregard the word "synthetic" and would treat it as the equivalent of alternate substance, the very product from which the synthetic fuel is produced. Congress did not intend, however, to subsidize the use of synthetic fuel. Such a subsidy is unnecessary because synthetic fuel in most cases is a close substitute for conventional fuel and does not require specialized equipment. For example, a credit is provided for equipment used to produce methane from landfill, but since such methane is a close substitute for pipeline quality natural gas, no credit is provided for equipment which uses such methane as a fuel and which is indistinguishable from equipment using natural gas.

The suggestion that shale oil and tar sands be considered alternate substances was not adopted because those are oil substances although in a form which makes their recovery more difficult. Of course, in the case of oil shale property, Congress provided a credit for such equipment in section 48(l)(7). The Senate had adopted a $3 per barrel credit for production of oil from tar sands. See H.R. 5263, section 1044, as passed by the Senate on October 31, 1977. However, that provision was rejected in Conference. Such a credit was adopted as section 44D of the Code by Congress in the Crude Oil Windfall Profit Tax Act of 1980. (Pub. L. 96-223 94 Stat. 268)

There were some suggestions that synthetic fuel production equipment be expanded to include an oxygen plant. Under section 48(l)(3)(iii), synthetic fuel equipment is "equipment for *converting* and alternate substance into a synthetic liquid, gaseous, or solid fuel. An oxygen plant does not convert the alternate substance into a synthetic fuel but merely supplies the catalyst use in the conversions process. If the statutory language meant to incorporate equipment not directly involved in the conversion process, language such as "used in connection with the conversion" would have been used instead. For this reason, oxygen plants are not synthetic fuel equipment under the regulations.

In response to comments, the definition of synthetic fuel has been changed to state that fuel derived from biomass which undergoes the process of defiberization is a synthetic fuel. This change is consistent with the "chemical change" requirement since biomass is changed into a refuse derived fuel through a series of chemical and heat treatments which break down the structural fibers of the substance.

Pollution Control Equipment

Under the proposed regulations, pollution control equipment was eligible for the energy credit only if installed on or in connection with eligible alternative energy property. Pollution control equipment required by Federal, State, or local government regulation in effect on October 1, 1978, with respect to property burning coal on that date was excluded. Any order permitting delayed compliance was to be disregarded in determining whether property was required to be installed on October 1, 1978.

Several comments took issue with the requirement in § 1.48-9(c)(8)(iii) that in order for pollution control equipment to qualify as alternative energy property, it must be installed in connection with eligible alternative energy property. These comments were not adopted. The inclusion of certain pollution control equipment under the energy credit was not intended to provide a general subsidy for pollution control equipment, but rather was intended to provide an incentive for the installation of new property using alternate substances. A credit was provided for pollution control equipment only to the extent that such equipment was required for the installation of the alternative energy property. Therefore, this limitation remains in the final rules.

Comments also suggested that orders which permit delayed compliance should be considered in determining what pollution control equipment was required on October 1, 1978. The statutory language in section 48(l)(3)(C) indicates an intention to determine what equipment was required by reference to rules of general application. The law clearly denies the credit to taxpayers who installed such equipment prior to October 1, 1978. Taxpayers, required to install pollution control equipment on that date, who arranged to delay compliance should not be given preferential treatment.

Geothermal Equipment

Under section 48(l)(3)(A)(viii), alternative energy property includes "equipment used to produce, distribute, or use energy derived from a geothermal deposit (within the meaning of section 613(e)(3)). . . ." The proposed regulations defined geothermal deposit by cross-reference to section 1.44C-2(h), which requires a wellhead temperature exceeding 50°C. The proposed regulations also provided that, to qualify, geothermal equipment (1) must be *specially adapted to use geothermal energy* and (2) must be used exclusively with energy derived from a geothermal deposit. Under the statute, production and distribution equipment qualifies while exploration and development equipment does not.

Comments suggested elimination of the "dual function rule." The dual function rule prevents unnecessary administrative burdens and reflects Congressional intent to limit the subsidy to equipment exclusively used for geothermal energy. Without such a rule, it frequently would be impossible to determine when energy from a geothermal deposit is being used. Further, property which uses energy from a conventional source in addition to geothermal energy is indistinguishable from property that performs the same function without the use of geothermal energy. Congress did not intend to provide a credit for property that would be purchased for conventional heating or cooling uses. However, as noted below, the rule is clarified to indicate that dual use is determined by reference to the particular application, and not by reference to any uses for any equipment.

In response to comments, the final regulations do not contain the specially adapted equipment rule. The comments noted that, in general, geothermal equipment is not specially designed for geothermal use. Consequently, adoption of this rule would have disqualified most geothermal equipment. In response to requests by commentators, the regulations also make it clear that "downhole" equipment necessary to produce geothermal energy (*e.g.*, screening or slotted liners, tubing and downhole pumps), and reinjection well property are production equipment.

Finally, comments have criticized the § 1.44C-2(b) requirement adopted by cross reference that the wellhead temperature exceed 50°C for an energy source to be considered to be a geothermal deposit. The statutory language "energy derived from a geothermal *deposit* (within the meaning of section 613(e)(3)) (emphasis added)" indicates a clear Congressional intent to limit the credit to property utilizing geothermal energy contained in a distinct, specific, and identifiable reservoir. Reference to the depletion provisions contemplates a depletable energy source, and not an aquifer whose water is being constantly replenished.

The intent to thus restrict the term geothermal is also reflected in the description of geothermal energy in the Ways and Means committee print, Energy Program, Number 11, "Geothermal Tax Provisions and Minimum Tax Treatment of Intangible Drilling Costs for Oil and Gas," prepared by the staff of the Joint Committee on Taxation, June 11, 1977. In the committee print, which provided the technical background material for the legislation which ultimately became the Energy Tax Act of 1978, geothermal energy is described by reference as definable deposits of steam, hot water and hot, dry rocks. The lowest temperature mentioned is 60°C, the highest, 1500°C. The technology described involved direct use of the heat from such resources.

Recognizing the difficulty taxpayers would otherwise face in demonstrating that energy was derived from a sufficiently identifiable and depletable deposit, the proposed regulations provide a 50°C rule as a safe-harbor rule. The final regulations retain this liberal rule.

Solar Energy Property

In response to comments, the definition of solar energy property was expanded to make it clear that it includes storage devices, power conditioning equipment, transfer equipment, and property solely related to the functioning of those items. However, such equipment does not include transmission equipment.

Wind Energy Property

A number of comments cited specific legislative history to the effect that wind energy property includes "transfer equipment." *See*, H. Rep. No. 95-496, Part III, 95th Cong., 1st Sess., p. 121; S. Rep. No. 95-1324, 95th Cong., 2d Sess., p. 62). Accordingly, transfer equipment is specifically added to the definition of wind energy property. Transfer equipment includes equipment which permits the aggregation of electricity generated by several windmills and equipment which alters voltage in order to permit transfer to a transmission line. However, transfer equipment does not include transmission lines, a distinction based upon the technical definition of the terms transfer and transmission, and on specific references to transmission in the Act (both including and excluding such equipment) indicating Congressional cognizance of the differences between the two functions.

Specially Defined Energy Property

Section 48(l)(5) lists items of specially defined energy property, which qualify for the energy credit if installed in an existing industrial or commercial process. The proposed regulations provided descriptions of the items listed. The proposed regulations also excluded equipment used in connection with general office, retail, and similar activities as not involving industrial or commercial processes.

A large number of comments suggested that the term "industrial or commercial process" should include office, retail, and similar activities. Specifically, many commentators argued that automatic energy control systems even when installed in retail stores, office buildings, or multi-family dwellings should qualify for the energy credit as specially defined energy property. The commentators relied primarily on the fact that the administration had proposed a business energy conservation credit which applied to all business buildings and on the appearance of the term "automatic energy control systems" in the statute. These comments were rejected as being inconsistent with the statute and the legislative history of the provision.

The Administration 1977 energy tax proposals contained a general business energy conservation credit which combined both industrial and commercial conservation property under one category. See the Treasury Department's Technical Explanation A-7, published May 16, 1977. Thus, automatic energy control systems, recuperators, and heart wheels (presently eligible for a credit as specially defined energy property) were on a list with insulation, double glazing, and other business insulation property. The House generally adopted the Administration proposal with respect to the business energy credits. However, the House distinguished between those items that were specially designed to achieve conservation in existing industrial processes and items for general business conservation uses.

Property identified as qualifying for the conservation credit, *in addition to* insulation, included items to be designated by the Secretary as being designed to reduce the heat loss or gain of an existing commercial or industrial building or facility. In contrast to "specifically" defined energy property the class of property described in the conservation credit was not limited by reference to recovery of waste heat or gas nor was it required that it be installed in connection with an existing process. (See, section 2001 (b) & (c) of H.R. 8444 as passed by the House on August 5, 1977; The Ways and Means Committee report (H. Rep. No. 95-498, Part III, 95th Cong. 1st Sess., p. 121).

The Senate bill expanded the definition of specially defined energy property, and retained the House conservation provision. Under the Senate bill, the requirement of use with an existing process was eliminated because the Senate has expanded the qualifying category of items to include non-process items. Thus, under the Senate bill the result called for in these comments would have been correct. (See section 1031 of H.R. 5263 as passed by the Senate October 31, 1977).

However, in Conference, the conferees adopted the House specially defined energy tax credit provision, reinserting the existing industrial or commercial process limitation which the Senate had deleted. The position taken in the comments would require interpreting "in connection with an existing industrial or commercial process," which Congress specifically reinserted, in a way which would cause it to have no meaning. The insulation and conservation credit was not adopted because of budgetary constraints. (See, S. Rep. No. 95-1324) (Conference Report), 95th Cong., 2d Sess., p. 64-67.)

In response to a number of comments, several technical changes were made in the definition of the listed items.

### Recycling Equipment

Under section 48(1)(6), recycling equipment is equipment that sorts or prepares solid waste for recycling or that recycles solid waste, as well as equipment that converts solid waste into useful energy. The proposed regulations defined solid waste by reference to the definition in the regulations under section 103(b)(4)(E), which permits tax-exempt financing of "solid waste disposal facilities." Under the proposed rules, the recycling process for recovering raw materials from solid waste is limited to one in which raw materials are recovered which may be used in fabricating an end product in the same way as materials from a virgin substance.

A number of comments suggested including "reconstituted products for commercial purposes" in the definition of recycling. Thus, equipment used to remanufacture used industrial and automotive parts, such as valves, gaskets, carburetors, and distributors or to retread tires would be eligible for the credit. These suggestions were not adopted. Permitting equipment used in these processes to qualify would be inconsistent with the Senate Report which requires that recycling equipment (other than conversion equipment) be designed to recover raw materials. (See, S. Rep. 95-529, 95th Cong., 1st Sess., at 82.) Thus, no change is made in the proposed rules in response to these comments.

In response to a request for clarification, the final rules specify that equipment that processes animal waste is not recycling equipment.

Some comments suggested that the regulations incorporate by reference the definition of solid waste under 42 U.S.C. § 6903, the Solid Waste Disposal Act, as amended, (which treats *e.g.*, liquid and gaseous wastes as "solid waste") rather than the definition of solid waste in the regulations under section 103(b)(4). It is not appropriate to adopt this suggestion.

There is no indication that Congress intended to alter the tax definition of solid waste (except to the extent described below). The legislative history of section 103(b)(4)(E) incorporates by reference, and specifically cites, the definition of solid waste in the Solid Waste Disposal Act in effect at that time. (See, H. Rep. No. 1533, 90 Cong., 2d Sess., p. 38). When that definition in that Act was subsequently amended, Congress did not conform the tax law to the new definition. Furthermore, the legislative history of the Energy Tax Act of 1978 contains no cross-reference to the Solid Waste Disposal Act, as amended, thereby impliedly accepting the existing tax definition.

As a general rule, Congress is presumed to intend terms to have the same meaning for tax purposes when used in more than one Code section. Therefore, under the final rules, the term continues to have the same meaning for purposes of the energy credit as under the regulations under section 103(b)(4)(E).

However, Congress clearly intended certain changes be made in the tax definition of solid waste for purposes of the energy credit. The section 103 regulation excludes from the definition of solid waste any substance that may be sold (*i.e.*, for value) to an unrelated third party. Under this rule, virtually none of the items identified in the Senate Report, such as scrap metal, newsprint, and fibers would be considered solid waste, since all of these items have a market value at least equal to the price a recycler would pay for the material. See, Senate Report, at 83.

Therefore, the proposed regulation defined solid waste by beginning with the section 103 definition but has modified it by deleting an irrelevant reference to the date of issue of obligations, by adding a provision which indicates that if the market value of material is attributable only to its recycling use the material is not considered to have a market value, and by permitting the recycled material to include not more than 10 percent virgin material during a taxable year.

### Shale Oil Equipment

In response to comments, the distinction in the proposed regulations between surface mining equipment and equipment used in *in situ* technology is eliminated in the final rules. The distinction appeared in the Senate Report at page 83, although it was not made in the Conference Report. It was decided that, consistent with the legislative intent to encourage shale oil development, the final rules should not favor any particular shale oil recovery technology. In addition, the rules are clarified to indicate that retorting includes direct cooling and condensing and that water supply and treatment equipment and handling equipment for spent shale qualifies. However, under the statute equipment which is used for hydrogenation, refining, or other process subsequent to retorting does not qualify. Consequently, gas cleanup equipment has not been included within the qualified category of equipment.

Several comments took issue with the incremental cost rule in the proposed regulations. Incremental cost is the excess of the total cost of equipment over the amount that would have been expended for the equipment if the equipment were not used for a qualifying purpose.

One item of property in many instances can be used in part for a qualifying energy purpose and in part for non-qualifying functions. The approach in this situation is to give no energy credit for the property, partial credit or full credit. Denying the credit entirely would discourage energy property investments. On the other hand, property which incidently serves an energy function should not receive the subsidy of a full energy credit. The fairer approach adopted in this regulation is the incremental cost rule.

### Drafting Information

The principal author of these regulations is Mary Frances Pearson of the Legislation and Regulations Division of the Office of Chief Counsel, Internal Revenue Service. However, personnel from other offices of the Internal Revenue Service and Treasury Department participated in developing the regulations, both on matters of substance and style.

### Adoption of Amendments to the Regulations

Accordingly, 26 CFR Part 1 is amended as follows:

Paragraph 1. Section 1.47–1 is amended as follows:

1. Paragraph (a)(1)(i) is amended by adding at the end thereof "For rules applicable to energy property, see paragraph (h) of this section."

2. A new paragraph (h) is added to read as set forth below:

**§ 1.47–1 Recomputation of credit allowed by section 38.**

* * * * *

(h) *Special rules for energy property*—(1) *In general.* A recapture determination is required for the investment credit attributable to the energy percentage (energy credit) if property is (i) disposed of or (ii) otherwise ceases to be energy property (as defined in section 48(l)) with regard to the taxpayer before the close of the estimated useful life (as determined under paragraph (a)(2)(i) of this section) which was taken into account in computing qualified investment.

(2) *Dispositions.* The term "disposition" is described in § 1.47–2(a)(1). A transfer of energy property that is a "disposition" requiring a recapture determination for the investment credit attributable to the regular percentage (regular credit) and the ESOP percentage (ESOP credit) will also be a "disposition" requiring a recapture determination for the energy credit.

(3) *Cessation.* The term "cessation" is described in § 1.47–2(a)(2). For energy property, a cessation occurs during a taxable year if, by reason of a change in use or otherwise, the property would not have qualified for an energy credit if placed in service during that year. A change in use will not require a recapture determination for the regular or ESOP credit unless, by reason of the change, the property would not have qualified for the regular or ESOP credit if placed in service during that year.

(4) *Recordkeeping requirement.* For recordkeeping requirements with respect to dispositions or cessations, the rules of paragraph (e)(1) of this section apply. For example, the taxpayer must maintain records for each recycling facility indicating the percentage of virgin materials used each year. See, § 1.48–9(g)(5)(ii).

(5) *Examples.* The following examples illustrate this paragraph (h).

*Example (1).* (a) In 1980, corporation X, a calendar year taxpayer, acquires and places in service a computer that will perform solely energy conserving functions in connection with an existing industrial process. Assume the computer has a 10 year useful life and qualifies for both the regular and energy credits. In 1981, a change is made in the industrial process (within the meaning of § 1.48–9(l)(2)). However, for 1981 the computer continues to perform solely energy conserving functions. In 1982, the computer ceases to perform energy conserving functions and begins to perform a production related function.

(b) For 1981, a recapture determination is not required. For 1982, the entire energy credit must be recaptured, although none of the regular credit is recaptured. If in 1989 the computer first ceased to perform an energy conserving function, no part of the energy credit would be recaptured.

*Example (2).* Assume the same facts and conclusion as in example (1). Assume further that X sells the computer in 1985. A recapture determination is required for the regular credit.

*Example (3).* In 1981, corporation Y, a calendar year taxpayer, acquires and places in service recycling equipment. Assume the equipment has a 7-year useful life and qualifies for both the regular credit and energy credit. During the course of 1982, more than 10 percent of the material recycled is virgin material. The energy credit is recaptured in its entirety, although none of the regular credit is recaptured. See § 1.48–9(g)(5)(B)(ii).

*Example (4).* In 1980, corporation Z, a calendar year taxpayer, acquires and places in service a boiler the primary fuel for which is an alternate substance. The boiler has a 7-year useful life. Assume the boiler is a structural component of a building within the meaning of § 1.48–1(e)(2). Assume further that the boiler is not a part of a qualified rehabilitated building (as defined in section 48(g)(1)) or a single purpose agricultural or horticultural structure (as defined in section 48(p)). Z is allowed only an energy credit since the boiler is a structural component of a building. In 1984, Z modifies the boiler to use oil as the primary fuel. A recapture determination is required for the energy credit. See § 1.48–9(c)(3).

Par. 2. A new § 1.48–9 is added to read as set forth below:

**§ 1.48–9 Definition of energy property.**

(a) *General rule*—(1) *In general.* Under section 48(l)(2), energy property means property that is described in at least one of 6 categories of energy property and that meets the other requirements of this section. If property is described in more than one of these categories, or is described more than once in a single category, only a single energy investment credit is allowed. In that case, the energy investment credit will be allowed under the category the taxpayer chooses by indicating the chosen category on Form 3468, Schedule B. The 6 categories of energy property are:

(i) alternative energy property,
(ii) solar or wind energy property,
(iii) specially defined energy property,
(iv) recycling equipment,
(v) shale oil equipment, and
(vi) equipment for producing natural gas from geopressured brine.

(2) *Depreciable property with 3-year useful life.* Property is not energy property unless depreciation (or amortization in lieu of depreciation) is

allowable and the property has an estimated useful life (determined at the time when the property is placed in service) of 3 years or more.

(3) *Effective date rules.* To be energy property—

(i) If property is constructed, reconstructed or erected by the taxpayer, the construction, reconstruction, or erection must be completed after September 30, 1978, or

(ii) If the property is acquired, the original use of the property must (A) commence with the taxpayer and (B) commence after September 30, 1978, and before January 1, 1983.

For transitional rules, see section 48(m).

(4) *Cross references.* (i) To determined if depreciation (or amortization in lieu of depreciation) is allowable for property, see § 1.48-1(b).

(ii) For the meaning of "estimated useful life", see § 1.46-3(e)(7).

(iii) The meaning of "acquired", "original use", "construction", "reconstruction", and "erection" is determined under the principles of § 1.48-2(b).

(iv) For the definition of energy investment credit (energy credit), see section 48(o)(2).

(v) For special rules relating to public utility property, see paragraph (n) of this section.

(b) *Relationship to section 38 property*—(1) *In general.* (i) Energy property is treated under section 48(l)(1) as meeting the general requirements for section 38 property set forth in section 48(a)(1). For example, structural components of a building may qualify for the energy credit. In addition, the exclusion from section 38 property under section 48(a)(3) (lodging limitation) does not apply to energy property. For purposes of the energy credit, energy property is treated as section 38 property solely by reason of section 48(l)(1). For example, if property ceases to be energy property, it ceases to be section 38 property for all purposes relating to the energy credit and, thus, if subject to recapture under section 47. See § 1.47-1(h).

(ii) See the effective date rules under paragraph (a)(3) of this section for limitations on the eligibility of property as energy property.

(iii) Section 48(l)(1) does not affect the character of property under sections of the Code outside the investment credit provisions. For example, structural components of a building that are treated as section 38 property under section 48(l)(1) remain section 1250 property and are not section 1245 property.

(2) *Other section 48 rules apply.* (i) In general, section 48(a) otherwise applies in determining if energy property is section 38 property. Thus, energy property excluded from the definition of section 38 property under section 48(a) (except by reason of section 48(a)(1) or (a)(3)) is not eligible for the energy credit. For example, energy property used predominantly outside the United States (section 48(a)(2)) or used by tax exempt organizations (section 48(a)(4)), in general, is not treated as section 38 property for any purpose and thus, is not eligible for the energy credit.

(ii) Other rules of section 48, such as those for leased property under section 48(d), also apply to energy property.

(3) *Regular credit denied for certain energy property.* In computing the amount of credit under section 48(a)(2), the regular percentage does not apply to any energy property which, but for section 48(l)(1), would not be section 38 property. See section 46(a)(2)(D). For example, energy property used for lodging (section 48(a)(3)) and, in general, structural components of a building (section 48(a)(1)(B)) re not eligible for the regular credit even though they may be eligible for the energy credit. However, a structural component of a qualified rehabilitated building (as defined in section 48(g)(1)) or a single purpose agricultural or horticultural structure (as defined in section 48(p)) may qualify for the regular credit without regard to section 48(l)(1).

(c) *Alternative energy property*—(1) *In general.* Alternative energy property means property described in paragraph (c)(3) through (10) of this section. In general alternative energy property includes certain property that uses an alternate substance as a fuel or feedstock or converts an alternate substance to a synthetic fuel and certain associated equipment.

(2) *Alternate substance.* (i) An alternate substance is any substance or combination of substances other than an oil or gas substance. Alternate substances include coal, wood, and agricultural, industrial, and municipal wastes or by-products. Alternate substances do not include synthetic fuels or other products that are produced from an alternate substance and that have undergone a chemical change as described in paragraph (c)(5)(ii) of this section. For example, methane produced from landfills is not an alternate substance; rather it is a synthetic fuel produced from an alternate substance. However, preparing an alternate substance for use as a fuel or feedstock or for conversion into a fuel does not create a new product if no chemical change occurs. For example, pelletizing, drying, compacting, and liquefying do not result in a new product if no chemical change occurs.

(ii) The term "oil or gas substance" means—

(A) oil or gas and

(B) any primary product of oil or gas.

(iii) For the definition of primary product of oil or gas, see § 1.993-3(g)(3)(i), (ii), and (vi). Thus, petrochemicals are not primary products of oil or gas.

(3) *Boiler.* (i) A boiler that uses an alternate substance as its primary fuel is alternative energy property.

(ii) A boiler is a device for producing vapor from a liquid. Boilers, in general, have a burner in which fuel is burned. A boiler includes a fire box, boiler tubes, the containment shell, pumps, pressure and operating controls, and safety equipment, but not pollution control equipment (as defined in paragraph (c)(8) of this section).

(iii) A "primary fuel" is a fuel comprising more than 50 percent of the fuel requirement of an item of equipment, measured in terms of Btu's for the remainder of the taxable year from the date the equipment is placed in service and for each taxable year thereafter. Electricity and waste heat are not fuels. For example, electric boilers do not qualify as alternative energy property even if the electricity is derived from an alternate substance.

(4) *Burners.* (i) A burner for a combustor other than a burner described in paragraph (c)(3)(ii) of this section is alternative energy property if the burner uses an alternate substance as its primary fuel (as defined in paragraph (c)(3)(iii) of this section).

(ii) A burner is the part of a combustor that produces a flame. A combustor is a process heater which includes ovens, kilns, and furnaces.

(iii) A burner includes equipment (such as conveyors, flame control devices, and safety monitoring devices) located at the site of the burner and necessary to bring the alternate substance to the burner.

(5) *Synthetic fuel production equipment.* (i) Equipment (synthetic fuel equipment) that converts an alternate substance into a synthetic solid, liquid, or gaseous fuel (other than coke or coke gas) is alternative energy property. Synthetic fuel production equipment does not include equipment, such as an oxygen plant, that is not directly involved in the treatment of an alternate substance, but produces a substance that is, like the alternate substance, a basic feedstock or catalyst used in the conversion process. Equipment is not eligible if it is used beyond the point at which a substance usable as a fuel has been produced. Equipment is eligible

only to the extent of the equipment's cost or basis allocable to the annual production of substances used as a fuel or used in the production of a fuel. For example, assume for the taxable year that 50 percent of the output of equipment is used to produce alcohol for production of whiskey and 50 percent is used to produce alcohol for use in a fuel mixture, such as gasohol. The alcohol production equipment qualifies as synthetic fuel equipment but only to the extent of one-half of its cost or basis. If, in a later taxable year, the equipment is used exclusively to produce whiskey, all of the equipment ceases to be synthetic fuel equipment.

(ii) A fuel is a material that produces usable heat upon combustion. To be "synthetic", the fuel either must differ significantly in chemical composition, as opposed to physical composition, from the alternate substance used to produce it or, in the case of solid fuel produced from biomass, the chemical change must consist of defiberization. Examples of synthetic fuels include alcohol derived from coal, peat, and vegetative matter, such as wood and corn, and methane from landfills.

(iii) Synthetic fuel equipment includes coal gasification equipment, coal liquefaction equipment, equipment for recovering methane from landfill, and equipment that converts biomass to a synthetic fuel.

(iv) Synthetic fuel equipment does not include equipment that merely mixes an alternate substance with another substance. For example, synthetic fuel equipment includes neither equipment that mixes coal and water to produce a slurry nor equipment that mixes alcohol and gasoline to produce gasohol. Equipment used to produce coke or coke gas, such as coke ovens, is also ineligible.

(6) *Modification equipment.* (i) Alternative energy property includes equipment (modification equipment) designed to modify existing equipment. For the definition of "existing," see paragraph (l)(1)(i) of this section. To be eligible, the modification must result in a substitution for the remainder of the taxable year from the date the equipment is placed in service and for each taxable year thereafter of the items in paragraph (c)(6)(ii)(A) or (B) of this section for all or a portion of the oil or gas substance used as a fuel or feedstock. As a result of the modification, the substituted alternate substance must comprise at least 25 percent of the fuel or feedstock (determined on the basis of Btu equivalency). If the modification also increases the capacity of the equipment, only the incremental cost (as defined in paragraph (k) of this section) of the equipment qualifies.

(ii) The substitutes for an oil or gas substance are—

(A) An alternate substance or

(B) A mixture of oil and an alternate substance.

(iii) Modification equipment does not include replacements or a boiler or burner. If the boiler or burner is replaced, the items must be described in paragraph (c) (3) or (4) of this section to qualify as alternative energy property. Modification may include, however, replacements of components of a boiler or burner, such as a heat exchanger.

(iv) The following examples illustrate this paragraph (c)(6).

*Example (1).* On January 1, 1980, corporation X is using oil to fuel its boiler. On June 1, 1980, X modifies the boiler to permit substitution of a coal and oil mixture for 40 percent of X's oil fuel needs. The mixture consists 75 percent of oil and 25 percent of coal. The equipment modifying the boiler does not qualify as modification equipment because the alternate substance comprises only 10 percent of the fuel.

*Example (2).* Assume the same facts as in example (1) except 75 percent of the mixture is coal. The equipment modifying the boiler qualifies.

*Example (3).* Assume the same facts as in example (2) except, instead of substituting an oil and coal mixture for 40 percent of X's oil fuel needs, X uses the modification to expand the boiler's fuel capacity by 40 percent using the mixture as additional fuel. The additional fuel mixture comprises only 28 percent of X's total fuel needs. Thus, even though 75 percent of the additional fuel mixture is an alternate substance, the boiler does not qualify as modification equipment because the alternate substance comprises only 21 percent of the total fuel.

(7) *Equipment using coal as feedstock.* Equipment that uses coal (including lignite) to produce a feedstock for the manufacture of chemicals, such as petrochemicals, or other products is alternative energy property. Equipment is not eligible if it is not directly involved in the treatment of coal or a coal product, but produces a substance that is, like coal, a basic feedstock or catalyst used in the coal conversion process. Equipment is not eligible if it is used beyond the point at which the first product marketable as a feedstock has been produced. Equipment used to produce coke or coke gas, such as coke ovens, is ineligible.

(8) *Pollution control equipment.* (i) Pollution control equipment is alternative energy property. Eligible equipment is limited to property or equipment to the extent it qualifies as a pollution control facility under section 103(b)(4)(F) and the regulations thereunder except that, if control of pollution is not the only significant purpose (within the meaning of those regulations), only the incremental cost (as defined in paragraph (k) of this section) of the equipment qualifies. However, if a Treasury decision changes the regulations under section 103(b)(4)(F) and, thus, the rules reflected in this subdivision (i), the rules as changed will apply as of the effective date of the Treasury decision.

(ii) To be eligible, the equipment must be required by a Federal, State, or local government regulation to be installed on, or used in connection with, eligible alternative energy property (as defined in paragraph (c)(8)(v) of this section).

(iii) Under section 48(l)(3)(D) equipment is not eligible if required by a Federal, State, or local government regulation in effect on October 1, 1978, to be installed on, or in connection with, property using coal (including lignite) as of October 1, 1978.

(iv) Under this subparagraph (8), pollution control equipment is required by regulation if it would be necessary to install the equipment to satisfy the requirements of any applicable law, including nuisance law. The pollution control equipment need not be specifically identified in the applicable law. If several different types of equipment may be used to comply with the applicable law, each type of equipment is considered necessary to satisfy the requirements of the law. An order permitting a taxpayer to delay compliance with any applicable law is disregarded.

(v) Under this subparagraph (8) "eligible alternative energy property" is energy property (as defined in section 48 (l)(2)) described in paragraph (c) (3) through (7) of this section. If equipment otherwise qualifying as pollution control equipment is installed on, or used in connection with, both eligible alternative energy property and property other than eligible alternative energy property, only the incremental cost (as defined in paragraph (k) of this section) of the equipment qualifies.

(vi) *Examples.* The following examples illustrate this subparagraph (8). Assume that the property or equipment in the examples are described in § 1.103-8(g)(2)(ii) and that their only purpose is control of pollution.

*Example (1).* On October 1, 1978, corporation X acquires and places in service in State A a paper mill. The facility includes a boiler the primary fuel for which is wood chips. The facility includes equipment necessary to comply with pollution control standards in effect on October 1, 1978 in State A. This equipment qualifies as pollution control equipment.

*Example (2).* On October 1, 1978, corporation Y was burning coal at its facility in State B. The emissions from the facility exceeded State air pollution control requirements in effect on October 1, 1978. On January 1, 1979, X installed cyclone separators to comply with the State pollution control requirements. The cyclone separators do not qualify as pollution control equipment.

*Example (3).* Assume the same facts as in example (2) except that Y installs a baghouse instead of cyclone separators to meet more stringent standards that take effect on December 31, 1978. The baghouse qualifies as pollution control equipment because the baghouse was not necessary to meet the standards in effect on October 1, 1978.

*Example (4).* On October 1, 1978, corporation Z is burning coal at its facility in State C. The emissions from that facility exceed State air pollution control standards in effect on October 1, 1978. C orders Z to install cyclone separators before January 1, 1979. However, C allows Z to operate its facility until January 1, 1979, under less stringent interim standards applicable only to Z. The separators do not qualify as pollution control equipment. The delayed compliance order is disregarded.

(9) *Handling and preparation equipment.* (i) Alternative energy property includes equipment (handling and preparation equipment) used for unloading, transfer, storage, reclaiming from storage, or preparation of an alternate substance for use in eligible alternative energy property (as defined in paragraph (c)(9)(ii) of this section). Handling and preparation equipment must be located at the site the alternate substance is used as a fuel or feedstock. For example, equipment used to screen and prepare coal for use at a power plant qualifies if located at the plant. However, similar equipment located at the coal mine would not qualify.

(ii) Under this subparagraph (9), "eligible alternative energy property" is energy property (as defined in section 48(l)(2)) described in paragraph (c) (3) through (8) of this section. If equipment otherwise qualifying as handling and preparation equipment is installed on, or used in connection with, property other than eligible alternative energy property, only the incremental cost (as defined in paragraph (k) of this section) of the equipment qualifies.

(iii) The term "preparation" includes washing, crushing, drying, compacting, and weighing of an alternate substance. Handling and preparation equipment also includes equipment for shredding, chopping, pulverizing, or screening agricultural or forestry byproducts at the site of use.

(iv) Handling and preparation equipment does not include equipment, such as coal slurry pipelines and railroad cars, that transports a fuel or a feedstock to the site of its use.

(10) *Geothermal equipment.* (i) Alternative energy property includes equipment (geothermal equipment) that produces, distributes, or uses energy derived from a geothermal deposit (as defined in § 1.44C–2(h)).

(ii) In general, production equipment includes equipment necessary to bring geothermal energy from the subterranean deposit to the surface, including well-head and downhole equipment (such as screening or slotted liners, tubing, downhole pumps, and associated equipment). Reinjection wells required for production also may qualify. Production does not include exploration and development.

(iii) Distribution equipment includes equipment that transports geothermal steam or hot water from a geothermal deposit to the site of ultimate use. If geothermal energy is used to generate electricity, distribution equipment includes equipment that transports hot water from the geothermal deposit to a power plant. Distribution equipment also includes components of a heating system, such as pipes and ductwork that distribute within a building the energy derived from the geothermal deposit.

(iv) Equipment that uses energy derived from a geothermal deposit is eligible only if it uses geothermal energy exclusively. Thus, geothermal equipment does not include equipment that uses energy derived both from a geothermal deposit and from sources other than a geothermal deposit. However, the existence of a backup system designed for use only in the event of a failure in the system providing energy derived from a geothermal deposit will not disqualify any other equipment. For example, radiators, fan-coil units, and baseboard heaters are not eligible if they are used in a particular application with hot water from sources other than a geothermal deposit. If geothermal energy is used to generate electricity, equipment using geothermal energy includes the electrical generating equipment, such as turbines and generators. However, geothermal equipment does not include any electrical transmission equipment, such as transmission lines and towers, or any equipment beyond the electrical transmission stage, such as transformers and distribution lines.

(v) *Examples.* The following examples illustrate this subparagraph (10):

*Example (1).* In 1979, corporation X installs a system which heats its office building by circulating hot water heated by energy derived from a geothermal deposit through the building. Geothermal equipment includes the circulation system, including the pumps and pipes which circulate the hot water through the building.

*Example (2).* The facts are the same as in example (1), except that corporation X also installs a boiler to produce hot water for heating the building exclusively in the event of a failure of the geothermal equipment. Such a boiler is not geothermal equipment, but the existence of such a backup system does not serve to disqualify property eligible in example (1).

*Example (3).* The facts are the same as in example (1), except that the water heated by energy derived from a geothermal deposit is not hot enough to provide sufficient heat for the building. Therefore, X installs a system in which the water is heated by an electric boiler before being circulated in the heating system. In this case, neither the boiler nor the circulating system is considered to be geothermal equipment.

*Example (4).* Corporation Y acquires a commercial vegetable dehydration system in 1981. The system operates by placing fresh vegetables on a conveyor belt and moving them through a dryer. The conveyor belt is powered by electricity. The dryer uses solely energy derived from a geothermal deposit. The dryer is geothermal equipment while the equipment powered by electricity does not qualify.

(d) *Solar energy property*—(1) *In general.* Energy property includes solar energy property. The term "solar energy property" includes equipment and materials (and parts solely related to the functioning of such equipment) that use solar energy directly to (i) generate electricity, (ii) heat or cool a building or structure, or (iii) provide hot water for use within a building or structure. Generally, these functions are accomplished through the use of equipment such as collectors (to absorb sunlight and create hot liquids or air), storage tanks (to store hot liquids), rockbeds (to store hot air), thermostats (to activate pumps or fans which circulate the hot liquids or air), and heat exchangers (to utilize hot liquids or air to create hot air or water). Property that uses, as an energy source, fuel or energy derived indirectly from solar energy, such as ocean thermal energy, fossil fuel, or wood, is not considered solar energy property.

(2) *Passive solar excluded* (i) Solar energy property excludes the materials and components of "passive solar systems," even if combined with "active solar systems."

(ii) An active solar system is based on the use of mechanically forced energy transfer, such as the use of fans or pumps to circulate solar generated energy.

(iii) A passive system is based on the use of conductive, convective, or radiant energy transfer. Passive solar property includes greenhouses, solariums, roof ponds, glazing, and mass or water trombe walls.

(3) *Electric generation equipment.* Solar energy property includes equipment that uses solar energy to

generate electricity, and includes storage devices, power conditioning equipment, transfer equipment, and parts solely related to the functioning of those items. In general, this process involves the transformation of sunlight into electricity through the use of such devices as solar cells or other collectors. However, solar energy property used to generate electricity includes only equipment up to (but not including) the stage that transmits or uses electricity.

(4) *Pipes and ducts.* Pipes and ducts are solar energy property if used exclusively to carry energy derived from solar energy.

(5) *Specially adapted equipment.* Equipment that uses solar energy beyond the distribution stage is eligible only if specially adapted to use solar energy.

(6) *Auxiliary equipment.* Solar energy property does not include equipment (auxiliary equipment), such as furnaces and hot water heaters, that use a source of power other than solar or wind energy to provide usable energy. Solar energy property also does not include equipment, such as ducts and hot water tanks, whether utilized solely by auxiliary equipment or by both auxiliary equipment and solar energy equipment.

(7) *Solar process heat equipment.* Solar energy property does not include equipment that uses solar energy to generate steam at high temperatures for use in industrial or commercial processess (solar process heat).

(8) *Example.* The following example illustrates this paragraph (d).

*Example.* (a) In 1979, corporation X constructs an apartment building and purchases equipment to convert solar energy into heat for the building. Corporation X also installs an oil-fired water heater and other equipment to provide a backup source of heat when the solar energy equipment cannot meet the energy needs of the building.

(b) The items purchased in addition to the water heater include a roof solar collector, a heat exchanger, a hot water tank, a control component, pumps, pipes, fan-coil units, and valves. Assume the fan-coil units could be used with energy derived from an oil or gas substance without significant modification. All items are depreciable and have a useful life of three years or more. The use of the equipment to heat the building is the first use to which the equipment has been put.

(c) Water is pumped from the basement through pipes to the roof solar collector. Heated water returns through pipes to a heat exchanger which transfers heat to the water in the hot water tank.

(d) The hot water tank and the oil-fired water heater utilize the same distribution pipe. Pumps and valves at the points of connection between the hot water tank, the oil-fired water heater, and the distribution pipe regulate the auxiliary energy supply use. They also prevent the oil-fired water heater from heating water in the hot water tank.

(e) An integrated control component determines whether hot water from the hot water tank or from the oil-fired water heater is distributed to fan-coil units located throughout the building.

(f) The roof solar collector is solar energy property. The pump that moves the water to the roof collector and the pipes between the roof collector and the hot water tank qualify because they are solely related to transporting solar heated water. The hot water tank qualifies because it stores water heated solely by solar radiation. The heat exchanger also qualifies.

(g) The oil-fired water heater does not qualify as solar energy property because it is auxiliary equipment.

(h) The distribution pipe, the control component, and the pumps and valves do not qualify because they serve the oil-fired water heater as well as the solar energy equipment. All of these items would qualify if used solely in connection with solar energy equipment. The fan-coil units do not qualify because they are not specially adapted to use energy derived from solar energy.

(e) *Wind energy property*—(1) *In general.* Energy property includes wind energy property. Wind energy property is equipment (and parts solely related to the functioning of that equipment) that performs a function described in paragraph (e)(2) of this section. In general, wind energy property consists of a windmill, wind-driven generator, storage devices, power conditioning equipment, transfer equipment, and parts solely related to the functioning of those items. Wind energy property does not include equipment that transmits or uses electricity derived from wind energy. In addition, limitations apply similar to those set forth in paragraph (d)(5) and (6) of this section.

(2) *Eligible functions.* Wind energy property is limited to equipment (and parts related solely to the functioning of that equipment) that—

(i) Uses wind energy to heat or cool, or provide hot water for use in, a building or structure, or

(ii) Uses wind energy to generate electricity (but not mechanical forms of energy).

(f) *Specially defined energy property*—(1) *In general.* Specially defined energy property means only those items described in paragraph (f) (4) through (14) of this section that meet the requirements of paragraph (f)(2) of this section. The items described in paragraph (f) (4) through (14) of this section also consist of related equipment, such as fans, pumps, ductwork, piping, and controls, the installation of which is necessary for the specified item to reduce the energy consumed or heat wasted by the process.

(2) *General requirements.* To be eligible, each item described in paragraph (f) (4) through (14) of this section must be installed in connection with an existing industrial or commercial facility. In addition, the principal purpose of each of those items must be reduction of energy consumed or heat wasted in any existing industrial or commercial process. See section 48(l)(10) and paragraph (l) of this section. If an item performs more than one function, only the incremental cost (as defined in paragraph (k) of this section) of the equipment qualifies.

(3) *Industrial or commercial process.* (i) A process is a means or method of producing a desired result by chemical, physical, or mechanical action. For example, equipment installed in connection with retail sales, general office use, and residential use are not used in a process within the meaning of this paragraph (f)(3).

(ii) An industrial process includes agricultural processes and thermal processes relating to production or manufacture, such as those involving boilers and furnaces.

(iii) A commercial process includes laundering and food preparation.

(iv) More than one process may be conducted in a single facility. The fact that several processes involved in the production of a product are integrated does not cause such integrated processes to be treated as one process. For example, in a food canning facility, producing prepared food from fresh vegetables is not one process but rather an integration of several processes including washing, cooking and canning.

(v) The following example illustrates this paragraph (f)(3).

*Example.* Corporation X, an advertising agency, acquires an automatic energy control system designed to reduce energy consumed by heating and cooling its office building. Although the use of an office for X's business is a commercial activity, heating or cooling an office is not an industrial or commercial process. The automatic energy control system does not qualify because it does not reduce energy consumed in an industrial or commercial process.

(4) *Recuperators.* Recuperators recover energy, usually in the form of waste heat from combustion exhaust gases, hot exiting product, or product cooling air, that is used to heat incoming combustion air, raw materials, or fuel. Recuperators are configurations of equipment consisting in part of fixed heat transfer surfaces between two gas flows, and include related baffles, dividers, entrance flanges, transition sections, and shells or cases enclosing the other components of the recuperator. In general, a fixed heat transfer surface absorbs heat from a gas or liquid flow or dissipates heat to the gas or liquid flow.

(5) *Heat wheels.* Heat wheels recover energy, usually in the form of waste heat, from exhaust gases to preheat incoming gases. Heat wheels are items of equipment consisting in part of regenerators (which rotate between two gas flows) and related drive components, wiper seals, entrance flanges, and transition sections.

(6) *Regenerators.* Regenerators are devices, such as clinker columns or chains, that recover energy by efficiently storing heat while exposed to high temperature gases and releasing heat while exposed to low temperature gases, fluids, or solids.

(7) *Heat exchangers.* Heat exchangers recover energy, usually in the form of waste heat, from high temperature gases, liquids, or solids for transfer to low temperature gases, liquids, or solids. Heat exchangers consist in part of fixed heat transfer surfaces (described in paragraph (f)(4) of this section) separating two media. Heat exchange equipment does not include fluidized bed combustion equipment.

(8) *Waste heat boilers.* Waste heat boilers use waste heat, usually in the form of combustion exhaust gases, as a substantial source of energy. A substantial source of energy is one that comprises more than 20 percent of the energy requirement on the basis of Btu's during the course of each taxable year (including the start-up year).

(9) *Heat pipes.* Heat pipes recover energy, usually in the form of waste heat, from high temperature fluids to heat low temperature fluids. A heat pipe consists in part of sealed heat transfer chambers and a capillary structure. In general, the heat transfer chambers alternatively vaporize and condense a working fluid as it passes from one end of the chamber to the other.

(10) *Automatic energy control systems.* Automatic energy control systems automatically reduce energy consumed in an industrial or commercial process for such purposes as environmental space conditioning (*i.e.*, lighting, heating, cooling or ventilating, etc.). Automatic energy control systems include, for example, automatic equipment settings controls, load shedding devices, and relay devices used as part of such system. Property such as computer hardware installed as a part of the energy control system also qualifies, but only to the extent of its incremental cost (as defined in paragraph (k) of this section).

(11) *Turbulators.* Turbulators increase the rate of transfer of heat from combustion gases to heat exchange surfaces by increasing the turbulence in the gases. A turbulator is a baffle placed in a boiler firetube or in a heat exchange tube in industrial process equipment to deflect gases to the heat transfer surface.

(12) *Preheaters.* Preheaters recover energy, usually in the form of waste heat, from either combustion exhaust gases or steam, to preheat incoming combustion air or boiler feedwater. A preheater consists in part of fixed heat transfer surfaces (described in paragraph (f)(4) of this section) separating two fluids.

(13) *Combustible gas recovery systems.* Combustible gas recovery systems are items of equipment used to recover unburned fuel from combustion exhaust gases.

(14) *Economizers.* Economizers are configurations of equipment used to reduce energy demand or recover energy from combustion exhaust gases and other high temperature sources to preheat boiler feedwater.

(15) *Other property added by the Secretary.* [Reserved]

(g) *Recycling equipment*—(1) *In general.* Recycling equipment is equipment used exclusively to sort and prepare, or recycle, solid waste (other than animal waste) to recover usable raw materials ("recovery equipment"), or to convert solid waste (including animal waste) into fuel or other useful forms of energy ("conversion equipment"). Recycling equipment may include certain other onsite related equipment.

(2) *Recovery equipment.* Recovery equipment includes equipment that—

(i) Separates solid waste from a mixture of waste,

(ii) Applies a thermal, mechanical, or chemical treatment to solid waste to ensure the waste will properly respond to recycling, or

(iii) Recycles solid waste to recover usable raw materials, but not beyond occurrence of the first of the following:

(A) The point at which a material has been created that can be used in beginning the fabrication of an end-product in the same way as materials from a virgin substance. Examples are the fiber stage in textile recycling, the newsprint or paperboard stage in paper recycling, and the ingot stage for other metals (other than iron and steel). In the case of recycling iron or steel, recycling equipment does not include any equipment used to reduce solid waste to a molten state or any process thereafter.

(B) The point at which the material is a marketable product (*i.e.*, has a value other than for recycling) even if the material is not marketed by the taxpayer at that point.

(3) *Conversion equipment.* Conversion equipment includes equipment that converts solid waste into a fuel or other usable energy, but not beyond the point at which a fuel, steam, electricity, hot water, or other useful form of energy has been created. Thus, combustors, boilers, and similar equipment may be eligible if used for a conversion process, but steam and heat distribution systems between the combustor or boiler and the point of use are not eligible.

(4) *On-site related equipment.* Recycling equipment also includes onsite loading and transportation equipment, such as conveyors, integrally related to other recycling equipment. This equipment may include equipment to load solid waste into a sorting or preparation machine and also a conveyor belt system that transports solid waste from preparation equipment to other equipment in the recycling process.

(5) *Solid waste.* (i) The term "solid waste" has the same meaning as in § 1.103–8(f)(2)(ii)(*b*), subject to the following exceptions and the other rules of this subparagraph (5):

(A) The date the equipment is placed in service is substituted in the first sentence of § 1.103–8(f)(2)(ii)(*b*) for the date of issue of the obligations, and

(B) Material that has a market value at the place it is located only by reason of its value for recycling is not considered to have a market value.

(ii) Solid waste may include a nominal amount of virgin materials, liquids, or gases, not to exceed 10 percent. If more than 10 percent of the material recycled during the course of any taxable year (including the "start up" year) consists of virgin material, liquids, or gases, the equipment ceases to be energy property and is subject to recapture under section 47. The determination of the portion of virgin material, liquids, or gases used is based on volume, weight, or Btu's whichever is appropriate.

(6) *Ineligible equipment.* Transportation equipment, such as trucks, that transfer solid waste between geographically separated sites (*e.g.*, the collection point and the recycling point) is not eligible. Steam and heat distribution systems are also ineligible.

(7) *Increased recycling capacity.* If the equipment both replaces recycling capacity and increases that capacity at a particualr site, only the incremental cost (as defined in paragraph (k) of this section) of increasing the capacity qualifies. Recycling capacity is determined by the ability to produce a product not previously produced by the taxpayer, or more of an existing product, in a way that does not lower overall production.

(8) *Examples.* The following examples illustrate this paragraph (g).

*Example (1)* Corporation W recycles aluminum scrap metal. W owns a junk yard where it collects and crushes the metal into compact units. W's trucks bring the scrap metal from the junk yard to its main plant located 3 miles away. W's furnace equipment at the main plant reduces the scrap to the molten state and W's rolling equipment rolls the aluminum into sheets. The furnace qualifies, but for two separate reasons the rolling equipment does not qualify. First, the molten aluminum would be a marketable product if reduced to ingots prior to rolling. It is not necessary that W actually reduce the molten aluminum to ingots. Second, the molten aluminum could be used in the same way as virgin material.

*Example (2)* Corporation X manufactures newsprint using wood chips discarded during X's lumber operations. Assume X could sell the wood chips to other companies located a short distance from X's mill for use as a fuel. None of the equipment used to manufacture the newsprint qualifies.

*Example (3)* Assume the same facts as in example (2) except X uses old newspapers which have no value except for recycling in the area where X's mill is located. The equipment qualifies.

*Example (4)* Corporation Y recycles municipal waste. Assume the municipal waste is "solid waste" under paragraph (g)(5) of this section. During the first taxable year Y operates the equipment, Y uses 8,500 pounds of municipal waste and 1,500 pounds of virgin material and liquids. No energy credit is allowed for the equipment.

*Example (5)* Corporation Z owns a waste recovery facility. The corrugated paper portion of the waste stream is picked off a conveyor as it enters the facility. The corrugated paper is baled and sold as a secondary paper product. Z acquires shredding and air-classification equipment. Corrugated paper that is not removed from the conveyor belt enters the new equipment for production as a fuel. Z increases the input of corrugated paper so that the same amount of corrugated paper is removed from the conveyor to be baled. The excess paper that is not removed for baling enters the shredding and air-classification equipment. The new equipment qualifies.

(h) *Shale oil equipment*—(1) *In general.* Shale oil equipment used in mining or either surface or *in situ* processing qualifies as energy property. Shale oil equipment means equipment used exclusively to mine, or produce or extract oil from, shale rock.

(2) *Eligible processes.* In general, processing equipment qualifies if used in or after the mining stage and up through the retorting process. Thus, eligible processes include crushing, loading into the retort, and retorting, but not hydrogenation, refining, or any process subsequent to retorting. However, with respect to *in situ* processing, eligible processes include creating the underground cavity.

(3) *Eligible equipment.* Shale oil equipment includes—

(i) Heading jumbos, bulldozers, and scaling and bolting rigs used to create an underground cavity for *in situ* processing,

(ii) On-site water supply and treatment equipment and handling equipment for spent shale,

(iii) Crushing and screening plant equipment, such as hoppers, feeders, vibrating screens, and conveyors,

(iv) Briquetting plant equipment, such as hammer mills and vibratory pan feeders, and

(v) Retort equipment, including direct cooling and condensing equipment.

(i) [Reserved]

(j) *Natural gas from geopressured brine.* Equipment used exclusively to extract natural gas from geopressured brine described in section 613A(b)(3)(C)(i) is energy property. Eligible equipment includes equipment used to separate the gas from saline water and remove other impurities from the gas. Equipment is eligible only up to the point the gas may be introduced into a pipeline.

(k) *Incremental cost.* The term "incremental cost" means the excess of the total cost of equipment over the amount that would have been expended for the equipment if the equipment were not used for a qualifying purpose. For example, assume equipment costing $100 performs a pollution control function and another function. Assuming it would cost $60 solely to perform the nonqualifying function, the incremental cost would be $40.

(l) *Existing*—(1) *In general.* for purposes of section 48(l), the term "existing" means—

(i) When used in connection with a facility or equipment, 50 percent or more of the basis of that facility or equipment is attributable to construction, reconstruction, or erection before October 1, 1978, or

(ii) When used in connection with an industrial or commercial process, that process was carried on in the facility as of October 1, 1978.

(2) *Industrial or commercial process.* (i) A process will be considered the same as the process carried on in the facility as of October 1, 1978, unless and until capitalizable expenditures are paid or incurred for modification of the process. The expenditures need not be capitalized in fact; it is sufficient if the taxpayer has an option or may elect to capitalize. In general, the date of change will be the date the expenditures are properly chargeable to capital account. If the taxpayer properly elects to expense a capitalizable expenditure, the date of change will be the date the expenditure could have been properly chargeable to capital account if the expenditure had been capitalized. Recapture will not occur by reason of a change in a process unless the process change also changes the use of the equipment. See example (1) of § 1.47-1(h)(5).

(m) *Quality and performance standards*—(1) *In general.* Energy property must meet quality and performance standards, if any, that have been prescribed by the Secretary (after consultation with the Secretary of Energy) and are in effect at the time of acquisition.

(2) *Time of acquisition.* Under this paragraph (m) the time of acquisition is—

(i) The date the taxpayer enters into a binding contract to acquire the property or

(ii) For property constructed, reconstructed, or erected by the traxpayer, (A) the earlier of the date it begins construction, reconstruction, or erection of the property, or (B) the date the taxpayer and another person enter into a binding contract requiring each to construct, reconstruct, or erect property and place the property in service for an agreed upon use. See example under paragraph (m)(4) of this section.

(3) *Binding contract.* Under this paragraph (m), a binding contract to construct, reconstruct, or erect property, or to acquire property, is a contract that is binding at all times on the taxpayer under applicable State or local law. A binding contract to construct, reconstruct, or erect property or to acquire property, does not include a contract for preparation of architect's sketches, blueprints, or performance of any other activity not involving the beginning of physical work.

(4) *Example.* The following example illustrates this paragraph (m).

*Example.* Corporation X owns a junk yard. Corporation Y manufactures recycling equipment and operates several recycling facilities. On January 1, 1979, X and Y enter into a written contract that is binding on both parties on that date and at all times thereafter. Under the contract's terms X will supply scrap metals to Y and Y agrees in return to build a recycling facility on land adjacent to the junk yard. Y will own and operate the facility using the scrap metal supplied by X. Y may treat the agreement as a binding contract under paragraph (m)(2) and (3) of this section.

(n) *Public utility property*—(1) *Inclusions.* Public utility property is included in both of the following categories of energy property:

(i) Shale oil equipment and

(ii) Equipment for producing natural gas from geopressured brine.

(2) *Exclusions.* Public utility property is excluded from each of the following categories of energy property:

(i) Alternative energy property,

(ii) Specially defined energy property,

(iii) Solar or wind energy property, and

(iv) Recycling equipment.

(3) *Public utility property.* The term "public utility property" has the meaning given in section 46(f)(5).

(Sec. 7805 (68A Stat. 917, 26 U.S.C. 7805) and 38 (b) (76 Stat. 962, 26 U.S.C. 38) of the Internal Revenue Code of 1954)

William E. Williams,

*Acting Commissioner of Internal Revenue.*

Approved: January 19, 1981.

Emil M. Sunley,

*Acting Assistant Secretary of the Treasury.*

[FR Doc. 81-2467 Filed 1-19-81; 5:10 pm]

BILLING CODE 4830-01-M

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## 26 CFR Parts 20 and 25

**[T.D. 7761]**

## Employee Retirement Benefits Excluded From Gross Estate and Taxable Gifts

**AGENCY:** Internal Revenue Service, Treasury.

**ACTION:** Final regulations.

**SUMMARY:** This document provides final regulations relating to the estate and gift tax treatment of amounts payable under qualified employee pension, profit-sharing, stock bonus and annuity plans and under individual retirement plans. Changes to the applicable tax law were made by the Tax Reform Act of 1976, the Revenue Act of 1978 and the Technical Corrections Act of 1979. The regulations provide necessary guidance to the public for compliance with the law, and primarily affect the estates of decedents with respect to whom amounts are payable under such plans.

**DATE:** The regulations are generally effective for decedents dying and transfers made after December 31, 1976.

**FOR FURTHER INFORMATION CONTACT:** Richard L. Johnson of the Employee Plans and Exempt Organizations Division, Office of the Chief Counsel, Internal Revenue Service, 1111 Constitution Avenue, NW., Washington, D.C. 20224, Attention: CC:LR:T:EE-25-78, 202-566-3544 (Not a toll-free number).

**SUPPLEMENTARY INFORMATION**

### Background

On March 2, 1979, the Federal Register published at 44 FR 11791 proposed amendments to the Estate Tax Regulations (26 CFR Part 20) and the Gift Tax Regulations (26 CFR Part 25) under sections 2039 and 2517 of the Internal Revenue Code of 1954. The amendments were proposed to conform the regulations to section 2009(c) of the Tax Reform Act of 1976 (90 Stat. 1894) and section 142 of the Revenue Act of 1978 (92 Stat. 2796). No public hearing was requested. After consideration of all comments regarding the proposed amendments, those amendments are adopted as revised by this Treasury decision.

Code section 2039(f) was also amended by section 101(a)(8)(B) of the Technical Corrections Act of 1979 (94 Stat. 201). The regulations adopted by this Treasury decision reflect that amendment.

### Rollovers by a Surviving Spouse

The proposed regulations took no position with regard to the consequences to an employee's gross estate if the employee's surviving spouse rolls over to an individual retirement plan all or a portion of a lump sum distribution paid on account of the death of the employee. The final regulations provide that in the case of such a rollover, the lump sum distribution is excluded from the employee's gross estate. The final regulations further provide that, with respect to the gross estate of a spouse who has made such a rollover, amounts payable under an individual retirement plan are not eligible for the estate tax exclusion to the extent that they are attributable to the rollover.

### Taxpayer's Election

Under the proposed regulations, no amount paid or payable as a lump sum distribution under a qualified plan is excludable from a deceased employee's gross estate unless the recipient makes the required "section 402(a)/403(a) taxation election." The proposed regulations provided that the election is made by the recipient's filing an income tax return for the taxable year of the distribution that is consistent with the election.

Some comments requested that the regulations be revised to provide that the recipient make the election on the estate tax return. Although the election is provided for under the estate tax law, for the electing taxpayer the election is primarily an income tax election. Accordingly, the final regulations follow the proposed regulations. However, the proposed regulations have been revised to provide that when the estate tax return is filed before the recipient's income tax return, the return for the estate may reflect the exclusion of a lump sum distribution from the gross estate, even though the recipient has not yet made the required election.

The regulations have also been clarified to emphasize that once a recipient files an income tax return or makes a rollover contribution that constitutes the election described in the regulations, the election cannot be revoked. Thus, the filing of an amended income tax return reflecting either the long-term capital gain or 10-year averaging treatment otherwise afforded lump sum distributions will not be given effect for income tax and estate tax purposes. This is true even if the amended return is accompanied by the payment of any estate tax that would be due if the distribution were included in the gross estate.

### IRA Provisions Added

The final regulations also contain two additional clarifying rules governing the estate tax exclusion for amounts payable under individual retirement plans. The first of these rules reflects § 1.408-2(b)(7)(ii) of the Income Tax Regulations. That section permits a beneficiary under an individual retirement plan to elect, for purposes of the income tax rules, to treat the plan as one established on the beneficiary's behalf, rather than as a plan under which amounts are payable to the beneficiary as a beneficiary. Under § 20.2039-5(c)(5), the amount with respect to which the decedent, as a beneficiary, made the election is not an amount with respect to which the exclusion described in section 2039(e) will apply.

The final regulations also contain, in § 20.2039-5(c)(6), rules relating to individual retirement plan rollovers. Under section 408(d)(3)(A)(i) or 409(b)(3)(C), amounts paid under an individual retirement plan may, subject to certain conditions, be paid ("rolled over") to another such plan. Under the income tax rules, the rolled over amounts are not included in gross income. The final regulations clarify that the rules under section 2039(e) are applied to the plan that is the recipient of the rollover (the "transferee plan") by taking into account the source of the contributions made to the transferor plan. Under the regulations the exclusion described in 2039(e) does not apply with respect to any portion of the rollover contribution to the transferee plan that is determined to be attributable to a contribution to the transferor plan with respect to which the exclusion is denied.

Examples (3) and (4) have been added to § 20.2039-5(d) to illustrate these added clarifying rules.

U.S. Department of Housing and Urban Development
Office of Public Affairs

Washington, D.C. 20410

# News Release

HUD-No. 81-97
Jackie Conn (202) 755-5284
Leonard Burchman (202) 755-6980

FOR RELEASE:
Tuesday
May 5, 1981

## HUD/DOE TO ASSESS OLD ENERGY SOURCE

Twenty eight American communities will test the possibility of heating and cooling buildings by a low cost, energy efficient system invented in this country over a hundred years ago.

U.S. Department of Housing and Urban Development Secretary Samuel R. Pierce, Jr. today announced that HUD and the Department of Energy will jointly fund a $1.5 million district heating and cooling program to help communities find alternative approaches to meeting their energy demands.

The communities selected today represent a cross section of the Nation, ranging from Santa Ana Pueblo, an Indian tribe in New Mexico, to New York City.

District heating and cooling systems capture heat normally wasted in burning trash, generating electricity, manufacturing and other processes. At a central location this captured energy is used to heat water or create steam which is then pumped out over a network of pipes to heat apartments, offices, schools, hospitals, homes and factories. These same buildings can be cooled by captured energy when it is processed into cold water.

-more-

District heating, a 19th century development in the Northeast and Midwest, almost disappeared in the United States when gas, oil and electricity became cheap commodities after World War II.

Today district heating is widely used throughout Europe in Scandanavia, Germany and Russia. In Sweden, for example, approximately three million people live or work in buildings served by district heating and cooling. In the United States, New York City and Philadelphia, along with a few other major cities, have been using these systems for many years in some high density areas.

In announcing the program, Secretary Pierce noted there is a renewed and intense interest in district heating and cooling. "With today's sharply rising fuel prices, local governments are looking for ways to drastically cut energy costs and, at the same time, revitalize their communities.

"Some cities are interested in rejuvenating existing unused systems while other cities are interested in building new ones," Secretary Pierce said. All of them are aware that district heating and cooling has the potential for lowering energy costs of the businesses that drive their economies."

The selected cities are: Albany, NY, Allentown, PA, Atlanta, GA, Atlantic City, NJ, Baltimore, MD, Bellows Falls/ Rockingham, VT, Berlin, MD, Cambridge, MA, Campbellsville, KY, Columbus, OH, Dayton, OH, Devils Lake, ND, Ecorse, MI, Fort Wayne, IN, Galax, VA, Gary, IN, Holland, MI, Lawrence, MA, Lewiston, ME, Missoula, MT, New York, NY, Norwalk, CT, Provo, UT, Richmond, IN, Santa Ana Pueblo, NM, Springfield, MA, Thermopolis, WY, Union County, OR.

Over six hundred cities were interested in participating in this program. Final selection was made from the one hundred and eleven cities which submitted full applications.

"At HUD we are looking forward to working cooperatively with DOE in helping these twenty-eight communities assess their ability to use district heating," Secretary Pierce said.

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The cities will spend the next six to twelve months examining the most effective ways of connecting local heat suppliers with consumers. With the help of a local advisory committee, representing the varied interests of the community, they will study the financial and technical feasibility of the best systems. The committees will also help make the final selection of the district heating systems that have the best potential for fostering economic development and community revitalization through reduced energy costs.

Secretary Pierce expects many of the cities to be able to carry their analysis far enough, through this program, to get local financial and institutional support to further develop their projects.

Additional information is available from Wyndham Clarke, Office of Environmental Quality, U.S. Department of Housing and Urban Development, Area Code 202-755-6290.

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Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

February 9, 1981 81ETEC-DRF-0536

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team

Dear Team Member:

The State-Federal Geothermal Conference was held in Seattle on January 28 and 29, 1981. At the conference ETEC presented background information on the HUD/DOE solicitation of proposals for district heating feasibility studies and plans for forming a Geothermal District Heating Technical Assistance Team. At the request of several participants on the Geothermal District Heating Technical Assistance Team, an informal meeting was held on January 30, 1981 with DOE representatives and team members attending the conference to discuss ETEC's plans for coordinating the team and to exchange ideas relative to implementation of the technical assistance program.

For potential participants on the Geothermal District Heating Technical Assistance Team who were not at the Seattle conference, this letter and a copy of the viewgraphs and handout package (Enclosure 1) for ETEC's presentation at the conference will serve to bring all participants up-to-date. (Copies of Enclosure 1 are being sent only to Team members not attending the meeting.) Organizations which did not respond to the invitations to participate (ETEC letter 80ETEC-DRF-3987, September 23, 1980 and DOE's (H. Sullivan) letter, copies of both included in the handout package) and other organizations desiring to participate are invited to do so under the conditions noted in the letters. A final team listing will be prepared from those previously responding affirmatively and those responding to this letter.

The agenda for the January 30th meeting included a discussion of the HUD-DOE solicitation and the role of ETEC in coordinating the Geothermal District Heating Technical Assistance Team activities. The group determined that the needs of the grant winners (expected to be municipalities, for the most part) for technical information will be extensive, including resource evaluation, economics, engineering, legal and institutional considerations, financing, and other topics. It is expected that 20 to 35 grants will be awarded, of which 5 to 10 will be for systems using geothermal heat. DOE will probably fund some additional feasibility studies for geothermal district heating systems for proposers not selected under the HUD-DOE program. These studies will also benefit from the assistance of the Geothermal

District Heating Technical Assistance Team.

The basic plan for technical assistance will be as follows:

1. Determine HUD-DOE and DOE grant winners proposing geothermal systems.

2. Provide to grant winners a list of members, addresses, phone numbers, and areas of expertise of the Geothermal Heating Technical Assistance Team.

3. Prepare a bibliography with short abstracts of documents arranged by areas of interest.

4. Submit the bibliography to grant winners proposing geothermally heated systems.

5. Submit an analysis guide for design of geothermal district heating systems and possibly hold a workshop to discuss use of the analysis guide.

6. Hold one or more seminars or discussions to review and discuss with grant winners the areas of expertise available and organizations prepared to provide technical assistance. Schedule, site, and participants for the seminars will be determined at a later date.

Several questions were raised relative to the evaluation and selection process for the HUD-DOE solicitation which could not be answered. A major desire is that the evaluation process include an assessment of the potential existence of a geothermal resource based on the best available information, particularly in light of the possible unavailability of resource evaluation funds in the future.

In order to meet the above outlined plan, the following actions are requested of the members of the Geothermal District Heating Technical Assistance Team:

1. Organizations desiring to participate on the Geothermal District Heating Technical Assistance Team are requested to notify ETEC in writing and respond to the following actions as appropriate.

2. Team members or others aware of communities or organizations submitting geothermal district heating feasibility study proposals for the HUD-DOE solicitation are requested to submit the names of these communities to ETEC for compilation and distribution and for planning technical activities. These communities will be included in the report establishing the priority of communities with hydrothermal potential that the University of Utah Research Institute is preparing. Due date: March 1, 1981.

3. Submit a resume of the capabilities of your organization which are germane to the feasibility studies. This information may exist in a brochure or similar document. Addresses and phone numbers of the principal contact should be included. These data will be compiled by ETEC for submittal to the grant winners.

4. Prepare a bibliography and abstracts of reports by areas of interest. Format for the bibliography and abstracts is attached as Enclosure 2. Due date: March 1, 1981.

5. Dr. Paul Lineau of Oregon Institute of Technology, Geo-Heat Utilization Center, is preparing a geothermal district heating system analysis guide for a paper to be presented in China. This document appears to be ideally suited for use by the grant winners. A draft of the guide will be distributed for review the latter part of February 1981 with publishing scheduled for April 1981. This schedule is consistent with the need date for the grant winners.

6. UURI is preparing a priority list of communities with hydrothermal potential. The report should be submitted to DOE/HQ and Team members. Due date: March 15, 1981.

The Team members' cooperation is solicited in submitting the requested information to ETEC by the scheduled date.

If you have any questions, please call Bob Eichelberger or me at ETEC on extension 6165 or 6474, respectively.

Sincerely yours,

G S Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosures

2/9/81

# MAILING LIST

## GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

## (TENTATIVE)

Individual/Organization

Hilary Sullivan
Program Coordinator, Geothermal Energy Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

* George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-100, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Jess Pascual
Building 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Telephone: (312) 972-5249

*Enclosure 2 only - All others Enclosures 1 and 2

Individual/Organization

* Ms. Ann. W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. New York 11973
Telephone: (516) 345-2666

Dr. Ishai Oliker
Project Manager, District Heating Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, New Jersey 07649
Telephone: (201) 265-2000, Ext. 2702

Ms. Susan Brown
California State Commercialization Team
California Energy Commission
1111 Howe Avenue
Sacramento, California 95825
Telephone: (916) 924-2499

Mr. Michael Gersick, Deputy Director
Department of Conservation
1416 9th Street
Sacramento, California 95825

J. C. Austin
$CH_2M$ Hill, Boise Office
P. O. Box 8748
Boise, Idaho 83707
Telephone: (208) 345-5310

Richard E. Pearl, Project Coordinator
Geothermal Commercialization and Planning Project
Colorado Geological Survey
715 State Centennial Building
1313 Sherman Street
Denver, Colorado
(303) 839-2611

* Roald Bendixen
U.S. Dept. of Energy Region X
1992 Federal Bldg.
915 Second Ave.
Seattle, Washington 98174
Telephone: (206) 442-2820

Individual/Organization

John Nimmons
Earl Warren Legal Institute
University of California
Berkeley, California 94726
Telephone: (415) 642-8305

Mr. Robert Van Horn, Executive Director
GRIPS Commission
2628 Mendocino Avenue
Santa Rose, California 95401
Telephone:

Mr. Jim Woodruff
Department of Planning and Economic Development
P. O. Box 2359
Honolulu, Hawaii 96804
Telephone:

* William Toth
Hydrothermal Energy Commercialization Division
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83401
Telephone: (208) 526-9217

Mr. Bill Eastlake
Office of Energy
Statehouse
Boise, Idaho 83720
Telephone:

Mr. Dave Pierson, Director
Public Works Department
Imperial County
The Courthouse
El Centro, California 92243
Telephone:

Doug Sacarto
National Council of State Legislatures
1125 - 17th Street, Suite 1500
Denver, Colorado 80202
Telephone: (303) 623-6600

Individual/Organization

Dr. Fletcher C. Paddison
Johns Hopkins University - Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Telephone: (301) 953-7100

* Mr. Michael Chapman
Energy Planning Division
Montana Department of Natural Resources
32 South Ewing
Helena, Montana 59620
Telephone: (406) 449-4624

Phillip M. Wright, Debra Struhsacker
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Telephone: (801) 581-5283

William Isherwood
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025
Telephone: (415) 323-8111, Ext. 2841

* Dr. R. Gordon Bloomquist
Washington State Energy Office
400 East Union Street
Olympia, Washington 98504
Telephone: (206) 754-0774

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 South Ivanhoe, Suite 4
Denver, Colorado 80222
Telephone: (303) 758-8206

Rick James
Research Dept.
University of Wyoming
P. O. Box 3825
Laramie, Wyoming 82071
(307) 766-4820

Individual/Organization

Mr. Noel Clark, Director
Nevada Department of Energy
1050 East Williams, Suite 405
Carson City, Nevada 89710
Telephone:

Dr. Larry Icerman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico 88003
Telephone: (505) 646-1745

Mr. George Scudella
New Mexico Energy and Mineral Department
P. O. Box 2770
Santa Fe, New Mexico 87501
Telephone:

Mr. Bruce Gaugler
State Energy Office
State Capitol
Bismarck, North Dakota 58501
Telephone:

* Debra Justus
Geothermal Specialist
Oregon Department of Energy
102 Labor and Industry Building
Salem, Oregon 97310
Telephone:

* Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch Post Office
Klamath Falls, Oregon 97601
Telephone: (503) 882-6321

Mr. Robert Gant
Oak Ridge National Laboratory
Building 3550
Oak Ridge, Tenn. 37830
Telephone: (615) 574-5178

Individual/Organization

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, Oregon 97331
Telephone: (503) 754-2575, Ext. 3441

* C. H. Bloomster, Linda Fassbender
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352
Telephone: (509) 946-2442

Marshall Conover
Radian Corporation
P. O. Box 9948
Austin, Texas 78766
Telephone: (512) 454-4797

N. Richard Friedman
Resource Dynamics Corporation
962 Wayne Avenue
Silver Springs, Maryland 20910
Telephone: (703) 356-1300

Phil Lidel, Director
Geothermal Program
Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501
Telephone: (605) 773-3603

Mr. Stanley Green
Utah Department of Natural Resources
Division of Water Rights
200 Empire Building
231 East 400 South
Salt Lake City, Utah 84111
Telephone:

* Mr. Alex Sifford
Eliot Allen & Associates Inc.
5006 Commercial St., S.E.
Salem, Oregon 97302
Telephone: (503) 371-4561

# PREFERRED FORMAT FOR BIBLIOGRAPHY AND ABSTRACTS

Bakewell, C. A. and Herron, E. H., 1979, Low-Temperature Direct Use Geothermal Energy Costs, in Geothermal Resources Council, TRANSACTIONS, Volume 3, September 1979, Page 23.

The economic feasibility of direct use geothermal applications was analyzed in this Department of Energy study. The cost of geothermal energy to 20 different processes was calculated using a geothermal design and economics model developed to ensure consistent results.

Subject categories in the bibliography:

- Corrosion, Scaling and Materials Selection
- Direct Use Applications
- Economics of Direct Use Development
- Exploration
- Financing Direct Use Projects
- Legal, Institutional, and Environmental Consideration
- Progress Reports
- Resource Assessment
- Well Drilling

DEC 18 1980

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

DEC 15 1980

Dr. Phillip M. Wright
Associate Director, Earth Science
Laboratory
University of Utah Research Institute
Research Park
420 Chipata Way, Suite #120
Salt Lake City, Utah 84108

SUBJECT: Geothermal District Heating - Technical Assistance Program

Dear Mike:

This letter confirms the conversation between Ms. Debbie Struhsacker of the University of Utah Research Institute (UURI) and George S. Budney of the Energy Technology Engineering Center (ETEC) in which the technical assistance program ETEC is coordinating for DOE was discussed. DOE has decided that it would be desirable to establish a priority for cities having hydrothermal district heating potential. Such a list could be used to advise city authorities, utilities and energy district heating systems and the technical assistance and federal government programs available to assist them in developing geothermal district heating systems.

Several studies have been performed identifying cities with hydrothermal potential. The results of these studies are summarized in the following reports:

1. Allen, E. and Shreve, J. - Preliminary Inventory of Western U. S. Cities with Proximate Hydrothermal Potential; Vol I Report, August 1980; Vol II State Mass.

2. Addendum - Preliminary Inventory of Western U. S. Cities with Proximate Hydrothermal Potential.

3. Science Application, Inc. - List of Cities for Geothermal District Heating.

4. P. O'Dea, et al, "Cities and Towns in the Rocky Mountain Basin and Range Region, Data Report, "NMEI 10-5, New Mexico Energy Institute, May 1979.

It was agreed that the University of Utah Research Institute could prepare a priority list of cities having hydrothermal potential using the cities identified in the above documents as a basis. If you are aware of additional cities having hydrothermal potential please include those in the results.

It is suggested that the priority list be segrated into three categories as follows:

I Cities near hydrothermal resources where the hydrothermal potential is fairly certain and development is economically attractive.

II Cities more distant from fairly certain hydrothermal resources (or near less attractive resources) with the potential for economic development.

III Cities more distant from hydrothermal resources where the potential for economic development, because of the unknown characteristics of the resource, is uncertain.

In addition to establishing the priority of cities with hydrothermal potential, it is desirable to summarize the characteristics of the resource for each of the cities. Sufficient data should be provided to form a basis for subsequent geothermal district heating system feasibility and economic studies by prospective developers.

It is requested that UURI prepare a plan and schedule for the proposed report and submit it to DOE (with a copy to ETEC) for comments by December 19, 1980. The plan should indicate the contents of the report.

Funding for this activity should be discussed and resolved with UURI's DOE Contracting Officer.

If any additional information is desired, please contact G. S. Budney of ETEC on (213) 341-1000, extension 6474.

Sincerely,

Wayne Bryan

for Hilary Sullivan
Program Coordinator
Geothermal Energy Division

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

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Rockwell International

APR 0 1 1981

March 26, 1981

81ETEC-DRF-1284

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team, Final Roster

Dear Team Member:

The enclosed listing provides a final compilation of those institutions/individuals who will constitute the Geothermal District Heating Technical Assistance Team for support to communities receiving feasibility study funding under the recent HUD/DOE solicitation. Also included is a description of the information received by ETEC to show the capabilities of the listed organizations. For many of those listed, the information is very brief and perhaps not sufficiently informative for the needs of the communities who will use it. You are urged to provide at least a one page summary of your organization's capabilities if you have not already done so.

About twenty communities with geothermal potential have responded to the HUD/DOE feasibility study solicitation. Although it is expected that only five to ten of them will be awarded funds from this source, it is possible that some communities will receive support from other sources. Therefore it is requested that each Team organization provide ETEC 24 copies of its brochure or other capability information for eventual distribution. ETEC will package and distribute this information as appropriate. In addition to the Team roster and organization capabilities, the package being prepared for the HUD/DOE award winners will include the Geothermal District Heating Bibliography in final form, a Geothermal District Heating Design Guide (prepared by OIT), a Geothermal Resource Potential Evaluation (prepared by UURI), and a site-specific reference list. Team member's recommendations will be requested when the solicitation winners are announced.

This and subsequent mailings to Geothermal Technical Assistance Team members will be sent to one individual at each participating organization. Please circulate the information to others within your organization who need it. Questions should be addressed to me at extension 6474 or to Dr. R. L. Eichelberger at extension 6165.

Sincerely yours,

G. S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosure: as noted

# GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

## DOE and Technical Assistance Management

Hilary Sullivan
Program Coordinator, Geothermal Energy Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Roald Bendixen
U. S. Department of Energy Region X
1992 Federal Building
915 Second Avenue
Seattle, Washington 98174
Telephone: (206) 442-2820

| Participating Organizations | Capability Information Received by ETEC |
|---|---|
| Mr. George Lawson<br>Oak Ridge National Laboratory<br>Building 3550<br>Oak Ridge, Tennessee 37830<br>Telephone: (615) 574-5210 | Coordination with ANL/ORNL technical assistance program. |
| Jess Pascual<br>Building 214, Engineering Division<br>Argonne National Laboratory<br>9700 South Cass Avenue<br>Argonne, Illinois 60439<br>Telephone: (312) 972-5249 | One paragraph listing of areas of expertise. |
| Ms. Ann W. Reisman<br>Energy Systems Analysis<br>Department of Energy and Environment<br>Brookhaven National Laboratory<br>Associated Universities, Inc.<br>Upton, L.I. New York 11973<br>Telephone: (516) 345-2666 | No information. |
| Dr. Ishai Oliker<br>Project Manager, District Heating Project<br>Burns and Roe, Inc.<br>800 Kinderkamack Road<br>Oradell, New Jersey 07649<br>Telephone: (201) 265-2000, Ext. 2702 | No information. |
| Ms. Susan Brown<br>California State Commercialization Team<br>California Energy Commission<br>1111 Howe Avenue<br>Sacramento, California 95825<br>Telephone: (916) 924-2499 | State Commercialization Team. |
| J. C. Austin<br>$CH_2M$ Hill, Boise Office<br>P. O. Box 8748<br>Boise, Idaho 83707<br>Telephone: (208) 345-5310 | Fourteen pages of descriptions of geothermal projects. |

| Participants Organizations | Capability Information Received by ETEC |
|---|---|
| Richard E. Pearl, Project Coordinator<br>Geothermal Commercialization and Planning Project<br>Colorado Geological Survey<br>715 State Centennial Building<br>1313 Sherman Street<br>Denver, Colorado<br>Telephone: (303) 866-2611 | State Commercialization Team. |
| Mr. Robert Van Horn, Executive Director<br>GRIPS Commission<br>2628 Mendocino Avenue<br>Santa Rose, California 95401<br>Telephone: (707) 527-2025 | No information. |
| William Toth<br>Hydrothermal Energy Commercialization Division<br>EG&G Idaho, Inc.<br>Idaho National Engineering Laboratory<br>P. O. Box 1625<br>Idaho Falls, Idaho 83401<br>Telephone: (208) 526-9217 | Eighteen page packet describing assistance programs for state commercialization teams. |
| Mr. Alex Sifford<br>Eliot Allen & Associates, Inc.<br>5006 Commercial Street, S.E.<br>Salem, Oregon 97302<br>Telephone: (503) 371-4561 | No information. |
| Mr. Bill Eastlake<br>Office of Energy<br>Statehouse<br>Boise, Idaho 83720<br>Telephone: (208) 334-3721 | State Commercialization Team. |
| Dr. Fletcher C. Paddison<br>Johns Hopkins University -<br>Applied Physics Laboratory<br>Johns Hopkins Road<br>Laurel, Maryland 20810<br>Telephone: (301) 953-7100 | Letter commenting on availability of Economic Model GRITS. |

| Participants Organizations | Capability Information Received by ETEC |
|---|---|
| Mr. Michael Chapman<br>Energy Planning Division<br>Montana Department of Natural Resources<br>32 South Ewing<br>Helena, Montana 59620<br>Telephone: (406) 449-4624 | State Commercialization Team. |
| Doug Sacarto<br>National Council of State Legislatures<br>1125 - 17th Street, Suite 1500<br>Denver, Colorado 80202<br>Telephone: (303) 623-6600 | No information. |
| Mr. Noel Clark, Director<br>Nevada Department of Energy<br>1050 East Williams, Suite 405<br>Carson City, Nevada 89710<br>Telephone: (702) 885-5157 | State Commercialization Team. |
| Dr. Larry Icerman<br>Box 3 EI<br>New Mexico Energy Institute<br>New Mexico State University<br>Las Cruces, New Mexico 88003<br>Telephone: (505) 646-1745 | State Commercialization Team. |
| Mr. Bruce Gaugler<br>State Energy Office<br>State Capitol<br>Bismarck, North Dakota 58501<br>Telephone: (701) 224-2107 | State Commercialization Team. |
| William Sidle<br>Geothermal Project Director<br>Oregon Department of Energy<br>Labor and Industry Building<br>Salem, Oregon 97310<br>Telephone: (503) 378-5981 | State Commercialization Team. |
| Gene Culver<br>Geo-Heat Utilization Center<br>Oregon Institute of Technology<br>Ortech Branch Post Office<br>Klamath Falls, Oregon 97601<br>Telephone: (503) 882-6321 | One paragraph statement of areas of expertise. |

| Participants Organizations | Capability Information Received by ETEC |
|---|---|
| Dr. Gordon Reistad<br>Department of Mechanical Engineering<br>School of Engineering<br>Oregon State University<br>Corvallis, Oregon 97331<br>Telephone: (503) 754-2575, Ext. 3441 | One paragraph outline of areas of expertise. |
| C. H. Bloomster, Linda Fassbender<br>Manager, Advanced Energy Analysis<br>Pacific Northwest Laboratories<br>P. O. Box 999<br>Richland, Washington 99352<br>Telephone: (509) 376-4357, 376-4361 | Three paragraph discussion of areas of expertise. |
| Marshall Conover<br>Radian Corporation<br>P. O. Box 9948<br>Austin, Texas 78766<br>Telephone: (512) 454-4797 | No information. |
| N. Richard Friedman<br>Resource Dynamics Corporation<br>1340 Old Chain Bridge Road<br>McLean, Virginia 22101<br>Telephone: (703) 356-1300 | Printed brochure on Services and Capabilities. |
| Phil Lidel, Director<br>Geothermal Program<br>Office of Energy Policy<br>Capitol Lake Plaza<br>Pierre, South Dakota 57501<br>Telephone: (605) 773-3603 | State Commercialization Team. |
| Phillip M. Wright, Debra Struhsacker<br>Associate Director, Earth Sciences Laboratory<br>University of Utah Research Institute<br>Research Park<br>420 Chipeta Way, Suite 120<br>Salt Lake City, Utah 84108<br>Telephone: (801) 581-5283 | One paragraph discussion of areas of expertise. |

| Participants Organizations | Capability Information Received by ETEC |
|---|---|
| William Isherwood<br>U. S. Geological Survey<br>345 Middlefield Road<br>Menlo Park, California 94025<br>Telephone: (415) 323-8111, Ext. 2841 | One page listing of areas of geothermal expertise. |
| Dr. R. Gordon Bloomquist<br>Washington State Energy Office<br>400 East Union Street<br>Olympia, Washington 98504<br>Telephone: (206) 754-0774 | State Commercialization Team. |
| Dr. R. T. Meyer<br>Western Energy Planners, Ltd.<br>2180 South Ivanhoe, Suite 4<br>Denver, Colorado 80222<br>Telephone: (303) 758-8206 | Printed brochure on Corporate Qualification and Key Personnel. Basic hydrothermal data for states. |
| Rick James<br>Geothermal Commercialization Office<br>P. O. Box 4096<br>University Station<br>Laramie, Wyoming 82071<br>Telephone: (307) 766-4820 | State Commercialization Team. |
| Stanley Green<br>Utah Department of Natural Resources<br>Division of Water Rights<br>200 Empire Building<br>231 East 400 South<br>Salt Lake City, Utah 84111<br>Telephone: (801) 533-6071 | State Commercialization Team. |

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

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March 6, 1981

81ETEC-DRF-0946

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team - Review of Geothermal District Heating Bibliography

Dear Team Member:

Thank you for your contributions to the Geothermal District Heating Bibliography. ETEC has taken the lists you provided and compiled the document which is enclosed (Enclosure 1). The references were divided into the eight categories shown and arranged alphabetically by author or source. As may be noted, the Bibliography is quite voluminous. For this reason, abstracts will not be included in the Bibliography. To improve its utility, Team Members are requested to review the Bibliography in the areas of their expertise considering the proposed use of the document.

It is intended to provide copies of the Bibliography as part of the information package to be submitted to communities and organizations considering geothermal district heating and cooling systems. As a subsequent step in the technical assistance process, when the communities and organizations selected by DOE/HUD for performing feasibility studies for geothermal district heating and cooling systems are identified, Team Members will be requested to identify specific documents in the Bibliography applicable to each community's site. Each community will then be advised of the site-specific and generally applicable documents that should be considered in its study. Team Members should be prepared to provide copies of needed documents not readily obtainable by communities. Communication will be established between community representatives and Team Members to provide the assistance desired.

To meet the above objectives, Team Members are requested to review the enclosed Bibliography for the following:

1. Advise ETEC of listings that should be removed from the Bibliography because they are irrelevant, duplicate information in other references, obsolete unobtainable, or inadequately referenced.

2. Advise ETEC of references which are pertinent to the feasibility study and have not been included in the Bibliography.

3. Table 1 (Enclosure 2), Geothermal District Heating Document Sources, lists Report Identifiers for documents originated by Team Members or their subcontractors. These documents are assumed to be available from the originator for possible distribution to award winners. Please advise ETEC of any changes or additions desired in the list.

It is requested that Team Members telephone their responses to the above requests to Bob Eichelberger, Extension 6165, by March 20, 1981. The final issue of the Geothermal District Heating Bibliography will be distributed to Team Members on approximately April 1, 1981.

Sincerely yours,

G. S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosures: as noted

Enclosure #1 to
81ETEC-DRF-0946

# GEOTHERMAL DISTRICT HEATING

## BIBLIOGRAPHY

DRAFT

Energy Technology Engineering Center

March 5, 1981

DRAFT



TABLE OF CONTENTS

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6. Bamford, R. W., Christensen, O. D., and Capuano, R. M., 1980; Multielement Geochemistry of Solid Materials in Geothermal Systems and Its Application, Part 1: The Hot-Water System at the Roosevelt Hot Springs KGRA, Utah. DOE/ET/27002-7, ESL-30.

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## VI. LEGAL, INSTITUTIONAL, & ENVIRONMENTAL CONSIDERATIONS


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DRAFT



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Table 1

GEOTHERMAL DISTRICT HEATING DOCUMENT SOURCES

| Geothermal District Heating Team Member | Report Identifiers |
|---|---|
| Applied Physics Lab., Johns Hopkins University | APL/JHU |
| Brookhaven National Laboratory | BNL- |
| E G & G, Idaho | TREE- |
| New Mexico Energy Institute | NMEI- |
| Oregon Institute of Technology, GeoHeat Utilization Center | GMS-. OreBin, OIT-GeoHeat |
| Pacific Northwest Laboratory (Battelle) | PNL-, BNMW- |
| U.S. Geological Survey | USGS- |
| University of Utah Research Institute | ESL- |

It is expected that team members whose organizational names are explicit in the identification of reports will be a source for such reports. Examples are National Conference of State Legislatures, Oregon Department of Energy (includes Oregon Department of Geology and Mineral Industries publications), Western Energy Planners, among others.

Enclosure to 81ETEC-DRF-0946

MAILING LIST

GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

(TENTATIVE)

Individual/Organization

Hilary Sullivan
Program Coordinator, Geothermal Energy Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-100, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Jess Pascual
Building 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Telephone: (312) 972-5249

Individual/Organization

Ms. Ann. W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. New York 11973
Telephone: (516) 345-2666

Dr. Ishai Oliker
Project Manager, District Heating Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, New Jersey 07649
Telephone: (201) 265-2000, Ext. 2702

Ms. Susan Brown
California State Commercialization Team
California Energy Commission
1111 Howe Avenue
Sacramento, California 95825
Telephone: (916) 924-2499

Mr. Michael Gersick, Deputy Director
Department of Conservation
1416 9th Street
Sacramento, California 95825

J. C. Austin
$CH_2M$ Hill, Boise Office
P. O. Box 8748
Boise, Idaho 83707
Telephone: (208) 345-5310

Richard E. Pearl, Project Coordinator
Geothermal Commercialization and Planning Project
Colorado Geological Survey
715 State Centennial Building
1313 Sherman Street
Denver, Colorado
(303) 839-2611

Roald Bendixen
U.S. Dept. of Energy Region X
1992 Federal Bldg.
915 Second Ave.
Seattle, Washington 98174
Telephone: (206) 442-2820

Individual/Organization

John Nimmons
Earl Warren Legal Institute
University of California
Berkeley, California 94726
Telephone: (415) 642-8305

Mr. Robert Van Horn, Executive Director
GRIPS Commission
2628 Mendocino Avenue
Santa Rose, California 95401
Telephone: (707) 527-2025

Mr. Jim Woodruff
Department of Planning and Economic Development
P. O. Box 2359
Honolulu, Hawaii 96804
Telephone: (808) 458-4195

William Toth
Hydrothermal Energy Commercialization Division
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83401
Telephone: (208) 526-9217

Mr. Bill Eastlake
Office of Energy
Statehouse
Boise, Idaho 83720
Telephone: (208) 526-0111

Mr. Dave Pierson, Director
Public Works Department
Imperial County
The Courthouse
El Centro, California 92243
Telephone:

Doug Sacarto
National Council of State Legislatures
1125 - 17th Street, Suite 1500
Denver, Colorado 80202
Telephone: (303) 623-6600

Individual/Organization

Dr. Fletcher C. Paddison
Johns Hopkins University - Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Telephone: (301) 953-7100

Mr. Michael Chapman
Energy Planning Division
Montana Department of Natural Resources
32 South Ewing
Helena, Montana 59620
Telephone: (406) 449-4624

Phillip M. Wright, Debra Struhsacker
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Telephone: (801) 581-5283

William Isherwood
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025
Telephone: (415) 323-8111, Ext. 2841

Dr. R. Gordon Bloomquist
Washington State Energy Office
400 East Union Street
Olympia, Washington 98504
Telephone: (206) 754-0774

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 South Ivanhoe, Suite 4
Denver, Colorado 80222
Telephone: (303) 758-8206

Rick James
Research Dept.
University of Wyoming
P. O. Box 3825
Laramie, Wyoming 82071
(307) 766-4820

Individual/Organization

Mr. Noel Clark, Director
Nevada Department of Energy
1050 East Williams, Suite 405
Carson City, Nevada 89710
Telephone: (702) 885-5157

Dr. Larry Icerman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico 88003
Telephone: (505) 646-1745

Mr. George Scudella
New Mexico Energy and Mineral Department
P. O. Box 2770
Santa Fe, New Mexico 87501
Telephone: (505) 827-2471

Mr. Bruce Gaugler
State Energy Office
State Capitol
Bismarck, North Dakota 58501
Telephone: (701) 224-2107

Debra Justus
Geothermal Specialist
Oregon Department of Energy
102 Labor and Industry Building
Salem, Oregon 97310
Telephone: (503) 378-2778

Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch Post Office
Klamath Falls, Oregon 97601
elephone: (503) 882-6321

eorge Lawson
dge National Laboratory
3550
Tenn, 37830
615) 574-5210

Individual/Organization

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, Oregon 97331
Telephone: (503) 754-2575, Ext. 3441

C. H. Bloomster, Linda Fassbender
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352
Telephone: (509) 946-2442

Marshall Conover
Radian Corporation
P. O. Box 9948
Austin, Texas 78766
Telephone: (512) 454-4797

N. Richard Friedman
Resource Dynamics Corporation
962 Wayne Avenue
Silver Springs, Maryland 20910
Telephone: (703) 356-1300

Phil Lidel, Director
Geothermal Program
Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501
Telephone: (605) 773-3603

Mr. Stanley Green
Utah Department of Natural Resources
Division of Water Rights
200 Empire Building
231 East 400 South
Salt Lake City, Utah 84111
Telephone: (801) 533-6071

Mr. Alex Sifford
Eliot Allen & Associates Inc.
5006 Commercial St., S.E.
Salem, Oregon 97302
Telephone: (503) 371-4561

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

April 8, 1981

81ETEC-DRF-1443

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team, Responses to HUD/DOE District Heating and Cooling Solicitation

Reference: 81ETEC-DRF-1284, Budney to Geothermal District Heating Technical Assistance Team Members, March 26, 1981

Dear Team Member:

A workshop on Community Assistance Training for District Heating Assistance was conducted by ANL/ORNL on April 3, 1981. At the meeting, general information on responses to the HUD/DOE solicitation was presented by ORNL representatives. This information is presented in the enclosure.

It has been stated that approximately 30 awards will be made. An announcement on the award winners will be made in the latter part of April 1981.

Team members are reminded that this may be the final opportunity to submit or upgrade their submittals of information requested in the reference letter.

Sincerely yours,

G.S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosure: as noted

Mike -
Thought you might like to see this
ds

## Cooperative Agreement Outlines With Communities to Assess the DHC Potential Were Solicited and Evaluated

1. 111 applications were received.

2. 104 applications were evaluated.

3. Communities were ranked according to:

   - Ability to assess DHC systems now and in the future
   - The extent the community demonstrated the willingness and ability to develop a consensus for a DHC based on depth of community involvment in the work effort
   - Distress eligibility toward a CDBG
   - Understanding of the elements of a DHC system

4. Recommendations made to the Source Selection Board in mid-March.

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Location of Applicants by States

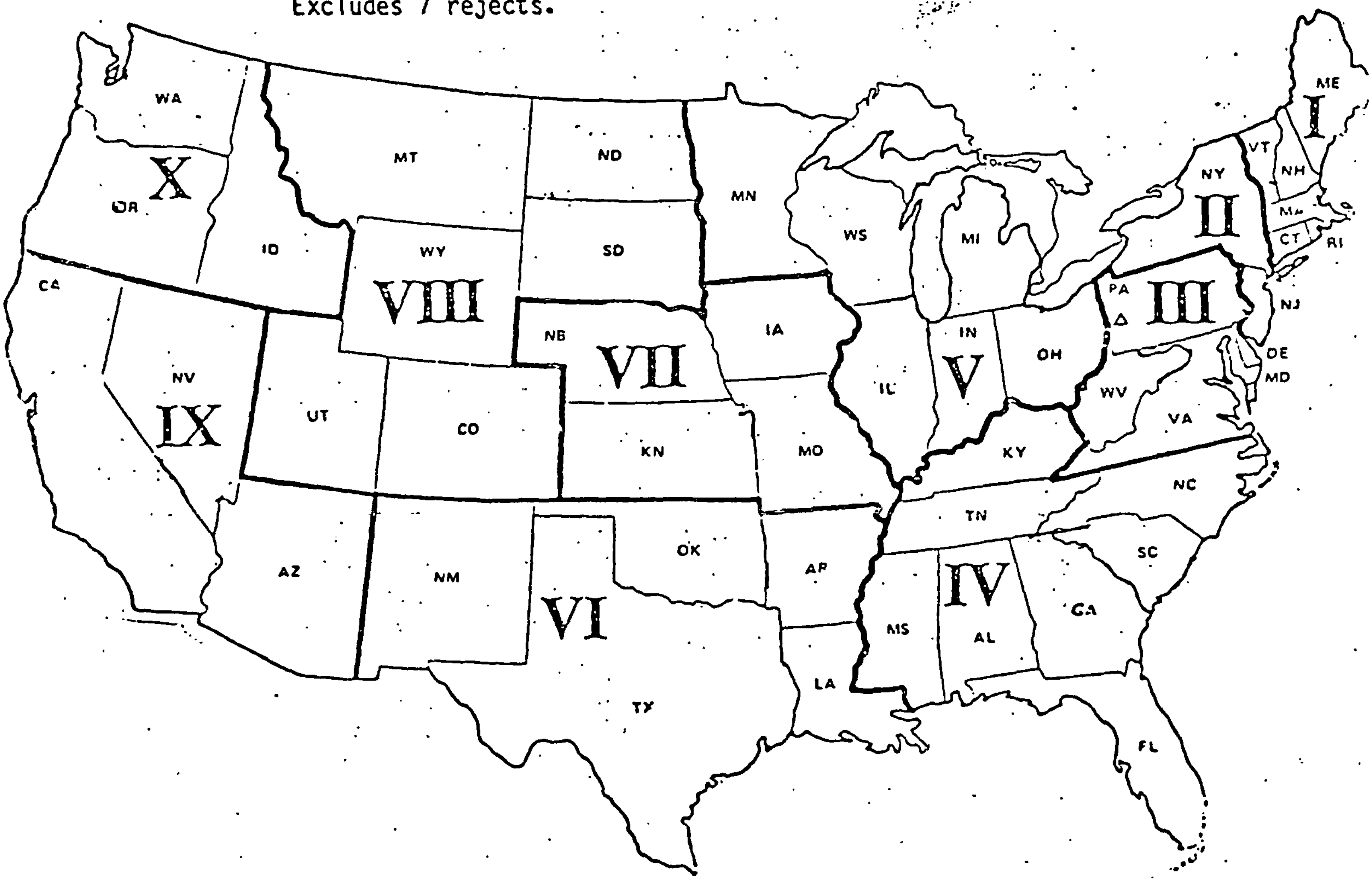
| | State | Applicants |
|---|---|---|
| 1. | New York | 11 |
| 2. | Massachusetts | 10 |
| 3. | Minnesota | 10 |
| 4. | California | 7 |
| 5. | Michigan | 7 |
| 6. | New Jersey | 5 |
| 7. | Ohio | 5 |
| 8. | Pennsylvania | 5 |
| 9. | Maine | 4 |
| 10. | Connecticut | 3 |
| 11. | Indiana | 3 |
| 12. | Montana | 3 |
| 13. | Nevada | 3 |
| 14. | New Mexico | 3 |
| 15. | Maryland | 2 |
| 16. | Oregon | 2 |
| 17. | Colorado | 2 |
| 18. | Texas | 2 |
| 19. | Utah | 2 |
| 20. | Vermont | 2 |
| 21. | Virginia | 2 |
| 22. | Washington | 2 |
| 23. | Wisconsin | 2 |
| 24. | Alaska | 1 |
| 25. | District of Columbia | 1 |
| 26. | Florida | 1 |
| 27. | Georgia | 1 |
| 28. | Idaho | 1 |
| 29. | Illinois | 1 |
| 30. | Iowa | 1 |
| 31. | Kentucky | 1 |
| 32. | Louisania | 1 |
| 33. | New Hampshire | 1 |
| 34. | North Carolina | 1 |
| 35. | North Dakota | 1 |
| 36. | South Dakota | 1 |
| 37. | Wyoming | 1 |

TOTAL: Thirty-seven states Applicants 111

Number of HUD Applicants by Region
District Heating/Cooling Assessment

| Region | All Applicants | Top 13 Applicants | Rank 14-39 Applicants |
|---|---|---|---|
| I | 18 | 0 | 8 |
| II | 16 | 1 | 4 |
| III | 9 | 4 | 2 |
| IV | 4 | 2 | 1 |
| V | 26 | 4 | 6 |
| VI | 6 | 0 | 2 |
| VII | 1 | 0 | 0 |
| VIII | 10 | 2 | 2 |
| IX | 8 | 0 | 0 |
| X | 6 | 0 | 1 |
| TOTAL | 104* | 13 | 26 |

* Excludes 7 rejects.




Department of Housing and Urban Development Regional Areas

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Number of HUD Applicants by Community
Population District Heating/Cooling Assessment

| Population | All Applicants | Top 13 Applicants | Rank 14-39 Applicants |
|---|---|---|---|
| 0-10,000 | 25 | 3 | 6 |
| 10-50,000 | 22 | 1 | 12 |
| 50-100,000 | 28 | 2 | 4 |
| 100-250,000 | 14 | 4 | 2 |
| 250-500,000 | 5 | 1 | 0 |
| 500-1,000,000 | 8 | 1 | 2 |
| over 1,000,000 | 2 | 1 | 0 |
| TOTAL | 104* | 13 | 26 |

* Excludes 7 rejects.

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Summary of All Energy Sources Discussed in 111 Applications

| Code No. | Heating/Cooling Source | Number Indicated |
|---|---|---|
| 1 | Municipal incinerator | 56 |
| 2 | Industrial incinerator | 18 |
| 3 | Industrial waste heat | 46 |
| 4 | Utility cogeneration | 55 |
| 5 | Goethermal | 35 |
| 6 | Solar | 13 |
| 7 | Gas boiler | 23 |
| 8 | Oil boiler | 17 |
| 9 | Coal boiler | 36 |
| | Sub-total | 299 |
| | Wood | 7 |
| | Hydro-electric | 2 |
| | Wind | 1 |
| | Shale oil | 1 |
| | Peat | 1 |
| | Bread oven | 1 |
| | Sub-total | 13 |
| | TOTAL | 312 |

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DISTRIBUTION LIST

GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

DOE and Technical Assistance Management

Hilary Sullivan
Program Coordinator, Geothermal Energy Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Roald Bendixen
U. S. Department of Energy Region X
1992 Federal Building
915 Second Avenue
Seattle, Washington 98174
Telephone: (206) 442-2820

Participating Organizations

Mr. George Lawson
Oak Ridge National Laboratory
Building 3550
Oak Ridge, Tennessee 37830
Telephone: (615) 574-5210

Jess Pascual
Building 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Telephone: (312) 972-5249

Ms. Ann W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. New York 11973
Telephone: (516) 345-2666

Dr. Ishai Oliker
Project Manager, District Heating Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, New Jersey 07649
Telephone: (201) 265-2000, Ext. 2702

Ms. Susan Brown
California State Commercialization Team
California Energy Commission
1111 Howe Avenue
Sacramento, California 95825
Telephone: (916) 924-2499

J. C. Austin
$CH_2M$ Hill, Boise Office
P. O. Box 8748
Boise, Idaho 83707
Telephone: (208) 345-5310

Richard E. Pearl, Project Coordinator
Geothermal Commercialization and Planning Project
Colorado Geological Survey
715 State Centennial Building
1313 Sherman Street
Denver, Colorado
Telephone: (303) 866-2611

Mr. Robert Van Horn, Executive Director
GRIPS Commission
2628 Mendocino Avenue
Santa Rose, California 95401
Telephone: (707) 527-2025

William Toth
Hydrothermal Energy Commercialization Division
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83401
Telephone: (208) 526-9217

Mr. Alex Sifford
Eliot Allen & Associates, Inc.
5006 Commercial Street, S.E.
Salem, Oregon 97302
Telephone: (503) 371-4561

Mr. Bill Eastlake
Office of Energy
Statehouse
Boise, Idaho 83720
Telephone: (208) 334-3721

Dr. Fletcher C. Paddison
Johns Hopkins University -
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Telephone: (301) 953-7100

Participants Organizations

Mr. Michael Chapman
Energy Planning Division
Montana Department of Natural Resources
32 South Ewing
Helena, Montana 59620
Telephone: (406) 449-4624

Doug Sacarto
National Conference of State Legislatures
1125 - 17th Street, Suite 1500
Denver, Colorado 80202
Telephone: (303) 623-6600

Mr. Noel Clark, Director
Nevada Department of Energy
1050 East Williams, Suite 405
Carson City, Nevada 89710
Telephone: (702) 885-5157

Dr. Larry Icerman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico 88003
Telephone: (505) 646-1745

Mr. Bruce Gaugler
State Energy Office
State Capitol
Bismarck, North Dakota 58501
Telephone: (701) 224-2107

William Sidle
Geothermal Project Director
Oregon Department of Energy
Labor and Industry Building
Salem, Oregon 97310
Telephone: (503) 378-5981

Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch Post Office
Klamath Falls, Oregon 97601
Telephone: (503) 882-6321

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, Oregon 97331
Telephone: (503) 754-2575, Ext. 3441

C. H. Bloomster, Linda Fassbender
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352
Telephone: (509) 376-4357, 376-4361

Marshall Conover
Radian Corporation
P. O. Box 9948
Austin, Texas 78766
Telephone: (512) 454-4797

N. Richard Friedman
Resource Dynamics Corporation
1340 Old Chain Bridge Road
McLean, Virginia 22101
Telephone: (703) 356-1300

Phil Lidel, Director
Geothermal Program
Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501
Telephone: (605) 773-3603

Phillip M. Wright, Debra Struhsacker
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Telephone: (801) 581-5283

Participants Organizations

William Isherwood
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025
Telephone: (415) 323-8111, Ext. 2841

Dr. R. Gordon Bloomquist
Washington State Energy Office
400 East Union Street
Olympia, Washington 98504
Telephone: (206) 754-0774

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 South Ivanhoe, Suite 4
Denver, Colorado 80222
Telephone: (303) 758-8206

Rick James
Geothermal Commercialization Office
P. O. Box 4096
University Station
Laramie, Wyoming 82071
Telephone: (307) 766-4820

Stanley Green
Utah Department of Natural
Resources
Division of Water Rights
200 Empire Building
231 East 400 South
Salt Lake City, Utah 84111
Telephone: (801) 533-6071

DEBRA STRUSAKER

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell International

April 17, 1981

81ETEC-DRF-1608

Multiple Addressees
(List Attached)

Subject: Geothermal and District Heating Systems, Proposed Tour of Facilities

Dear Colleague:

Arrangements are being made by Trans Energy Systems, through their French parent organization, Compagnie Generale de Chauffe, and by the Danish firm, Harry og Mogens Larsen I/S, the Danish Board of District Heating, and the Danish consulate to tour various geothermal and other district heating facilities in France and Denmark. A preliminary itinerary for the visit reproduced from their letters is enclosed.

The principal objective of the tour is to determine the experience of the French and Danes in designing and operating hot water district heating systems. This information would be directly applicable to the current HUD/DOE district heating feasibility study solicitation. It is believed that the tour would be most beneficial to persons managing the HUD/DOE program and to individuals in organizations providing support to DOE or technical assistance and advice to geothermal energy district heating facility developers.

In order to finalize plans, our French and Danish hosts request that we advise them as soon as possible of the approximate number of persons that will make the tour. In addition, suggestions on desired changes to the itinerary are solicited. The scheduled period for the tour was selected to be compatible with the French and Danish vacation customs.

If you propose to make the tour, please advise the undersigned by telephone not later than April 28, 1981. Any suggestions relative to the proposed itinerary can be made at the same time.

If any additional information is desired, please contact me on extension 6474.

Sincerely yours,

G. S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs Office
Energy Technology Engineering Center

Enclosure: as noted

cc w/encl: H. Sullivan, SAN
E. Peterson, DOE, HQ

cc w/o encl: J. K. Hartman, ETEC PO

# Tentative Itinerary

Tour of Geothermal and District Heating Facilities

Visit to geothermal and district heating facilities in France.

Paris region, July 27, 28, 1981

Melun - Geothermal District Heating

Rugis - Wood/Oil Commercial District Heating

Bures-Orsay - Oil Residential District Heating

District heating facilities outside of the Paris region are listed on the following page.

Recommended hotels in the Paris region.

Hotel De La Tremoille
14 Rue De La Tremoille
75008 - Paris
Telephone: 723-75-12

Hotel Meridien
81, Bld. Gouvion Saint Cyr
75017 - Paris
Telephone: 758-12-30
Telex: Homer 290 952

## MAJOR DISTRICT HEATING SCHEMES OPERATED BY

## COMPAGNIE GENERALE DE CHAUFFE AND ITS SUBSIDIARIES

| LOCATION | NUMBER OF APTS. | PEAK DEMAND Therms/Hr | TYPE OF FUEL | SUPPLY WATER TEMP. | AGE | DESIGN BY CGC | OPERATED BY CGC |
|---|---|---|---|---|---|---|---|
| AIX EN PROVENCE | 4,600 | 48,500 | Oil | 180°C | 15 | X | X |
| ZAC DE BLAGNAC | 2,000 | 409 | Geothermal | 60°C | 140°F 4 | X | X |
| BURES-ORSAY | 7,115 | 91,900 | Oil | 190°C | 10 | | X |
| BOURGES | 5,720 | 50,200 | Coal | 180°C | | X | |
| CALAIS | 2,940 | 30,500 | Oil | 180°C | 12 | X | X |
| CHERBOURG | 2,950 | 25,300 | Oil | 110°C | 14 | X | X |
| ANNAPES (Cite Scientifique) | 3,280 | 26,525 | Oil/Gas/ Coal | 190°C | 14 | X | X |
| EVREUX | 3,530 | 44,700 | Oil | 190°C | 15 | X | X |
| LAVAL | 2,290 | 31,300 | Solid Waste | 110°C | 8 | X | X |
| LILLE ST. SAUVEUR | 1,402 | 36,000 | Oil/Gas | 180°C | 15 | X | X |
| LILLE EST | 1,380 | 25,190 | Oil | 110°C | 6 | X | X |
| MELUN | 2,500 | 26,420 | Geothermal | 110°C | 238F 10 | X | X |
| METZ-BORNY | 4,653 | 60,200 | Coal | 180°C | 13 | X | X |
| MONS EN BAROEUL | 5,300 | 56,200 | Oil | 190°C | 10 | | X |
| MONT DE MARSAN | 384 | 600 | Geothermal | 60°C | 140°F 3 | X | X |
| MONTEREAU | 3,700 | 40,000 | Coal | 190°C | 12 | | X |
| MOUBEUGE | 1,800 | 135,000 | Solid Waste | 180°C | 1 | X | X |
| NICE | 4,270 | 40,200 | Solid Waste | Steam | 5 | X | X |
| NIMES | 5,060 | 68,990 | Coal/Oil | 220°C | 10 | | X |
| RENNES | 4,805 | 80,260 | Solid Waste | 180°C | 15 | | X |
| RILLIEUX CREPIEUX | 3,600 | 48,000 | Oil | 180°C | 12 | | X |
| ROUBAIX | 3,075 | 36,180 | Oil | 110!C | 12 | X | X |
| ROUEN LES SAPINS | 7,370 | 62,000 | Oil | 180°C | 16 | X | X |
| RUNGIS | - | 135,000 | Solid Waste | 190°C | 11 | | X |
| ST. LOUIS MONTBELIARD | 2,900 | 36,300 | Oil/Gas | 180°C | 8 | X | X |
| SANNOIS | 3,000 | 25,000 | Oil | 110°C | 4 | X | X |
| SOISSONS | 2,433 | 27,500 | Oil | 110°C | 11 | X | X |
| STRASBOURG-ESPLANADE | 4,400 | 70,000 | Coal/Oil | 190°C | 11 | | X |
| VANDOEUVRE LES NANCY | 6,760 | 86,200 | Coal/Oil | 190°C | 13 | X | X |
| WATTRELOS | 2,150 | 25,880 | Oil | 110°C | 11 | X | X |

DANISH BOARD OF
DISTRICT HEATING

DRAFT PROGRAM - STUDY VISIT BY

AMERICAN DELEGATION, AUGUST 1981

**Sunday 2/8**

| | |
|---|---|
| | - Arrival Kastrup Airport, Copenhagen Check-in at Copenhagen hotel (Hotel Royal) |
| | - Reception with representatives of the Foreign Ministry and the Danish Board of District Heating |
| | - Evening visit to the Tivoli |

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**Monday 3/8**

| | |
|---|---|
| 08.30 - | - Depart hotel By coach |
| 09.00 - 10.30 | - Visit large refuse incineration/district heating scheme, Vestforbraending, on outskirts of Copenhagen |
| 11.00 - 12.30 | - Meeting at Ministry of Energy Copenhagen re. heat planning, fuel economy, etc. |
| 12.45 - | - Lunch |
| 14.00 - 15.00 | - Visit to City of Copenhagen's Lighting Dept., (Copenhagen D.H. Scheme) |
| 15.15 - | - Sightseeing tour by coach to Kronborg Castle, Elisinore, and parts of North Zealand with possible stop for dinner on the way |

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**Provisional Ladies' Program**

| | |
|---|---|
| Morning | - Free for shopping |
| 12.45 - | - Lunch with main party |
| 14.00 - 15.00 | - Lecture on Denmark |
| 15.15 - | - Sightseeing tour with main party |

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Rugårdsvej 274, DK-5210 Odense NV, Denmark, Phone (09) 16 16 88

Tuesday 4/8

| | |
|---|---|
| 08.30 - | - Depart hotel by coach for airport |
| 09.20 - 10.00 | - Flight to Odense on the island of Funen, by coach to hotel |
| 10.20 - | - Check in at Hotel (Hotel H.C. Andersen or Grand Hotel) |
| 11.00 - 12.30 | - Visit to Funen's combined heat and power station in Odense, Fynsvaerket. Film and tour of Plant. |
| 12.45 - 14.00 | - Lunch at "Under the Linden Tree" Restaurant |
| 14.00 - 14.30 | - Visit Hans Christian Andersen's Home (near restaurant) |
| 14.45 - 15.30 | - Visit to the offices of the City of Odense's District Heating Scheme Administration (planning, metering, billing and consumer relations) |
| 15.30 - 17.30 | - Visit to parts of the Odense Scheme and to see a typical consumer connection system in a house, returning to hotel |
| 19.00 - 20.00 | - Cocktails and presentation of the Member Companies of the Danish Board of District Heating (audio-visual aids) |
| 20.00 - | - Dinner as guests of the Danish Board |

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Provisional Ladies' Program

| | |
|---|---|
| Morning | - Free to shop and for individual local sightseeing (advice on both will be provided) |
| 12.45 - | - Lunch with main party |
| 14.45 - 17.30 | - Sightseeing tour, including visit to the Old Funen Village (reconstructed country village with re-sited original buildings) |
| Evening - | - Cocktails and dinner with main party |

DANISH BOARD OF
DISTRICT HEATING



Wednesday 5/8

| | |
|---|---|
| 09.15 - | - Depart hotel and Odense by coach |
| 10.00 - 11.00 | - Visit to Kommunekemi's Chemical and Waste Destruction Plant at Nyborg on the east coast of the island. (The plant supplies waste heat to the Nyborg D.H. Scheme). |
| 11.15 - 13.30 | - Visit to the offices of Tjærekompagniet in Nyborg. A local authorities owned company manufacturing prefabricated D.H. pipes and fittings, asphalt products, tar oil (for D.H. boiler-houses) and more.Lunch as guests of the Company |
| 13.45 - | - Visit to Nyborg Castle (the royal palace in the middle-ages), thereafter drive by coach through South Funen with stop at Egeskov Castle |
| 18.00 - | - Check in at Falsled Inn on the south coast of the island (Due to high season,the Inn's popularity and limited accomodation,we have provisionally reserved 9 double and 2 single rooms. Additional accomodation may be available nearby) |

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Provisional Ladies' Program

- The early morning free in Odense and then train to Nyborg, where the ladies join the main party for lunch at noon, thereafter following the main program

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Thursday 6/8

| | |
|---|---|
| 08.30 - | - Departure by coach to the ferry harbour of Boejden |
| 09.00 - | - By ferry thru the idyllic and island-dotted South Funen waters to the island of Aars |
| 1o.15 - 13.00 | - Visit to the head offices and factory complex of Danfoss, one of the world's largest automatic controls manufactures<br>Lunch as guests of Danfoss |

DANISH BOARD OF
DISTRICT HEATING



Thuesday 6/8 ......

| | |
|---|---|
| 14.15. - 16.30 | - Visit to the factories of Dûrotan and I.C. Moeller in the Jutland town of Fredericia, to see manufacture of prefabricated D.H. pipes & fittings |
| 16.45 - 18.00 | - Visit to the offices of Fredericia D.H. Scheme (a co-operatively owned utility) and factory of Superfos ( a fertilizer manufacturer supplying Fredericia's D.H. Scheme with surplus heat) |
| 18.30 - | - Check-in at Hotel Munkebjerg, Vejle |
| 19.15 - | - Coaktails and talk - Danish D.H. technology and its relevance in the U.S. |
| 20.00 - | - Dinner and informal get-together afterwards |

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Provisional Ladies' Program

| | |
|---|---|
| | - The ladies follow the main program until 14.15 when a sightseeing tour will be arranged |
| 18.30 - | - Check-in at hotel with main party, thereafter following main program again |

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Friday 7/8

| | |
|---|---|
| 09.00 - | - Depart hotel by coach to Aarhus |
| 1o.30 - 11.30 | - Visit to heat exchanger factory, Redan, in Aarhus |
| 12.00 - 14.00 | - Visit to the head offices of D.H. and refuse incineration engineers, Bruun & Soerensen, Aarhus, for talk & lunch as guests of B & S |
| 14.15 - 15.15 | - Visit to the factory of Kamstrup Metro, Aarhus, manufacturers of energy meters, etc. |
| 15.30 - 17.00 | - Visit to the offices of the City of Aarhus Public Works Dept. Meeting with Alderman Axel Baar-Nielsen and the City's Chief Engineer, Hans Matthiessen |
| 18.25 - | - Flight to Copenhagen |

Rugårdsvej 274, DK-5210 Odense NV, Denmark, Phone (09) 16 16 88

Friday 7/8.......

19.30 - - Check in at hotel in Copenhagen

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Provisional Ladies' Program

- Sightseeing tour of Aarhus including visits to the Old Town and to the Royal Palace, Marselisborg Castle

16.45 - - Meet up with main party at City of Aarhus before departure to airport and return to Copenhagen

Rugårdsvej 274, DK-5210 Odense NV, Denmark, Phone (09) 16 16 88

LIST OF POTENTIAL VISITORS

DOE

Dr. J. Salisbury, Washington, D.C.
Eric A. Peterson, Washington, D.C.
Ms. Hilary Sullivan, San Francisco
Mike Tucker, Idaho
Tom Heenan, San Francisco

DOE Support

George S. Budney, ETEC
Jim Bates, ETEC
Frank Childs, EG&G, Idaho
Ed DiBello, EG&G, Idaho

HUD

Wyndham Clarke, Washington, D.C.
Bob Groberg, Washington, D. C.

DOE Technical Assistance

Dr. Paul Lineau, Oregon Institute of Tech.
Gene Culver, Oregon Institute of Tech.
Bill Toth, EG&G, Idaho, Inc.
Ms. Debra Strusaker, University of Utah Research Inst.
Marshall Conover, Radian Corp.
Dr. Fletcher Paddison, Johns Hopkins University, APL
Ms. Ann Reisman, Brookhaven National Lab

Advisory Contractors

Jim Balzhiser, Balzhiser/Hubbard & Assoc.
William Diskant, American Hydrotherm Corp.
Norman Taylor, International District Heating Assoc.
Ray Costello, Burns & Roe Industrial Services Corp.
Monte Koepf, Koepf & Lange
John C. Austin, $CH_2M$ Hill, Boise
Dr. Gordon Reistad, Oregon State Univ.
Glenn E. Coury, Coury & Associates

DR. PHILIP M. WRIGHT
DEBRA STRUSACKER

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

April 16, 1981 81ETEC-DRF-1557

Multiple Addressees
(See Attached List)

Subject: Geothermal District Heating Technical Assistance Team;
Distribution of Geothermal District Heating Bibliography

Dear Team Member:

Enclosed is a copy of the Geothermal District Heating Bibliography, dated April 10, 1981. This bibliography was prepared by ETEC from contributions to the bibliography by members of the Geothermal District Heating Team. To make the bibliography more useful to HUD/DOE District Heating and Cooling System feasibility study solicitation winners, most of the site-specific references were deleted. This reduced the length of the bibliography to a more manageable size.

As soon as the HUD/DOE solicitation winners are announced, Team members will be notified and requested to identify useful references in the enclosed bibliography pertinent to the site and to identify additional site-specific references for each of the proposed sites. These submittals will be compiled by site and submitted to the solicitation winners as part of the Geothermal District Heating Technical Assistance Information Package.

ETEC thanks the Team members for their past submittals and solicits your continued cooperation.

Sincerely yours,

G. S. Budney

George S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

Enclosure: as noted

cc: w/enc. H. Sullivan, SAN
E. Peterson, DOE, HQ.

w/o enc. J. K. Hartman, ETEC PO

DISTRIBUTION LIST

# GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

## DOE and Technical Assistance Management

Hilary Sullivan
Program Coordinator, Geothermal Energy Division
U. S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-7943

George S. Budney
Project Manager, Geothermal Programs
Energy Technology Engineering Center
P. O. Box 1449
Canoga Park, California 91304
Telephone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U. S. Department of Energy
12th & Pennsylvania Avenue, N.W.
Washington, D. C. 20451
Telephone: (202) 633-8760

Mike Tucker
Idaho Operations Office
U. S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401
Telephone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U. S. Department of Energy
P. O. Box 14100
Las Vegas, Nevada 89114
Telephone: (702) 734-3424

Roald Bendixen
U. S. Department of Energy Region X
1992 Federal Building
915 Second Avenue
Seattle, Washington 98174
Telephone: (206) 442-2820

Participating Organizations

Mr. George Lawson
Oak Ridge National Laboratory
Building 3550
Oak Ridge, Tennessee 37830
Telephone: (615) 574-5210

Jess Pascual
Building 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Telephone: (312) 972-5249

Ms. Ann W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. New York 11973
Telephone: (516) 345-2666

Dr. Ishai Oliker
Project Manager, District Heating Project
Burns and Roe, Inc.
800 Kinderkamack Road
Oradell, New Jersey 07649
Telephone: (201) 265-2000, Ext. 2702

Ms. Susan Brown
California State Commercialization Team
California Energy Commission
1111 Howe Avenue
Sacramento, California 95825
Telephone: (916) 924-2499

J. C. Austin
$CH_2M$ Hill, Boise Office
P. O. Box 8748
Boise, Idaho 83707
Telephone: (208) 345-5310

Richard E. Pearl, Project Coordinator
Geothermal Commercialization and Planning Project
Colorado Geological Survey
715 State Centennial Building
1313 Sherman Street
Denver, Colorado
Telephone: (303) 866-2611

Mr. Robert Van Horn, Executive Director
GRIPS Commission
2628 Mendocino Avenue
Santa Rose, California 95401
Telephone: (707) 527-2025

William Toth
Hydrothermal Energy Commercialization Division
EG&G Idaho, Inc.
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83401
Telephone: (208) 526-9217

Mr. Alex Sifford
Eliot Allen & Associates, Inc.
5006 Commercial Street, S.E.
Salem, Oregon 97302
Telephone: (503) 371-4561

Mr. Bill Eastlake
Office of Energy
Statehouse
Boise, Idaho 83720
Telephone: (208) 334-3721

Dr. Fletcher C. Paddison
Johns Hopkins University -
Applied Physics Laboratory
Johns Hopkins Road
Laurel, Maryland 20810
Telephone: (301) 953-7100

Participants Organizations

Mr. Michael Chapman
Energy Planning Division
Montana Department of Natural Resources
32 South Ewing
Helena, Montana 59620
Telephone: (406) 449-4624

Doug Sacarto
National Conference of State Legislatures
1125 - 17th Street, Suite 1500
Denver, Colorado 80202
Telephone: (303) 623-6600

Mr. Noel Clark, Director
Nevada Department of Energy
1050 East Williams, Suite 405
Carson City, Nevada 89710
Telephone: (702) 885-5157

Dr. Larry Iceman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico 88003
Telephone: (505) 646-1745

Mr. Bruce Gaugler
State Energy Office
State Capitol
Bismarck, North Dakota 58501
Telephone: (701) 224-2107

William Sidle
Geothermal Project Director
Oregon Department of Energy
Labor and Industry Building
Salem, Oregon 97310
Telephone: (503) 378-5981

Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch Post Office
Klamath Falls, Oregon 97601
Telephone: (503) 882-6321

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, Oregon 97331
Telephone: (503) 754-2575, Ext. 3441

C. H. Bloomster, Linda Fassbender
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352
Telephone: (509) 376-4357, 376-4361

Marshall Conover
Radian Corporation
P. O. Box 9948
Austin, Texas 78766
Telephone: (512) 454-4797

N. Richard Friedman
Resource Dynamics Corporation
1340 Old Chain Bridge Road
McLean, Virginia 22101
Telephone: (703) 356-1300

Phil Lidel, Director
Geothermal Program
Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501
Telephone: (605) 773-3603

Phillip M. Wright, Debra Struhsacker
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Telephone: (801) 581-5283

Participants Organizations

William Isherwood
U. S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025
Telephone: (415) 323-8111, Ext. 2841

Dr. R. Gordon Bloomquist
Washington State Energy Office
400 East Union Street
Olympia, Washington 98504
Telephone: (206) 754-0774

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 South Ivanhoe, Suite 4
Denver, Colorado 80222
Telephone: (303) 758-8206

Rick James
Geothermal Commercialization Office
P. O. Box 4096
University Station
Laramie, Wyoming 82071
Telephone: (307) 766-4820

Stanley Green
Utah Department of Natural
Resources
Division of Water Rights
200 Empire Building
231 East 400 South
Salt Lake City, Utah 84111
Telephone: (801) 533-6071

# GEOTHERMAL DISTRICT HEATING

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Prepared by

ENERGY TECHNOLOGY ENGINEERING CENTER

April 10, 1981

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# DRAFT

"A BLUEPRINT FOR FINANCING GEOTHERMAL DISTRICT HEATING IN CALIFORNIA" ... A DISCUSSION DRAFT

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Prepared for and submitted to:
DEPARTMENT OF CONSERVATION
State of California

By DEREK "PETE" HANSEN
DEREK HANSEN AND ASSOCIATES, INC.
3835 Seventeenth Street
San Francisco, California 94114
(415) 626-1045

JOHN GRATTAN: PROJECT MANAGER

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# EXECUTIVE SUMMARY

The purpose of this contract was to determine what actions, if any, could significantly improve the prospects for use of direct heat geothermal direct heating in California. The initial focus of effort was on space heating in a municipal context, but early research suggested that as a general rule only through cascading with industrial uses will space heating be economical. Thus, we have utilized a liberal interpretation of district heating as including both residential and commercial space heating and industrial or agricultural processing.

We found that the basic tools to implement direct heat use of geothermal energy in the form of state and federal programs, such as guaranteed loans, drilling assistance, special tax incentives and tax exempt bond financing, were largely in place. What is needed, however, is the proper structuring of institutional relationships so that these tools or incentives can be best utilized. In addition, modifications in federal law covering tax exempt bonds, and in state and local bond authorities, as well as state public utilities regulation, would be required. Finally, the marketabililty of state and local revenue bonds would have to be improved through some form of guarantee, insurance or risk pooling. The organization responsible for this effort would also be able to provide the needed financial management and technical expertise to help the private and public sector package individual projects.

Our specific program proposals are based upon several conclusions, the most important of these are:

1. The exploration, testing, and development of initial production wells are relatively risky (and if successul, rewarding) operations. The distribution phase, once the resource has been developed, is not.

2. The use of federal programs and tax incentives is best suited for private developers. The Federal Geothermal Loan

Guarantee Program is not currently useful for tax exempt bond financed projects.

3. Local public agencies are not capable of taking risks; and, in fact, cannot currently assume the risk involved even in the least risky phase of distribution.

4. The objective of utilizing as many incentives as possible, and properly assigning risks and rewards, is realized by combining private sector development with tax exempt bond financing of distribution, structuring both phases so as to minimize public utility regulation.

5. Many potential users are not currently aware of all the possibilities and means of financing of direct heat geothermal energy and consequently cannot make intelligent decisions without some technical and financial management assistance. Until this assistance is brought to bear in a meaningful way, there will be a great gap between the level of economic and technical feasibility and the successful delivery of direct heat projects.

Our recommendations include the following:

1. Encourage private development backed by the User Coupled Confirmation Drilling Program and the Geothermal Loan Guarantee Program during the exploration and production stages. After the resource is proven, either public or private ownership and management is possible, depending on the public utility regulatory situation. Tax exempt bond financing through a variety of sources should be available at this stage. Bonds issued by the California Alternative Energy Finance Authority under AB 2324 or by local

governments under AB 74 (the California Industrial Development Financing Act) can be available to the private sector to reduce long-term capital costs through refinancing.

2. If public agency ownership and management of distribution is deemed advisable or necessary for particular projects:

   a. Federal law or regulations governing tax exempt bond financing should be changed to make it <u>more</u> applicable to cascading uses of direct heat geothermal energy.

   b. The authority of state and local agencies to issue revenue bonds for direct heat geothermal projects should be expanded by amending AB 2324 to allow the state to issue bonds for local government acquisition of direct heat projects and enacting legislation to allow creation of geothermal heating districts with authority to issue bonds.

   c. The absence of PUC jurisdiction over certain arrangements between the public and private sector should be clarified.

3. If private ownership of distribution is deemed advisable or necessary for particular projects:

   a. The federal law or regulations for tax exempt bond financing mentioned in 2(a) <u>supra</u> should be similarly changed.

   b. Any PUC rate regulation of small direct heat projects should be based only on the costs of conventional forms of energy, and not on the costs to the developer/distributor.

4. Since use of tax exempt bonds, either for private refinancing or public acquisition of projects once the exploration

and production stages are complete, means that under present federal policies, geothermal loan guarantee will no longer be applicable; and since general obligation bonds are not politically feasible, some assurance of repayment of the bonds other than project(s)' revenues must be available if the bonds are to be marketable. Such assurance could be obtained by three different actions:

a. Use the political power of the state to convince the U.S. Treasury to drop its opposition to guaranteeing tax exempt bonds.

b. Create a California Geothermal Financing Insurance Program. This agency could insure, for a fee, tax exempt bonds. A limited insurance program rather than loan guarantees is believed to be more practical at the state level because of the State Constitutional requirement that all guaranteed obligations be fully funded. The insurance program would require a minimum of $5 million of initial funding which could be repaid over the long term from fees collected. We believe this to be the most practical and politically feasible of the options open to the state.

c. Create a California Geothermal Finance Authority backed by the insurance concept as suggested above, but with the direct authority to issue bonds. This option is less politically feasible given the opposition to proliferation of state bonding authorities, and in many ways is not necessary given the passage of AB 2324 and AB 74, allowing state and local governments, respectively, to issue bonds for private energy projects.

5. Each of the three options mentioned above should include a management and technical assistance capability at the state level to provide local public entities and private users with the necessary sophistication to be willing and able to enter into agreements with private developers. The state entity should also have the mission and capacity to assist both developers and users in packaging a financing program, incorporating federal guarantees, tax incentives and bond financing. Given a market and with the existing federal incentives, there is developing a corps of private developers and equity investors. The bottleneck to project development is in creating such a market, i.e., finding a user, even when the economics are extremely favorable. The inertia of public and private entities, average cost pricing techniques, and the perceived newness of the industry all militate against rapid development even in the face of technical advances and improving economics. Management and technical assistance can, in some part, overcome these problems.

# I. INTRODUCTION

The harnessing of California's geothermal energy resources to produce electricity has been a reasonably successful enterprise. The outstanding dry steam resource field called the Geysers currently produces approximately 650 megawatts of power, enough to supply all the electricity requirements of a city of 500,000. By the end of this year, Pacific Gas and Electric anticipates a total of 900 megawatts from the Geysers. By the mid 1980's it is estimated that the total power produced in the Geysers will nearly double that figure. During that time another 600 megawatts of geothermally produced power could be added from other parts of the state, specifically the Imperial Valley. Although it has been a long haul (over 20 years) geothermal energy for electric power in California, at least in the Geysers is now a respectable business proposition, and there appears to be no major or unusual impediments to raising the necessary capital to finance their electric projects.

## A. Direct Heat Use of Geothermal Energy

There is, however, another key use of geothermal energy which is largely undeveloped in California. That is direct heat applications, whereby the heat content of the geothermal fluid is used either directly or through a heat exchanger for industrial processing or space conditioning (heating or cooling) or both in combination. Many reasons have been advanced for the lack of progress in direct use of geothermal energy in California. Some of these hindrances, such as the remoteness of the resource from population centers, and the mild climate of California cannot be affected by any general study, but can be overcome in a number of specific projects by creative land use and economic planning, such as engaging a series of end users, industrial, commercial and residential.

A major problem which direct heat geothermal development has, and which this study does address, is the inability of these direct heat projects to attract investors, and consequently to secure the capital to finance their completion. One of the reasons for this is quite simple, the financial community perceives the application of direct heat geothermal energy as a technology and an enterprise that is still in its infancy. Whether this perception is true or not is irrelevant; the fact that it exists is enough to stifle development. The market for private capital is extremely competitive, and proven investments win out every time over new ventures.

Another reason for this lack of progress is that potential users are ignorant or skeptical of the possibilities of direct heat geothermal energy. Thus the need for investors never even arises, and in this case the objective becomes one of education and financial and technical assistance for potential users, rather than a hunt for investors.

What is needed in both cases is a record of successes similar to that of electric generation before users will want and private capital will flow to direct heat geothermal projects. This is a clear case of "chicken and egg". Successful projects can't happen without financing, and financing apparently doesn't occur until there are successful projects. Given a 20 year period and an ample supply of visionary and intrepid entrepreneurs, there is little doubt that direct heat use of geothermal energy could achieve a record of success, enabling its projects to compete successfully in capital markets. However, current economic and political conditions regarding the price, source and continued availability of much of our energy supplies, make it imperative that development of domestic, renewable energy sources be stimulated with some immediacy.

This fact has been recognized by both state and federal governments. There exist many programs which provide for tax advantages, access to tax exempt bond financing, loan guarantees, and freedom from onerous state public utilities regulation for alternative energy development. (Many of these incentives, in fact, existed prior to the current promotion of alternative energy.)

However even with these incentives, direct heat use of geothermal energy in California has proceeded at a snail's pace. What progress there has been has largely occured because of government grants, which help to demonstrate the technology involved, but do not necessarily indicate commercial viability. Thus the California Department of Conservation desired an evaluation of the principal institutional options available for making large scale use of direct heat geothermal energy a reality in California. The emphasis of this study was to be for space heating in a municipal context, but cascading of space heating and industrial processing uses was not precluded.

Derek Hansen & Associates was awarded the contract for this study in April 1980. An early evaluation of the existing institutions which could develop geothermal district heating (A district heating system is..."one involving the transmission and the retail distribution of geothermally heated fluids from a central extraction source to multiple end-users within a more or less contiguous area..." with space conditioning being the predominant use.) indicated that no one existing institution, had the necessary combination of interest and ability to finance the exploration, production, and distribution phases of geothermal district heating. It also became clear that creating a new entity, such as a Geothermal Heating District, would not of itself solve the financing problems of an industry that is, as was mentioned before, viewed with some skepticism by the financial community.

What is needed is a blueprint for a series of institutional relationships between the public and private sector. These institutional relationships would be structured in such a way as to take maximum advantage of the private sector's capacity to take risks and to be rewarded for such ventures, and the public sector's ability to manage and possibly finance, at lower cost, the distribution of the resource. Maximum utilization of the ability of public (and certain private) entities to borrow at lower rates through tax exempt bond financing would be an essential part of the relationship, as would the capacity of a private business to use tax incentives. Superimposed on this structure would be federal guarantees for the riskier parts of the operation. Finally, any such relationship would have to be fashioned in such a manner as to avoid or at least minimize public utility regulation, which the consultants have found to be a major disincentive to private involvement in geothermal district heating. Simply stated the consultants have found that practically all the necessary elements for encouraging geothermal district heating are in place, but no one existing institution is either capable or inclined to take advantage of these incentives. Consequently Derek Hansen & Associates forsee some legislative and administrative changes which would be required to properly and effectively implement this scheme, but none represent either major policy changes, nor major expenditures of state money.

## B. Direct Heat Use and Electric Generation Compared

Since electric generation is the much more familiar and much more successful operation in California, it is important at the outset to detail the key differences in electric generation and direct heat use of geothermal energy. The temperatures required to generate electricity are quite high (at least $350^{\circ}$ Fahrenheit). Resources of this quality are not commonly found. The Geysers and the Imperial Valley are the only known fields in California. In order to reach a resource of this temperature very deep drilling is required. This makes exploration a very expensive process. In addition, except for certain proven areas in the Geysers, the chances of finding a viable resource are extremely risky. The field development necessary for production is also a costly proposition. Once the steam is recovered, however, the end product, electricity, is able to be transported over great distances to be consumed by an infinite variety of end uses.

The temperature required for direct heat use is not nearly as great ($100^{\circ}$ F for most space conditioning, $200^{\circ}$ F for most industrial processing). Resources of this quality are much more prevalent. They occur in 34 of California's 58 counties. There are often hot springs or other direct surface indications of where a particular resource is located. Frequently there will be some historic use of the resource. Low temperature resources are found much closer to the surface than are high temperature resources. All these factors mean that exploration for geothermal energy susceptible of direct heat use is much less risky and much less expensive than exploration for resources that can be used to generate electricity. Production and what little field may be necessary are also much less costly with a direct heat operation. However heat cannot be transmitted the distances that electricity can. This immobility of the resource requires that users be located in the immediate vicinity of the geothermal well(s). As geothermal resources of any type are not as a rule located near population centers in California, and as project economics seem to require a fairly constant use of the heat (a constancy not achieved by space heating requirements in California) efficient direct heat use will generally require the location of an industrial user in a relatively remote area.

Thus the key attributes of direct heat use of geothermal energy from a financing standpoint are the relative lack of risk in the exploration stage, and the relative inexpensiveness at all stages. This means that it is possible to use various federal loan guarantee programs at the exploration stage without either the risk or the tie-up of great sums of money that would be needed for electric projects. In more absolute terms there are some direct heat projects that can be financed for less than $1 million apiece and a great deal of projects can be financed for less than $10 million. As will be discussed later, this may have significant implications for tax exempt bond financing. Finally, if one looks at the very important public policy of demonstrating the economic and technical feasibility of a plentiful alternative energy source, and of spreading the risk involved, a little bit of money invested in direct heat can go a long way. It is not an exaggeration to say that 10 to 20 direct heat projects can be financed for the same amount of money as one electric project.

## II. ANALYSIS OF EXISTING PROJECTS

Once the key attributes of direct heat goethermal energy, from a financial insitutional perspective, have been identified, it becomes apparent that an analysis of some of the few direct heat projects which are in various stanges of development in the West could yield possitive and negative lessons for future development. Derek Hansen & Associates selected three projects, Boise, Idaho, Brady Hot Springs, Nevada and Susanville, California for evaluation.

### A. Boise

The Boise project, briefly described is a joint effort by the City of Boise and the Boise Warm Springs Water District to drill three new production wells, refurbish two existing wells, build two new transmission lines, and construct a disposal system for the spent geothermal fluid. The wells would be drilled into a new portion of a proven resource now owned by the city. The $140^{0}$ F to $170^{0}$ F water would be transported approximately 1.5 miles to downtown Boise. Once transported, it would be used to heat a majority of hospitals, state, county and city buildings in the area and would eventually be made available to other businesses and residences (74 commercial buildings and 310 single family homes). There would be no industrial processing associated with the project. The total fossil fuel replacement would be approximately 75,000 barrels of oil per year.

The Boise Warm Springs Water District has been successfully heating homes in the area from what all testing indicates is the same resource for over 90 years. While this is an expensive project (nearly $10 million as initially conceived, with the major expenditures being for the transmission and disposal systems), it is hard to imagine one with less risk. The Department of Energy has awarded the project a Program Opportunity Notice (PON) of $4,926,000 and The Economic Development Administration has funded another $500,000, both to be used essentially for the transportation system. The city, the heating district and the building owners have or will have contributed funds for such things as resource and environmental assessments, and the retro fitting of the heating systems of the existing buildings ($450,000 is the estimated cost of the latter). This left a $2.7 million shortfall. Early in 1980 the project scope was reduced and the short-fall decreased to $1.5 million, most of which would be needed for the wells and the pumphouses.

It would seem that a project of proven economic feasibility, with so little risk of resource failure (the project is basically an expansion in the use of a resource that has lasted for nearly 100 years with no sign of diminution) could easily secure the needed funds, even if there were not substantial federal grants involved.

However, the city and the district do not have the wherewithal to finance the remainder of the system out of existing revenues. Neither entity is willing to use either revenue bonds or general obligation bonds to finance this remainder. General obligation bonds, which are backed by the full faith and credit of the public entity, are viewed as an unacceptable political risk, even for such a "safe" project. Revenue bonds, which are tied solely to the success of the project are required by Idaho Law to be endorsed by a general election of the affected voters. The additional costs of the election (which, or course, is also required if general obligation bonds are to be sold), coupled with the uncertain marketability of bonds which are to be repaid solely out of revenues generated from a single "safe" but unconventional project have caused the city to reject this alternative. Use of the credit or bond rating of the Boise Warm Springs Water District was not favored by the district. This was because the district's primary function is to continue to supply its existing customers with low cost heating. This is in contrast to the city's interest in substituting low cost geothermal uses for existing fossil fuel uses. Pledging revenues, and thus jeopardizing existing low rates to its customers was not in the institutional interest of the Boise Warm Springs Water District.

Consequently the City of Boise entered into negotiations with a private financing source which was interested in developing a limited partnership program to finance the development. Under the proposed arrangement the city would lease the resource (which it already owns) to the private developer. This developer would then proceed to drill the wells, make the necessary hookups (at a cost of approximately $1.5 million), and then sell the delivered heat resource to the city as a customer. The investor/developer would be the owner of the project for a considerable number of years, and during that time would be seeking a necessary, substantial rate of return.

By August 10, 1980, Boise and the private developer still had not reached agreement, but seemed optimistic that they were within a few percentage points of a satisfactory conclusion. As tentatively planned, the developer would lease the resource from the city at a nominal price. Once producing, the project's resource would be sold back to the city at rates tied to the cost of natural gas. The rates paid by the city would at no time exceed 75% of the cost of natural gas and as gas went up in price, the ratios would change. The private investors are seeking at least a 15% return on their investment over the full life of the agreement, which will run from fifteen to fifty years. At the end of fifteen years, and each five years thereafter, the City of Boise has the option of buying the project from the private developers. The resource must, or course meet specifications set out in advance by the city or there will be no purchase. It must last for the life of the project. To provide for this "uncertainty" the developer has obtained reservoir insurance. Where the developer will secure the needed financing to go ahead with his part of the project, be it venture capital, loans from financial institutions, or a combination, is not known to us at this time. We are also unaware of whether the developer intends to utilize the Department of Energy's Geothermal Loan Guaranty Program (which will be discussed in detail at another point in this paper).

## B. Susanville

The City of Susanville, California, a community of 7,000 people located on the northeastern slope of the Sierra Nevadas, has embarked on an ambitious program to utilize its geothermal resources both as a means of low cost heating of existing public and private buildings and as a vehicle to attract industry to the area. The Susanville City Council and the Lassen County Board of Supervisors represent constituencies that have committed themselves to a degreee of energy independence for their area. With the aid of woodwaste from the local logging industry, they see geothermal energy as the key to that independence.

Currently there are three projects initiated in the Susanville area. Each project has progressed due to a major government grant. Susanville, through its representative in Congress, Biz Johnson, has been quite adept in securing assistance from a plethora of government agencies, many of which are not often associated in the public's minds with geothermal energy. A fourth project is being planned and it too may be able to take advantage of a government grant.

The first project will be to heat public buildings in the central section of the town. The chief source of funding is a PON from the Department of Energy. However the city hopes to avail itself of State of California funds under AB 900, which allows borrowing for energy improvement for schools and hospitals to be paid back out of energy savings.

The Park of Commerce South project will provide 150$^{o}$ F water to approximately 120 homes and then to a planned greenhouse area. The City has applied for a $300,000 HUD grant, a Community Development Block Grant under a innovative energy system program that was designed with Susanville in mind. The Farmers Home Administration has committed $100,000 for a pipeline to the greenhouses, under its Industrial Development program.

The Park of Commerce East project envisions a complex of animal raising, grain and ethanol production. The complex will use water after it has heated the public buildings (cascading). However the temperature of this water will need to be raised again since it will have lost heat. This apparently will be done by the methanol produced. Another potential project is the drilling of production wells in the area near the state prison at Litchfield. After heating the prison, the geothermal water would be cascaded to more greenhouse and agricultural operations which the City hopes will locate nearby. The City anticipates using Farmer's Home Administration funding, and/or the Department of Energy User Coupled Confirmation Drilling Program for direct heat usage, which will be discussed later in this paper. This resource, as were nearly all the resources for the projects discussed above, was identified and tested by a special Bureau of Reclamation project, once again designed specifically for Susanville.

There is much to be learned from the Susanville experience. Susanville has planned its geothermal development to include both space heating and industrial (actually agricultural) processing. Aside from greatly increasing the economic efficiencies of the operation (and there are many who believe that direct heat can be economic only if there is at least one large scale, constant user), the new industry it would attract would greatly allieviate the area's unemployment problem which is largely the result of being a one industry (timber) region. Susanville's ability at grantsmanship is certainly worth study by other communities who wish to develop their geothermal resource.

However no community can reasonably hope to duplicate Susanville's success at utilizing the political process to obtain government grants. And even Susanville is at the point where it will need private capital if it is to proceed further.

The problems Susanville will have in this area will be similar to the problems Boise is experiencing, compounded by the fact that Susanville is a much smaller community, with much less flexibility in its budget and much less credibility in the bond market. Susanville is a general law city, and as such its legal ability to borrow money at lower interest rates by issuing revenue bonds for all phases of geothermal development is questionable at least. Under the California Constitution it clearly cannot issue a general obligation bond, i.e., one secured by the taxing power of the city, for any purpose without voter approval in an election, an expensive and often futile exercise in California in the aftermath of Proposition 13 (Jarvis-Gann). The legal impediment regarding the issuance could be circumvented by a joint venture with an entity which has such authority. (Susanville has explored the possibility of a joint venture with the Lassen-Modoc Flood Control District for the purpose of using a bond issue to finance geothermal and biomass power projection.)

However, these legal problems are insignificant next to the actual difficulty: on one hand the inability to market the bonds whose sole security is one project in a technology which investors view with suspicion, i.e., direct heat geothermal energy; and on the other hand the perceived unwillingness of the electorate (and consequently the political leadership) to risk the full faith and credit of the city on the success of a direct heat project through a more marketable general obligation bond.

Thus, Susanville appears to be forced into a solution similar to that of Boise. This would entail a joint venture with a private developer. The city would most likely lose some control over management of the resource and rate setting and would have to pay a rate of return to the developer similar to that paid by Boise (15%). This rate is considerably higher than that which could be obtained on the tax exempt bond market.

## C. Brady Hot Springs

The Brady Hot Springs project, located in the heart of the western Nevada desert, is a commercial processing plant which uses geothermal heat to dry vegetables, principally onions. Geothermal Food Processors, Inc. took over and secured refinancing for an existing project that had received a Department of Energy grant, but was in trouble financially. The refinancing was done through the aid of a DOE geothermal guarantee for \$3.5 million (out of a \$4.8 million total capital cost). The resource is one of extremely high quality (over $250^{\circ}$ F), and Geothermal Food Processors, Inc. has a contract with a major onion producer to dry a significant portion of the grower's output. At the present time the project is operating successfully from an economic and technological standpoint.

The Brady project demonstrates that it is possible to make an industrial processing plant work, despite a remote location (the nearest small towns are 20 and 50 miles away), and despite a history of previous economic difficulties. The prime mover behind the development, Mr. Paul Rodzianko, was able to utilize many of the federal tax advantages, discussed later in this paper, as an inducement to investors, as well as secure commercial loans backed by a DOE geothermal guarantee. This, coupled with a secure contract guaranteeing a market for the plant's services enabled the project to commence operations, provide a needed service for its users, and make money for its investors.

## D. Conclusions

All three of the projects discussed above have one element in common; a resource the extent and duration of which has been largely confirmed. All three have had historic uses: Boise having had over 90 years of extensive use; Susanville and Brady Hot Springs more recent and less extensive use. All three have been able to obtain some Federal grant assistance in drilling wells to test and confirm their reservoirs. Other projects may not be as fortunate, as grant money is limited, and thus will have to use means other than outright grants to see themselves through the exploration phase, the most uncertain aspect of direct heat geothermal development.

Once the resource was proven, Brady Hot Springs was able to secure the needed capital for development; Boise appears to be on the verge of doing so. Susanville has not yet reached that point. All have or will need to raise the money through private sources (investors, sale and lease back arrangements, or commercial loans), rather than through cheaper tax exempt bond financing. In order for Boise to obtain the needed capital for development, the City must give up some control over the resource it currently owns. The only commercial loan (Brady) is supported by a DOE geothermal loan guarantee. The Brady experience convinced the consultants of the importance of this tool, along with utilization of tax advantages available to the private sector, in an overall geothermal financing scheme.

At any rate the cascading of industrial and space heating uses, such as is planned by Susanville still provides the most economical utilization of direct heat geothermal energy. Many rural communities are plagued with the single industry blues (e.g., timber, tourism) and the accompanying chronic and seasonal unemployment. The addition of an industrial/agricultural processing plant which would utilize the cheap process heat provided by low temperature geothermal wells would greatly stimulate and diversify the economy of such a rural community. These same communities are also beset with increased heating costs for their public facilities, schools, hospitals, etc., and the private residences of their citizens.

Given the need of many communities in the rural areas where the resources are for cheap heating and an economic boost, and the need of many industries such as vegetable processing, greenhouses, animal husbandry, and fuel alcohols manufacturing, for cheap process heat, utilization of direct heat geothermal energy in the areas where is is found seems to be a natural. Other factors such as land availability and prices, minimal disruption to and relocation of existing infrastructure, zoning regulations, community attitudes, and nearness to raw materials make it desirable for such plants to locate in rural rather than urban areas. There also appears to be a developing demographic trend toward people moving to small communities. Thus a newly located plant could be assured of a work force, and in-migrants would more easily find employment. All these factors indicated that what now seems to be an unfortunate circumstance, the location of low temperature geothermal resources away from population centers could, in fact, be an advantage and that the Brady Hot Springs and Susanville experiences will not be isolated examples.

Another point worth noting in the analysis of these projects is the necessity of securing a specific, dependable market for the geothermal energy. No private developer, or even a government agency that is thinking clearly will undertake the risk involved in exploring for a geothermal resource, if there is no assurance that once the resource is found, it will be utilized, hence bought. On the other hand no user is his right mind can agree to depend upon and pay for a resource which is unreliable and unsuitable for his needs. The answer in Boise's case is a contract whereby the developer agrees to deliver a resource of a certain quality (temperature, pressure, chemical composition) for the uses involved and duration (as measured by certain agreed upon indicia of reservoir size and ability to recharge). If the specified resource is not delivered, the city pays nothing. The city, in turn, must take an amount which will allow the developer to recover his costs, plus a profit.

In the Brady project, where apparently the user has another means of drying his onions, the contract is simpler: the developer will dry all the onions the user can supply. Those that he can't dry, he won't be paid for. He bears the risk of the failure of his resource or plant, as well as the unlikely possibility of a crop failure, but the onion producer must at least offer him all the onions he can produce. There are many other forms of contracts between the developer and the user which can be written (unless, of course, the developer and user are one in which case the realtionship is understood), but all must apportion risks and supply a market.

In summary, after analyzing these three projects, and becoming familiar with several other projects, several major points come clear:

- There is a demand for direct heat geothermal energy both for process heat and for space heating.

- The most economically feasible way of utilizing this direct heat is through a combination or cascading of these uses.

. If structured in this matter the immobility and somewhat remote locations of the resources would not be the stumbling blocks to utilization that are often perceived.

. Direct heat geothermal development can, for financing purposes, be divided into three stages: (1) exploration and testing; (2) production; and (3) distribution. These stages are characterized by varying stages of risk, by far the most speculative being exploration and testing, the safest being distribution.

. Thus, most of the risks in the exploration and testing stage have been absorbed by the Federal Government through grant programs which are by their very nature limited. If geothermal development for direct heat use is to stand on its own two feet, a way must be devised to make private involvement at this stage feasible. (Local government involvement in this phase is inappropriate as it is far too risky, as will be seen in the discussion of the distribution phase.)

. There exist incentives which would enable the private sector to enter the exploration and development phase. These incentives both spread the risk (the DOE User Coupled Drilling Program and the Geothermal Loan Guarantee Program) and provide tax benefits to investors (the investment tax credits, depletion allowances, and current expensing of intangible drilling costs).

. Regardless of these incentives private developers and entrepreneurs will not spend money exploring and testing unless they can be assured of suitable recompense for the risk taking should they be successful. This means they require: (1) a certain market and (2) a reasonably rapid and unregulated return on investment.

- Involvement of local governments is most appropriate at the distribution stage.

- Even though this is the most risk free phase of direct heat geothermal development, local governments have had a difficult time financing distribution. What success there has been involved the surrender of the resource and an expensive long term pay back.

- The reason for this lack of success is that local public entities are not the proper institutions to take <u>any</u> risk, regardless of how small on the relative scale. Their means of raising money through locally generated revenues and even their ability to spend it are severely limited in California by Propositions 13 and 4. Their ability to borrow money based on their own full faith and credit (general obligation bonds) is almost totally curtailed by Constitutional debt limitations and requirements for voter approval, which is all but impossible under the current political climate.

- There is a less risky form of borrowing money through revenue bonds, which are secured solely by project revenues. These bonds transfer the risk, in effect to the bond holders.

- However the very fact that revenue bonds transfer this risk to the bond holders, makes them difficult if not impossible to market, without some form of guarantee or at least where the security is greater than one project. In spite of all this, once the resource has been proven, it may be possible for public and, with the recent passage of new legislation, interested private entities to borrow money at low, tax exempt bond rates and market those bonds, without pledging the full faith and credit of small local governments, and without making investors bet on the outcome of a single project.

# III. FASHIONING A BLUEPRINT FOR DIRECT HEAT GEOTHERMAL DEVELOPMENT

## A. Exploration and Production

### 1. Marketing Contact

The initial step in utilization of low heat geothermal energy is finding some indication that there is a viable resource. The U.S. Geological Survey, supplemented in California by the Department of Conservation, has charted the major areas where there are signs of geothermal reservoirs. However a designation on a resource map is not a sufficient basis on which to begin the process of producing usable geothermal energy. As discussed earlier, the first need is a contract that if a usable resource of sufficient longevity is produced, it will be bought. The temperature, chemical composition and pressure required are ascertainable. Objective indications of longevity are another matter. While there is a large body of opinion that given reasonable use and rates of recharge, a typical geothermal reservoir is infinite in duration, this opinion is not universal. The ability to contractually agree to certain objective indicia of longevity may be a function of the conservativeness of the potential user. A possible means of resolving this problem would be as in the Boise situation, the purchase of reservoir insurance (which party should buy it would be a part of the contract negotiations).

### 2. User Coupled Confirmation Drilling Program

Once a market has been assured, the developer must begin the process of exploration. This involves specific site drill selection, drilling, temperature and flow measurement and logging to determine the extent and consequently the productivity and longevity of the reservoir. This is a difficult task, particularly for the small developer who is the typical direct heat promoter. The developer must drill a well to the successful depth at the proper point on the ground. He must then measure temperature and flow rate and analyze the productivity and longevity of the resource by a complicated series of techniques. This is known as reservoir confirmation. The current state of the art of discovery and drilling procedures make successful completion of this phase the most risky element of direct heat geothermal development. A single unproductive well could mean financial ruin for a small developer.

The U.S. Department of Energy, wishing to stimulate the industry to a point where it will be later able to function its own, and anxious to expand the body of knowledge involved in locating low temperature geothermal resources, has devised a means of spreading the risks encompassed in reservoir confirmation. The User Coupled Confirmation Drilling Program is a cost sharing system whereby the DOE absorbs some of the front end costs for drill site selection, flow testing, reservoir engineering, and reinjection well drilling, if required. The percentage of costs which the DOE will pick up will depend on the utility of the resource produced. A totally successful well will bring a 20% cost sharing; a total failure 80%. Thus a developer would be at risk for only 20% of the costs in the event of a dry hole. The DOE expects that this program will function as a loan guarantee, with the developer securing private financing backed by the User Coupled Confirmation Drilling Program. In fact, one of the subsidiary goals of the program is to develop relationships between venture capitalists, bankers and developers that will be useful after the program is ended. This is the rationale for not providing the money directly up front and for not underwriting the entire costs.

In order to take advantage of this cost sharing, a developer must show that there is an end user of the resource, that the user or developer has or can obtain rights to the resource and that if the cost sharing takes place financing can be obtained. He must also demonstrate geologic evidence that a reservoir exists at the proposed site. This can be in the form of documentation of known thermal springs or wells or thermal spring deposits.

When the final testing is completed, the degree of cost sharing will be computed based upon a previously agreed upon formula. Certainly the key element in deciding whether a well is a total success is how the quality and longevity of the resource measure up to the standards in the developer's contract with the user. DOE's first solicitation under this program took place in late May, 1980, and the first awards were scheduled for September, 1980.

### 3. Geothermal Loan Guarantee Program

Let us now suppose that the developer has drilled a successful test well. Under the User Coupled Confirmation Drilling Program he receives 20% of his costs from the federal government, but probably has a loan outstanding which must be repaid. He must also secure the financing necessary to get the well(s) producing and the resource delivered. This is the point where he could avail himself of the Geothermal Loan Guarantee Program (GLGP) also sponsored by the Department of Energy.

The GLGP is a $350 million program to guarantee private loans for all phases of geothermal development, both electric and direct heat (unlike the user coupled program which is limited to direct heat explorations). Under the GLGP the Department of Energy will guarantee up to 100% of a loan for up to 75% of the developers costs. The developer or his limited partners must provide 25% equity, but this can include previous costs (i.e., initial exploration costs including that portion cost shared under the User Coupled Program).

The program was designed to accelerate the development of geothermal energy by minimizing the lenders' risks; to encourage new entrants into the geothermal market, and to establish a relationship between private capital and geothermal developers that will be in place after the program is ended (1984). The loan guarantees can be made for a variety of purposes, to include acquisition of the rights to the resource, and production and transmission of the resource. Loans for end use facilities can also be guaranteed under this program, but for the purposes of this discussion production and initial distribution will be emphasized. There are limits to the amount of loans which can be guaranteed ($50 million for a single direct use project), as well as the amount of guaranteed loans which will be allowed a single developer. Because of the relatively lower costs of direct heat uses, these limits have no real bearing on these uses.

Before making a guarantee the DOE will look at the viability of the resource, the engineering involved, the economics of the project, including marketing, capitalization and management of the project, as well as any environmental or legal problems the project might have. These review criteria and the types of activities which can receive loan guarantees give an excellent indication of how well the GLGP and the User Coupled Program, discussed above, can be made to dovetail to minimize the liability and unnecessary expenditures of all concerned as well as speed up the process of financing direct heat projects.

4. Tandem Use of GLGP and User Coupled Program

The developer who has a certified successful test well under the User Coupled Program (and has paid for that designation in terms of an 80% cost share) should be able to use that certification to convince the same Department of Energy that such a success makes the further development of the project an excellent risk for a loan guarantee. The "certification" basically states that the developer has convinced the government that his resource is suitable for the use intended, as measured by the contract with the user. This removes a major uncertainty in geothermal development. In addition, before qualifying for the User Coupled Program, he had to show evidence of a contract with a user and ability to get financing for the project. Thus about all that is left under the GLGP evaluation is a check of the production and distribution engineering, and possible legal and environmental problems (the economics are presumably there or financing could not have been arranged in the first place). The developer is now in a favorable position to secure venture capital, a private loan and a federal loan guarantee under the GLGP. Since most of the criteria required by the GLGP have been met in the course of the User Coupled Program, the

Department of Energy's normal objective of six months processing time for a loan guarantee should be reduced.

This logical juncture of these two programs, a stated objective of DOE, also allows the developer to limit his front end investment until he is at a point where he is confident of quality and longevity of the geothermal reservoir. For instance, he need not acquire the resource (only options) until he has demonstrated its utility under the User Coupled Program. Then he can use a loan guarantee to assist in the actual purchase of the resource. He only has to finance up front, assisted by the User Coupled Confirmation Drilling Program, the drilling and testing required to prove the resource. Once this is done and he has a certified success in terms of a resource, he then can use the GLGP for further development, to include production and distribution.

This two step procedure, made possible by the introduction of the User Coupled Program this year, also limits the government's liability, in that it is on the line for only some of the initial costs for reservoir confirmation. If the reservoir is not adequate under the User Coupled Program, the government will not put good money after bad through the GLGP. The DOE did not have this option when all it had was the GLGP. Consequently exploration programs because of their inherent risks were not good candidates for loan guarantees. And in fact the recent policy of the DOE has been not to guarantee any loans for the more expensive and risky electric exploration projects. With another program to assume small scale risks, and the consequent ability to then apply the GLGP, the likelihood of guaranteeing entire direct heat projects has been greatly increased.

There are still some problems with using the GLGP. A 1% up front service charge makes it difficult for small public entities to utilize the program. Because of U.S. Treasury regulations the GLGP cannot be used to guarantee tax exempt financing. While there is a capability to use normal, non tax exempt rates, and then get interest differential payments from the program to make up that difference, as was done recently by the Northern

California Power Agency in an electric project, this direct payment cannot be used extensively as it would deplete the required reserve in the GLGP fund. Another difficulty is that larger companies cannot avail themselves to the GLGP because their credit rating could not stand a default. They can, however, use Interim Risk Assuming Companies (IRAC) to absorb any default. There are also many smaller developers who won't have this problem. In addition the processing time for a loan guarantee has discouraged many potential users. Finally the limited funds and duration of the program requires that potential applicants secure committments at the earliest possible time, time which may not allow for development of all potential projects. The processing time problem, as mentioned earlier, could be cured, at least for direct heat projects, through a system of dual processing of the User Coupled and GLGP application. The service charge and tax exempt financing difficulties can be alleviated by selecting the proper mix of institutions to be responsible for the various phases of the project and will be discussed later is this paper.

## 5. Tax Advantages Available to the Private Geothermal Developer

Even if the initial phases of geothermal development presented less risk than is currently apparent, we would still recommend private involvement at these earlier states, mainly because of the federal tax advantages such development encompasses. These advantages, of course, are only available to an entity which has a tax liability, and thus development by a public entity could in a sense "waste" these tax advantages. A brief review of these major tax advantages is now in order.

### a. Intangible Drilling Costs

Intangible drilling costs are those costs which are indirectly related to, but necessary for, a drilling operation. These costs include such expenses as site preparation, access road, construction, and drilling overhead; they exclude tangible costs such as pipes and fittings. Obviously, these costs represent a substantial portion of total drilling costs for many geothermal projects.

Tax law allows (but does not require) these intangible costs to be treated as current expenses, and to be expensed at the time they are incurred, so the tax benefits are fully realized immediately. For taxpayers in high brackets, out of pocket costs can be immediately reduced by as much as 70%.

As will be discussed infra., a sale of the resource and plant will generally be in the interest of the developer, both in terms of realizing a quick profit, enabling him to go on to another venture, and also to avoid public utilities regulation. Thus we must look at the tax implications of a sale. If the developer of the property on which the drilling is done decides to sell the property within ten years of date of purchase, in order to realize his gain, some of this tax advantage is lost. If the property is sold at a gain within ten years, then some of the gain will be taxable as earned income. The amount of the gain that will be subject to ordinary income tax rates is equivalent to the difference between the sum of the intangible drilling costs that were actually expensed, and the sum of the depreciation benefits that would have been realized by the developer if these intangible drilling costs had been treated as assets, and amortized on a straight line basis over ten years.

This loss of tax benefits, which has the effect of penalizing a sale, acts as a disincentive to the sale of the property, but might not be decisive in a developer's decision to sell. This is true for two major reasons. First, the developer will have benefitted from the current expensing provision during the period that he owned the property, and the value of those benefits offset the tax disadvantage of an early sale. Second, a sufficiently attractive sales price will render insignificant the net tax benefit loss.

b. Investment Tax Credit

There are several other tax implications, including depreciation, investment tax credits, and residential energy tax credits. Depreciation will generally be unaffected by the sale of the property. If the new owner is a public entity, there is no need for tax reducing depreciation. If the new owner is private, he may deduct against the value paid for depreciable assets which may in fact be higher than the original cost and thus more useful to the new owner.

The investment tax credit, useful to reduce the front-end costs of tangible drilling costs that can be depreciated (such as pipes and pumps), is exceptionally attractive in geothermal development. Essentially, those costs which are not expensed immediately but that have a depreciable life are eligible for the investment tax credit. Since the passage of the Energy Security Act, investment tax credits total 25% of the cost of the depreciable assets. The basic rule for an investment tax credit is that the maximum credit is available to assets with a depreciable life of at least seven years (real property is not eligible) and a sale of the asset in less than seven years would involve a recapture of that portion of the credit which is not yet used up.

Developers at Brady Hot Springs and tax consultants from a variety of sources, believe that the use of the federal loan guarantees will not reduce access to utilization of the investment tax credit, even though the investment tax credit rules require that all of the money included in the investment tax credit calculation be considered "at risk". Although the use of the federal geothermal loan guarantee program might effectively eliminate the risk on 75% of the investment. Investors are betting that since the developer must default on the loan for it to be guaranteed, it is effectively "at risk". Thus, depending on how a project is designed, a large percentage of the total investment may be subject to the investment tax credit. For example, if a project totaled $1 million and the developers received a loan guarantee for 75% of the total, equity required would be $250,000. If 80% of the project, or $800,000 were eligible for the full 25% investment tax credit, the credit would be worth $200,000, effectively reducing tax liabilities to the investors by $200,000, leaving a real after tax investment of $50,000. This amount would be reduced even further by intangible drilling cost deductions, depreciation and depletion. Investment tax credits are in no way related to the capacity to depreciate assets as well. Even if $200,000 is taken as an investment tax credit, the full $800,000 of depreciable capital assets that make up the investment tax credit eligible pool, can then be depreciated at the normal rates. Given all of this, it is understandable why there is likely to be no shortage of investors in geothermal projects. The bottleneck is in finding the projects themselves.

The recapture costs are substantial, since the recapture tax is payable regardless of other tax benefits that taxpayers may enjoy. A seven year or longer asset, that is sold within three years, means a recapture of all of the investment tax credit; in three to five years, a recapture of two-thirds of the investment tax credit; and five to seven years, a recapture of one-third of the investment tax credit. In the interim, the investment tax credit is effectively a "loan" from the government, and if there is no sale, the loan is forgiven. Whatever profit is achieved over and above the amount covered by the investment tax recapture and the depletion recapture would generally be taxed at capital gains rates. While a straight sale may endanger the entire investment tax credit because of the requirement that the equipment be used in the "trade or business" of the taxpayer, a properly structured "option" contract should avoid any real difficulty.

C. Depletion Allowance

In many cases, the most attractive geothermal development format will involve leasing the resource from a public or private entity rather than owning the resource. In such cases, depletion would go to the owner of the resource, not the developer, and in cases where the owner is a public body, depletion would be meaningless. There are presently two methods of calculating depletion allowances. Cost depletion allows the taxpayer to deduct from his cost in the property. This will reduce current income, but may eventually be partially recaptured in capital gains taxes by reducing the cost basis of the property. Percentage depletion is a legally allowed depletion that can exceed the property cost. In the case of geothermal resources, percentage depletion allowed in 1980 is 22% of gross income and falls 2% a year to 15% by 1982, but in no case can the depletion allowance exceed 50% of net income.

The importance of depletion allowance depends in large part on what the "profit" is in the sale of the heat resource itself and who owns that resource and benefits from the depletion. Since depletion is a unique tax concept that allows a deduction for less of value in an asset but does not require that there ever had been registered income for the creation of value of the asset, it is a tax benefit that can effectively manufacture profit. On the other hand, the allowance being limited to 50% of net income means that the full benefit can only be realized by projects that already have good income value.

In addition to these tax benefits available to the developer, residential energy credits are also available to persons who pay for installing geothermal heating systems in their places of residence. The credit is equal to 30% of the first $2,000 and 20% of the amount between $2,000 and $10,000 up to a maximum of $2,200.

## 6. Venture Capital and Traditional Loans

Up to this point we have treated the incentives available to the private sector in the form of tax incentives and loan guarantees. These incentives, however, require some equity or venture capital, and presume the existence of loans from the financial community which can be the subject of the guarantees.

The favorable tax treatment afforded geothermal development, as leveraged by the GLGP (see above) seems to indicate that if users are found, venture capital will be available. Private loans, however, seem to be another matter. As amazing as it might seem, most of the larger California banks have expressed no interest in making geothermal loans to smaller direct heat projects, even with a 100% DOE guarantee. Fortunately, one bank, Bank of Montreal (California) is likely to be interested in any reasonable project. The problem for larger banks is the tendency to centralize processing of only their larger loan requests. Some major California banks such as Bank of America and United California Bank have a sophisticated capacity to deal with DOE guaranteed loans to larger geothermal electric projects but not to small projects of a direct heat nature. This they tend to leave to a local branch bank, and the local branch banker, not being familiar with either the government guarantee program or geothermal development, is unwilling to take the time to make an intelligent loan decision. A problem peculiar to loans for direct heat geothermal use is that banks must become familiar with the technology of direct heat geothermal energy and the economics of the industry that utilizes it. Aside from being an additional effort, the combination of a "new" technology and an off-beat industry such as catfish raising, may be too much for a banker who already has a desk full of traditional loan applications. Even with a 100% guarantee, banks rightfully feel that they cannot and should not make a loan that they do not understand reasonably well. If the bank proves to be too unconcerned about the success of the venture, it is at least theoretically possible for the federal government to refuse payment of the guarantee. In reality, the federal government will only do this reluctantly since such a refusal tends to create paranoia and panic in an already conservative banking industry.

## 7. Business and Industrial Development Corporations (BIDCOs)

However, despite a certain sluggishness in traditional money lending circles, there does exist in California (and not in any other states at this time) an important tool for financial assistance to private geothermal developers. California has created a unique set of financial institutions, licensed and regulated by the California State Banking Department and capable of providing a variety of debt and equity financing alternatives for private geothermal developers. BIDCOs may be publicly or privately owned and financed and may fund partnerships, proprietorships, corporations and cooperatives with debt or equity financing. Depending on sponsorship and the objectives of the various sponsors, BIDCOs can and will be available for certain types of financing for geothermal development. A key aspect of a BIDCO for the purposes of direct heat geothermal financing is the ability of a BIDCO to sell and use the leverage of the portion of the loan that is guaranteed by the federal government.

To give an example of the potential impact of a BIDCO, consider the following. Either through direct state funding, or through profits derived from the insurance fees on early geothermal projects, the state could fund a Geothermal BIDCO. If funded for $2 million, for example, the BIDCO could make $2 million in financing available for 100% of a project cost, with 75% guaranteed by the federal government. The guaranteed portion can be sold in money markets to raise additional funds and the process repeated. Eventually the $2 million would support $8 million in total financing. If some of the 25% exposure were to come from local sources, the total amount of leverage could be even greater. In fact, if loans were only made to cover the part that is 100% guaranteed, the potential leverage is infinite! The BIDCO as a source of high risk debt will also depend on how aggressive the federal government wishes to be, since the federal government accepts the guaranteed losses.

Unlike banks, BIDCOs may also become equity investors in geothermal projects. While it is unlikely (although not completely certain) that BIDCOs can be an equity investor as well as a guaranteed lender in the same project or business, it may be a possibility in the future. Nevertheless, BIDCOs provide the potential to be involved in geothermal development from a variety of financial perspectives and as the industry develops any momentum, it is highly likely that BIDCOs will become an active source of financial support on a statewide basis.

Given the fact that BIDCOs exist and have stated their interest in geothermal loans, the need to concern ourselves with the bank reluctance to deal with guaranteed small loans is not sufficient to warrant any action recommendations. For future reference, the activities of the California Pollution Control Finance Authority provide an excellent example of how to deal with lenders who want to focus only on larger projects, and could be suggested to the federal government if the program needs more small scale projects in the future than can be generated by the banking industry. The Pollution Control Finance Authority essentially required investment bankers to bring a certain number of smaller projects, or share their profit on larger projects with those who do develop small projects.

A longer term recommendation might be the consideration of a BIDCO sponsored by the State of California to support more aggressive geothermal development by seeking out and making loans to projects not quite capable of attracting private financial support. This would only be necessary if the state desired to fund more experimental projects. Regular projects should find sufficient debt financing from privately sponsored BIDCOs and eventually banks, and equity financing through limited partnerships especially in view of the tax advantages. In most cases, the state sponsored BIDCO could only proceed if the federal government were willing to provide a guarantee to cover a substantial part of the cost (and risk) involved in the project.

## B. Distribution

We have now reached the point where the developer, using a combination of venture capital, private loans, and federal loan guarantees, has a confirmed reservoir and a producing well(s). He also has a contract with a user or group of users to deliver the resource. The uncertain, high risk parts of the operation have been completed, and all that remains is the delivery of the resource in compliance with the terms of the contract.

### 1. Distribution by a Public Entity

One of the key questions is with what institution the developer has contracted to distribute the resource. We have selected for detailed analysis the methods of financing a purchase of the geothermal resource and plant by a public entity. It is clear that purchase of the resource and plant are not the only means of marketing and distributing the resource. It is also true that a public entity is not the only possible, or even likely distributor. In fact, due to recent changes in California law (AB 2324 and AB 74) it may well be that under the present state of the law private entities under public (state or local government) aegis may have better access to tax exempt bond financing (a key element in the financing scheme we have developed, which will be discussed infra.) than do many existing local public institutions. Keeping this in mind there are nonetheless many valid reasons to support public sector involvement at this less risky stage of geothermal development, and hence, to use public sector purchase as a starting point or model.

Perhaps the most compelling reason is that a public entity may be the only institution that is willing to distribute the resource where there will be a district heating system, as opposed to a strict industrial processing operation. Private resource developers are not interested in becomming public utilities, susceptible to rate regulation by the California Public Utilities Commission. Under the existing law this would be the case (a full discussion of the law and its implications will follow). Even if the law were changed, the actual business of being a distributor, an unregulated utility, is not an enterprise with which the typical resource developer is comfortable. A resource developer (and his limited partners) like to be in and out of an operation in a relatively short time, so that the money invested can be turned around and put into another project. Conversely, if there is a loss, he wants it up front and out of the way, taking whatever tax write-offs he can. He is not interested waiting for a 20-30 year pay back that will result from his running a business operation with which he is unfamiliar.

Existing investor owned gas and electric utilities would seem, at first blush, likely institutions to distribute low temperature geothermal resources, and indeed, a large majority of those recently polled in California by the Earl Warren Institute, answered "yes" to the question "Would you consider becoming a distributor of geothermal energy for direct uses if a suitable resource is developed near a populated section of your service area and hot water is offered to you for resale by an independent resource producer?"

However, this result is somewhat misleading. The question phrased in terms of "would you consider?", requires no real verbal commitment, and even to this non committal question, the largest utility in California, PG&E, responded in the negative. Further, when asked "If geothermal direct uses become developed in your region, do you expect that existing gas and electric utilities will play a major role?", three of the four major California utilities responded "no" and the fourth "maybe". Further insight to the seemingly positive reply to the first question can be seen from the fact that the utilities expressed an overwhelming preference for serving large industrial users rather than becoming involved in district heating. The reasons given were on grounds of engineering and economic efficiency and possible avoidance of PUC regulation. This view seems to put the major utilities in the same category as resource developers. The reluctance of these utilities to distribute geothermal district heating is understandable. By its very nature district heating is a small scale operation. Committing resources and hiring or training a corps of personnel for such a small potatoes operation as direct heat geothermal district heating probably does not make too much economic sense at the present time.

The Earl Warren poll arrived at similar though less conclusive results, from which these consultants, draw similar through less confident conclusions regarding the likelihood of involvement of smaller investor owned utilities and (even existing publically owned utilities) in direct heat geothermal district heating. This is not to state that an investor owned utility is an inappropriate entity to deliver direct heat geothermal energy (in fact their experience with gas delivery systems and involvement in high temperature geothermal energy makes them very suitable entities) nor that there are not such utilities who will be interested (such as Northwest Natural Gas Company in Oregon). All that we say is that private utilities are not stampeding to distribute direct heat geothermal energy.

Even if resource development companies or privately owned utilities were interested in distributing direct heat geothermal energy, there are other reasons to consider local public entities as appropriate institutions for this role. Public agencies, as will be discussed later, are clearly exempt from PUC regulations. They are also able, assuming equal efficiencies, to deliver heat at cheaper rates since a profit is not required and taxes are not paid. Often the local jurisdication has been actively involved in trying to make direct heat geothermal energy a reality at a very early stage and consequently would be the most experienced institution to manage and deliver the resource. In addition, a public entity that has been involved from the beginning is often the most capable insitution to deal with other government agencies, either those bearing gifts in the form of grants, or those adding burdens such as environmental and other regulations. Finally, where geothermal energy is being used as a tool for local economic and employment development, a local jurisdiction is certainly the most logical distributor.

## 2. Financing Distribution By a Public Entity - Tax Exempt Bond Financing

As discussed in the preceeding section, it is in the typical developer's interest to divest himself of the geothermal plant within a reasonable time of its attaining production capability and to allow another institution to distribute the resource (subject, of course, to the tax considerations involving sale, discussed supra.). If it can raise the money, it is also in the interest of the distributor to acquire ownership and control of the resource and plant at once, and thus avoid a long term payout and consequent high mark up, such as in the Boise situation. Since this is the stage where most of the risk is gone from the project, this is the point where a public agency (and now in California, a private enterprise under public sponsorship, see the discussion of AB 2324 and AB 74, infra.) should consider the use of tax exempt bond financing to come up with the purchase price of the system, and at a significantly lower cost. The advantage of tax exempt bonds is that since the interest paid is not includable in the holder's (lender's) gross (taxable) income, the borrower can borrow at cheaper rates.

a. General Obligation Bonds

Tax exempt bonds basically fall into two categories: general obligation bonds, which are backed by the full faith and credit of the issuing entity and revenue bonds whose only source of pay back is the income from the enterprise funded by the bond. General obligation bonds are very attractive to the investors because they can be assured repayment from the tax revenues of the political entity, city, county or state, which issues the bonds regardless of how well the bond is used, or how successful is the enterpirse it funds. On a state level, in California general obligation bonds have historically been used to fund veterans housing and some of the state's water projects. However, as attractive as they are to investors, general obligation bonds appear to be a dead issue in California at the present time. The political climate that has resulted from the recent financial cirsis in New York City and culminated in California with Proposition 13 makes it virtually impossible to secure the required voter approval. (Proposition 13 also limits a local government's ability to secure the bond through local property taxes.) State wide housing and renewable resources general obligation bonds as well as many local general obligation bonds have been defeated at the polls in California. Although Oregon has passed a $300 million general obligation bond issue for alternative energy, the prospects of California voters doing likewise are slim and thus we believe that a revenue bond approach offers the best hope of financing the purchase of direct heat geothermal distribution systems.

b. Revenue Bonds

The problem with revenue bond financing of geothermal direct heat energy is as discussed earlier, the fact that revenue bonds offer the bond holder no source of payback other than the project financed. In some areas where there has been successful experience with this type of financing, such as airports and even golf courses, the market responds well. This is also due to the fact that fees can provide a repayment source. For example revenue bonds may be used to finance a solid waste conversion site with the local public utility district or a similar body providing approval of a fee increase for garbage to cover the cost of retiring the bonds. Presently in San Francisco revenue bonds are being used to finance the massive sewer project with the fees charged the public raised substantially to cover repayment of the bonds. Since sewage transport and disposal is an essential service, bond holders can be assured repayment; the expenditure and subsequent repayment are secured by the need to use the facility and the impracticality of alternative service. While this is not quite the same as taxing authority, since the user at least theoretically can refuse to pay the fee by refusing to use the service, the effect upon conservative bond buyers is quite similar.

We believe this approach, even if fees are guaranteed, will not yet work with alternative energy bonds because of the newness of the enterprise, even at the fairly secure distribution stage. The bond market is both competitive and conservative, and there are many types of proven projects, paying a reasonable return, with which the bond buyers are quite comfortable. However, we have proposed a variety of modifications to the revenue bond approach which would make the source of repayment more secure and the bonds more marketable. This solution must await a general discussion of federal tax law as it applies to revenue bonds.

c. Federal Tax Exempt Bond Law

There is a major problem with tax exempt bond financing which should be addressed at this point: not every enterprise is eligible for such favorable tax treatment. Thus a survey of the Internal Revenue Code (IRC) and the implementing regulations is in order.

The general rule is that gross income does not include interest on the obligations of "a state...or any political subdivision..." (IRC Section 103(b)(1). This in effect allows a state or a political subdivision (a municipal corporation or another governmental unit which has been delegated a part of the sovereign power of the state, and thus could include a geothermal heating district, (see 26CFR Section 1.103-1)) to borrow money at cheaper rates since the interest paid to the lender is not taxable. However, this exemption from federal tax does not apply to industrial development bonds (IRC Section 103(b)(1)). Industrial development bonds are those obligations in which all or a major part (more than 25% - 26CFR Section 1.103-7(b)(3)(iii)) of the proceeds are used directly or indirectly in a trade or business, not carried on by a government entity (IRC Section 103(b)(3)(A)), and the payment of which is secured by an interest in property used in a trade or business, or to be derived from payments in respect of property or borrowed money used in a trade or business (IRC Section 103(b)(2)). This restriction applies to output contracts where more than 25% of the output, e.g., electricity, heat, is taken by non government entities and used in a trade or business (26 CFR Section 1.103-7(c)(5)).

This non favored treatment of industrial development bonds of states or political subdivisions does not include (and thus allows tax exempt treatment) bond issues the proceeds of which finance, among other things:

> "sewage or solid waste disposal facilities or facilities for the local (solely within the area consisting of a city and contiguous county) furnishing of electric energy or gas" (IRC Section 103(b)(4)(E)

or

> "facilities for the furnishing of water for any purpose if (1) the water is or will be made available to members of the general public (including electric utility, industrial, agricultural or commercial users) and (2) either the facilities are operated by a governmental unit or the rates for furnishing or sale of the water have been established or approved by a state or political subdivision thereof...(including a state PUC)" (IRC Section 103(b)(4)(G)).

In addition, IRC Section 103(b)(5) allows favorable tax treatment of bonds that would otherwise be industrial development bonds, which are used to finance "...acquisition or development of land as the site of an industrial park." The term "development of land" includes "the provision of water, sewage, drainage, or similar facilities, or of transportation, power, or communications facilities, which are incidental to the use of the site as an industrial park, but except with respect to such facilities does not include the provision of structures or buildings." The regulations (26 CFR Section 1.103-9(b)) define industrial park as:

> "a tract of land, other than a tract of land intended for use by a single enterprise, suitable primarily for use as building sites by groups of enterprises engaged in industrial distribution or wholesale businesses if either --
> (1) the control and administration of the tract is vested in an exempt person (government entity) or
>
> (2) the uses of the tract are normally (i) regulated by protective minimum restrictions, ordinarily including the size of individual sites, parking and load regulations and (ii) designed to be compatible under a comprehensive plan with the community in which the industrial park is located and with the uses of the surrounding land."

Finally "small" bond issues which would otherwise be deemed industrial development bonds and thus taxable as to interest are granted examptions from federal taxation under IRC Section 103(b)(6)(A) and (D). These sections basically allow for the financing of individual capital projects of under $1 million or aggregate expenditures of under $10 million over a 9 year period at the election of the local jurisdiction. (The "aggregate" restriction applies to the user or beneficiary, not to the public entity.)

The implication of the above points of federal tax law are quite significant for direct heat geothermal energy. As a starting point, bonds which are tax exempt cannot be issued by the private sector, but only by a government entity, i.e., a state or political subdivision, which has some attributes of sovereignty, such as police power, or the power to tax or condemn. Even where bonds are issued by a government entity, the Internal Revenue Service must look to the purpose for which the bonds were issued and determine the beneficiary, at least where the size of the issue is over $1 million individual or $10 million aggregate. If the bonds are issued solely for heating houses, there is no problem with tax exempt status. However, the economic facts of life for direct heat geothermal energy seem to dictate cascading of residential and institutional space heating uses with industrial and agricultural processing uses. And if, as is most likely, more than 25% of the heat output is used for and are secured by or paid out of trades or businesses, such as commercial space heating or industrial processing, then they are called industrial development bonds and must fall within certain exceptions if the interest is to be tax free.

One possibility would be the exemption relating to local supply of gas (i.e., geothermal steam) (IRC Section 103(b)(4)(E)). Another would be the exemption for supplying water (IRC Section 103(b)(4)(G)). The use of the exception for the supplying of gas could be hampered in some cases by the limitation to one county. The use of the exemption for water supply could in some cases be hindered by the requirement that private water supply enterprises be regulated by the PUC (thus building in a strong disincentive in terms of sacrificing a 10% investment tax credit as well as the expectation of an unregulated profit, as will be discussed infra.). Even more crucial, both these exceptions appear to have been interpreted by the IRS in Revenue Ruling 78-12 as not applicable to steam generating plants, i.e., steam is neither gas or water for exemption purposes. Whether this rather dubious ruling would stand up in court as is, or whether it applies to hot water (as opposed to steam), and whether the IRS would reconsider this ruling or revise its regulations in light of strong public policy considerations arising out of the energy crisis and allow an exemption for geothermal steam/water heat in light of the clear exemptions for electricity and gas is not known at this time. The consultants, however, urge that reconsideration or reinterpretation be pursued by whatever means.

Where there is more than one plant involved, and where local zoning provisions are made, the exemption for industrial parks appears to be suited for financing the delivery of direct heat geothermal energy for industrial processing (IRC Section 103(b)(5)), but not for the actual construction of the plants themselves. This seems to be allowed since the definition of the development of land includes facilities for the provision of water or similar facilities and power facilities, but after Revenue Ruling 78-12, nothing is certain.

Finally, the $1 million individual and $10 million aggregate (i.e., benefitting the same user over a 9 year period) exemptions can be put to good use in financing direct heat geothermal energy because of the relatively low cost of such projects. This is particularly true if the small isue exemptions can be used in conjunction with the other exemptions discussed in this section. It should be noted at this point that while federal tax law may sanction certain types of industrial development bonds, until this year such bonds for most purposes were not allowable under California law. This year the Legislature enacted and the Governor signed AB 2324 which made it possible for the State to issue bonds for private alternative energy projects, and AB 74 by which local governments can issue bonds for a variety of small private projects to include geothermal energy. Thus, the distinction between bonds issued by a government entity where the output goes to private commercial or industrial enterprises, and bonds issued by a government agency for plant and equipment to be owned and operated by a private entity has for tax purposes become blurred.

#### d. Authority of Existing Local Public Agencies to Issue Revenue Bonds

We have discussed earlier why it is safe to assume that either by default or for sound public policy reasons local public agencies will in many cases be the distributor of direct heat geothermal energy. The question arises whether existing agencies have the authority under state law to issue tax exempt revenue bonds (as previously discussed general obligations bonds are at the present time a political impossibility). Counties do not appear to have the authority to operate any kind of public utility and they are limited to issuing bonds for public beaches, boat harbors, golf courses, and ski areas. (Government Code Section 23601). General law cities can acquire, own, construct, maintain and operate "..works for...heat" (Government Code Sections 34000, 39732). However it appears that direct heat geothermal systems cannot be financed through revenue bonds, since heat is not included in the definition of "enterprises" which can be funded under the Revenue Bonds Acts of 1941 and 1974 (water systems for domestic, agricultural and industrial use are included (Government Cose Section 254309)), but it is doubtful whether in this context it can be construed to apply to direct heat geothermal energy (see the federal taxation discussion, supra.) Charter cities under the California Constitution (Article XI, Sections 3 and 5) and the provisions of most of their charters can enact ordinances allowing for the issuance of revenue bonds to finance direct heat geothermal energy. Joint powers agencies of themselves have no more power than local agencies under the Revenue Bonds Act(s), but it may be possible for a charter city, which is a member of joint powers agency to issue revenue bonds to finance the entire project (see South Pasadena vs. Pasadena Land and Water Company ((1908) 152 Cal 759)). The vast majority of existing special districts would not have the authority to issue revenue bonds for any phase of direct heat goethermal energy.

Thus it appears that there is a major gap in the ability to use tax exempt revenue bonds to finance direct heat geothermal energy in California. The newly enacted AB 2324 and AB 74 would allow the State and local governments, respectively, to issue revenue bonds for private geothermal development, but AB 74 was clearly not set up to allow bond financing for public sector ventures and AB 2324 does not clearly cover (nor was it intended to cover) public ventures. Only charter cities can issue revenue bonds for direct heat geothermal development. Public sector involvement at the distribution stage may be imperative, and often would be desirable. Certainly revenue bond financing ought to be available for this involvement, and available to more than charter cities.

One option which we recommend would be amendment of AB 2324 to clarify that this state bonding authority would be available to public entities. Another option, which is not mutually exclusive, and which we also recommend is enactment of legislation which would authorize the establishment of geothermal (and perhaps solar and other) heating districts, with full powers to issue revenue bonds. The advantage of special heating districts is that they can be tailored to the specific needs of the particular enterprise. They also can transcend existing political boundaries and thus avoid jurisdictional problems where a reservoir or service area is in more that one city or county. Any geothermal heating district should have, in addition to the power to issue revenue bonds, the authority to receive government grants, sell heat and finance new development even beyond its boundaries, set rates, use eminent domain, tax, and set special assessments. It should also have the power to engage in all phases of geothermal development. This latter recommendation is made even in the light of previous statements regarding the inadvisability of government entities taking the risks involved in geothermal exploration, since often federal grants in effect assume that risk. In addition, as the industry becomes more sophisticated that risk may lessen.

Another possible option would be amendment of the State Revenue Bond Act to make it clear that at least general law cities can finance geothermal heat distribution systems. However, geothermal heating district authorization would be specifically designed to allow efficient operation of the system as well as financing the system, and would under any circumstance render amendment of the Revenue Bond Acts superfluous.

3. Refinancing Private Projects

We have used a transfer from a private developer to a public entity which will distribute the resource as a model. We have used this transfer to avoid public utilities regulation of the developer (discussed infra.) and to take advantage of tax exempt bond financing and thus decrease the project cost. With the passage of AB 2324, the California Alternative Energy Finance Authority, and AB 74, the Industrial Development Bond Authority, there is now a way to refinance the project without a transfer using tax exempt bonds at the stage where the resource is proven. This refinancing would also decrease the projects cost, but distribution of the resource would remain in private hands. The developer could refinance the project with sufficient funds to repay the initial loan (most likely guaranteed by the DOE) and to replace what equity capital was initially invested. This process of refinancing, which does not involve a sale, should enable the investor to retain substantial tax benefits and show a cash profit without a tax liability. The process is similar to that of refinancing a personal residence a maneuver that can generate additional cash income and yet not involve a taxable gain.

Basically, AB 2324 and AB 74 provide the authority in state law for private projects under the aforementioned $1 million and $10 million limitations, or otherwise exempt, to be financed out of state or local, bond issues. AB 2324 is definitly applicable to this refinancing at the distribution stage, but the applicability of AB 74 is questionable (Section 91503(a)(2) allows financing of energy projects, but Section 91503(b)(5) precludes financing of gas and electric <u>distribution</u>).

The rationale for using government sponsored tax exempt refinancing for systems which remain in private hands would be that it can lessen the cost of the project and thus where a district heating system is involved, would lessen the cost to the consumers. This will only happen if government extracts such a pricing as a quid pro quo for its assistance in its form of tax exempt bond refinancing.

The disincentives of PUC regulation still remain in any refinancing where the systems remain in private hands. However, we have recommended (<u>infra.</u>) the elimination of such regulation based on rate of return where the consumer is protected by government pricing control input at the supply contract stage as a return for its providing tax exempt refinancing.

## C. Public Utilities Regulation

We have discussed the necessary preconditions and incentives to direct heat geothermal development, the advantages of borrowing money at lower rates through the issuance of tax exempt bonds and the legal authority of local agencies to issue such bonds. Before an array of institutional options can be fashioned to utilize these incentives and advantages, it is necessary to take into account the spectre of regulation of direct heat geothermal development by the California Public Utilities Commission.

The California Public Utilities Commission (PUC) historically regulates businesses which could be considered natural monopolies. This regulation takes three forms, market entry, rate setting, and securities regulation. Control over market entry entails the granting of a franchised monopoly if a showing of public convenience and necessity is made (Section 1001, Public Utilities Code). The applicant must show a demand, financing ability and reasonable rates and charges. The key issue in indicating a demand is that there be no duplication of existing services. This has been construed to mean that it not be identical in kind to existing services (i.e., gas for gas, electric for electric). Introduction of another energy source is not considered duplication. Securities regulation encompasses the necessity of prior PUC approval of the issuance of stock. PUC rate regulation involves limiting utilities' charges based upon three calculations:

(1) depreciation on plant and equipment in actual use plus interest paid during construction for newly opened plants;

(2) operating expenses; and

(3) fair rate of return which is the weighted average of the actual interest cost of debt instruments and the prevailing market rate for equity for companies with similar risk characteristics. The PUC currently allows an additional .5% return on renewable resources investment to include geothermal (PU Code, Section 454(a)).

We have found the possibility of regulation by the PUC, particularly where rates are involved to be a very strong disincentive to resource developers from entering certain areas of geothermal development. The prospect of having a government agency control or limit profits that result from high risk exploration does not appeal to most resource developers. In addition, the 10% supplementary investment tax credit allowed by Section 301(a) and (b) of the Federal Energy Tax Act does not apply to equipment owned by an entity whose rates are regulated by a State Public Utilities Commission.

The law in California defines a public utility as including

> ". . . every common carrier, toll bridge corporation, pipeline corporation, gas corporation, electrical corporation, water corporation, sewer system corporation, wharfinger, wharehouseman and heat corporation where the service is performed for or the commodity delivered to the public or portion thereof". (PU Code, Section 216(a)).

Thus, as a starting point a direct heat geothermal operation is a heat corporation. A heat corporation . . .

> "includes every corporation or person owning, controlling, or managing any heating plant for compensation within the state, except where heat is generated on or distributed by the producer through private property alone solely for his own use or the use of his tenants and not for sale to others". (PU Code, Section 224).

It also may be a water corporation, which "Includes every corporation or person owning, controlling, operating or managing a water system for compensation within this state." (PU Code, Section 241).

> "Water system includes all reservoirs, tunnels, shafts, dams, dikes, headgates, pipes, flumes, canals, structures, and appliances, and all other real estate, fixtures, and personal property owned, controlled, operated or managed in connection with or to facilitate the diversion, development, storage, supply distribution, sale, furnishing, carriage, apportionment or measurement of water for power, irrigation, reclamation, or manufacturing, or for municipal, domestic, or other beneficial use". (PU Code, Section 240).

A direct heat operation is probably not a pipeline corporation, as this definition excludes pipelines carrying water. (PU Code, Sections 227-228).

Thus, a person or corporation supplying direct heat geothermal energy is a public utility and subject to the rate regulation, securities approval, and perhaps the market entry control (a water corporation is, a heat corporation is not (PU Code, Section 1001)) of the PUC, unless it fits under a specified exemption. The most notable exemption from regulation is that given non-privately owned utilities, including municipally owned utilities and special districts, such as geothermal heating districts. (Article 12, Section 3, California Constitution.)

Another series of exceptions are based on Section 216(a) of the PU Code, quoted earlier in the definition of a public utility which requires that ". . . the service is performed or the commodity delivered to the public or a portion thereof." Section 207 of the PU Code defines public or portion thereof to mean "the public generally or any limited portion of the public, including a person, private corporation, municipality, or political subdivision of the state." Thus, the public is very inclusively, if somewhat tautologically, defined. When this definition is read in connection with that of Section 216(c), it becomes clear that entities which indirectly deliver services or commodities to the public, i.e., to another ". . . person, private corporation, municipality or other political subdivision of the state . . ." which in turn delivers to the public, are subject to PUC jurisdiction. However, there is an additional court imposed criterion: before an activity or service is subject to PUC jurisdiction, it must be "dedicated to public use". The courts have held that this dedication is evidenced by some act which the public reasonably interprets and relies upon as a willingness to provide service _on equal terms to all who might apply_ and which results in a legal duty on the part of the utility to provide such services. (_California Water & Telephone Co. vs. PUC_ (1959) 51 C2d 478, 494). This has been interpreted to mean that when service is provided to only selected customers through negotiated contracts, no dedication to public use exists, and PUC jurisdiction will not lie. (_Richfield Oil Corp. vs. PUC_ (1960) 54 C2d 419). This public use rationale will also be effective to exclude the PUC from sales of surpluses to selected users (_Story vs. Richardson_ (1921) 186 Cal 162).

Also, as noted above, Section 224 of the PU Code excludes heat (but not water) corporations from the definition of public utility where the heat supplied is on the owner's property and is for his use or the use of his tenants or employees. Section 2705 of the Code does exempt water companies which deliver solely to their stockholders and certain political subdivisions. This exemption is not lost by delivery to a member or shareholder who then delivers to the public at large.

Under this legal framework, it is possible to enumerate many sale and lease arrangements where a developer and users can avoid PUC regulation. These will be set out along with the tax implications later in this paper. For the present, however, it should be noted that the sale of the resource and the plant by the developer to a public entity for the distribution of the resource to the public, and sale of the resource through negotiated contract with individual users, or sales of surplus heat are clearly not subject to PUC regulation. Under the current law, private, non-negotiated sales to residential users, no matter how small, would be subject to PUC jurisdiction. It is not clear whether the developer's leasing of the plant equipment to a public entity which then distributes the resource to the public comes under the jurisdiction of the PUC. And it does appear that private selling of the resource to a public entity which then distributes to the public is technically subject to the regulatory jurisdiction of the PUC.

Both of these latter methods of transfer (selling of only the resource to a public entity, and leasing of the plant to the public entity) could be important measurers for the developer to retain all or part of his investment tax credit upon transfer to a public entity. Thus, legislation to clarify that these types of transfer do not make the developer subject to PUC regulation may be necessary.

## IV. RECOMMENDATIONS

This paper has set out a series of institutional relationships whereby a developer can use a battery of available Federal loan guarantee programs to spread his risk and that of his limited partners at the uncertain initial stages of geothermal development. While there is some perceived reluctance on the part of the private financial community to participate at this stage, even with loan guarantees, there appear to be at least some traditional financial institutions as well as Business and Industrial Development Corporations which will fill this void. The spectre of PUC regulation of private sales to public entities may discourage some developers, but this may largely be perceptual, avoidable with properly structured agreements, and certainly capable of legislative remedy. Thus, the only major problem at the initial phase of direct heat geothermal development would be that of convincing larger numbers of potential users of the viability of direct heat geothermal energy for their operations.

The place where the scheme of encouraging geothermal district heating tends to break down is at the distribution stage. Because of existing institutional considerations (i.e., the possibility or likelihood of PUC regulation), and certain economies of scale, resource developers and utilities are not particularly interested. Public entities would seem to be the logical institutions to step into this void, and could, in fact, bring direct heat geothermal applications into fruition more cheaply since they theoretically have access to tax exempt financing. There are, however, some major difficulties with this supposition: (1) the problems of marketing traditional revenue bonds even for this supposedly safe phase of direct heat applications; (2) the absence of legal authority on the part of most local jurisdictions in California to issue revenue bonds for direct heat geothermal applications; (3) the apparent inability of the state to issue revenue bonds for local jurisdictions to take over distribution systems for direct heat geothermal energy; (4) the difficulty in securing tax exempt status under federal law for many geothermal heating projects involving industrial or commercial use that are over $1 million, one time costs, or $10 million, aggregate costs for the same beneficiary over a nine-year period. (Numbers (1) and (4) above would also apply to private entities under public auspices, should they wish to become involved.)

We do not believe it is the purpose of this study to choose between the public and private sector as the best institution to distribute the resource to industrial, commercial, and residential users. We do believe that it is incumbent upon us to recommend solutions which would enable both private and public institutions to deliver the resource, should they choose to do so. Thus, we recommend the following steps to solve the following enumerated problems:

## A. The Problem of Marketability of Revenue Bonds

### 1. Change the Federal Policy Concerning Federal Loan Guarantees for Tax Exempt Issues Related to Conservation and Alternative Energy Development, Most Specifically, Geothermal Energy Development

Given the degree of regulation of energy producers and distributors and the institutional networks that are most likely going to be interested in direct heat use for geothermal energy, a logical "developer" is a local governmental body, either a city, a county, or a special district. The review of the Boise project and the problems facing Susanville graphically point out the financial difficulties faced by potential local government sponsors of such projects. General obligation bonds are impossible to get approved in most cases. Revenue bonds are difficult to sell given the uncertainty about such a new industry and the always present possibility of failure which would result in loss to the bondholders. Private financing is expensive. It is hard to arrange and negotiate satisfactory terms and prices, and such negotiation often results in a reduction of much of the benefit to the users.

A solution to the problem that is easiest and most sensible would be for the federal government to rescind its opposition to loan guarantees for tax exempt bonds and develop specific guarantees under the GLGP to support geothermal direct heat development by local governments. The reluctance on the part of the federal government is based in large part on the current Administration's effort to substantially reduce or eliminate the use of tax exempt bonding both for local government-sponsored private ventures and for more traditional types of government involvement. The Federal Treasury reasons correctly that tax exempt bonds are a major form of subsidy, reducing federal income from taxes to favor development of projects, public and private, that may or may not be that worthwhile. The thrust of the tax exempt loan guarantee opposition is based on the belief that nothing should be done to expand use of tax exempts.

Unfortunately, the policy now in effect has done little to curb the use of the tax exempt bonds to finance projects as frivolous as municipal golf courses or small publically sponsored industrial development bonds for almost any private commercial purpose, but the policy makes it nearly impossible for revenue bonds to be used by local governments to finance worthwhile conservation and energy development projects.

The most important precedent for federal loan guarantees for energy projects would be the Small Business Administration's loan guarantees for pollution control bonds. The program was spearheaded by the State of California with the California Pollution Control Finance Authority playing an important role getting the program established and being the first to utilize the program. The CPFA program was designed to help California businesses finance costly government mandated improvements for abatement of pollution. Initially the program was utilized almost exclusively by large companies such as Standard Oil of California. The large companies were responsible for the repayment of the bonds, and given their excellent credit ratings, the bonds sold very well. As the legislature and administration became increasingly concerned with the fact that only large companies were using the program, the efforts began to get more small companies involved, but this presented a problem in terms of the ability of the agency to sell the bonds. The development of the SBA pollution control loan guarantees provided a 100% guarantee for bonds sold under the program, and the program has proven to be quite successful.

A federal loan guarantee program for energy-related tax exempt bonds could focus exclusively on government program revenue bonds, or could be expanded to include small publically sponsored industrial development bonds as well. As we have discussed, California now has authority to issue small industrial development bonds at the state level and has authorized such bonds at the local level as well. Further testing of the political climate surrounding the issue would provide better guidance as to whether it is better to seek merely a public revenue bond guarantee or also seek a more expansive industrial development bond guarantee as well. At any rate, it is clear that the geothermal loan guarantee program just doesn't work for public agencies. Even if the agencies are willing to pay taxable rates, it is unclear that they can legally issue taxable bonds, and most would be unwilling to do so. More importantly, the geothermal loan guarantee program unfairly discriminates against public developers in the sense that private developers, using all of the tax benefits, can virtually eliminate the real cost of the 25% unguaranteed portion while a public agency has no opportunity to do so, and must accept at least 25% of the risk. For most local public agencies, working out the capacity to deal with risk is the issue. The difference between 25% or 100% is not that important. Any risk at all is the problem.

California should not underestimate its ability to impact federal legislation. California's PUC is considered the leader in public utility efforts for energy development. The California Energy Commission is a potent member of the energy establishment, and our Congressional delegation is the largest in the nation.

It is important to understand that these types of changes do not take place without considerable time and effort. We believe it is the most attractive option to substantially change the climate for direct heat geothermal development and merits substantial work on the part of the state. In addition, the benefits will expand beyond the realm of direct heat geothermal development if the concept is useful for a variety of local government energy projects, not just geothermal. This provides the potential for a wider coalition of interests than would be possible for a measure designed only to benefit geothermal development.

We have previously mentioned the great need for financial and management assistance to users and "packaging" aid to developers. Our other institutional recommendations have provided for this. (See A., 2 and 3, infra.) However, while the development of federal loan guarantee authority for tax exempts would largely solve the major financing problems which we see remaining for direct heat geothermal development, the question of providing technical assistance to users and developers would remain. Local governments can issue revenue bonds or industrial development bonds, and the California Alternative Energy Source Financing Authority (AB 2324) can issue industrial development bonds as well, but there is no source of long-term expertise to promote geothermal development by acting as a technical and financial consultant to local governments or businesses potentially interested in geothermal development.

In conjunction with pursuing guarantees for tax exempt bonds, we recommend that California seek federal funding and possible state funding from the funds available through the geothermal lease program to establish an office of geothermal development, staffed with both technical and financial experts, who are capable of acting as advisors to local governmental agencies with direct heat geothermal potential.

The financial advisor could work with the local government to arrange a deal for a private developer to develop the resources with subsequent arrangements for tax exempt buy out or refinancing and for a loan guarantee for the refinancing. The technical consultant could provide advice on choosing contractors and developers, making sophisticated decisions on the viability of the project, given known characteristics of the resource and the users, and also help determine the economic feasibility of the project. This kind of assistance requires a certain degree of sophistication and could be carried out in part by long-term on-call contract arrangements rather than full staffing of the office itself. Nevertheless, the office will need full-time direction and a specific geothermal responsibility.

A major thrust of the effort to seek federal guarantees for tax exempt revenue bonds for publicly sponsored private projects should include a clear understanding of the big business bias of the present policy against loan guarantees. Big business can take advantage of the existing capacity by its ability to provide the necessary credit security to potential bond buyers. Small businesses are unfairly restricted from access to this low-cost source of capital, given their inability to assure payment from their other corporate operations regardless of the prospects of the specific expenditure supported by the bond sales. Again, California is in a logical position of leadership on this issue, having spearheaded the development of the Pollution Control Bond Guarantee program. Potential allies in the battle could well include the National Federation of Independent Business, the National Small Business Association, and many small business advocates in Congress and the administration in Washington.

## 2. Establish a California Geothermal Finance Insurance Program

Our initial inclinations were to suggest a California Geothermal Finance Authority, with full powers to issue revenue bonds (an option that has been moved to third place and will be covered in the next section). However, the passage of Proposition 8, and of AB 2324, its implementing legislation, establishing a California Alternative Energy Source Financing Authority and the passage of AB 74 allowing for local governments to issue small industrial development bonds were instrumental in suggesting another approach. In additon, the tax laws require recapture of certain tax benefits if there is a sale of the property to a public agency for conversion to tax exempt long-term financing. These basic considerations suggested that issuance of three types of bonds would be useful in different situations, with existing bonding authority available for all three if the risk issues could be resolved. Local goverments that have the authority could issue revenue bonds for projects they would own, or they could issue industrial development bonds for privately-owned geothermal projects. Finally, if a local agency is not available for such bonding, the State Alternative Energy Financing Authority can issue the bonds to support privately-developed projects. All three bonds could be tax exempt under existing Federal law if kept under the $1 or $10 million dollar limits, if fitted under a specific exemption discussed supra, or if less than 25% of the output of the particular project goes to commercial entities.

The main difficulty is that all three bonds are revenue bonds. As previously mentioned, revenue bonds do not guarantee payment to the holder as does a general obligation bond, so the issue becomes one of whether the bonds can be sold, not a matter of authority to sell.

Given the preference of a federal guarantee, but faced with the fact that the State of California cannot force the federal government to develop such a program, the question then remains what can the State of California do itself to encourage geothermal direct heat development? The state cannot guarantee as does the federal government unless the full amount of the guarantee has been budgeted from currently available funds regardless of the probable loss rate.

While the state cannot guarantee loans, it can develop an insurance program approach. The difference between an insurance program and a guarantee program is that a guarantee is available to back all losses regardless of how many occur, while an insurance program is limited to the amount in the insurance fund. For example, if there were $100 million in bonds, backed by an insurance fund of $15 million, any losses would be covered as long as the losses did not exceed 15% of the total, or the available $15 million.

There is a program precedent in California for an insurance pool approach to stimulating private finance. This is in the California Job Creation Program which was designed to stimulate bank loans to minority and disadvantaged business. The program was established in 1969 and was initiated with a $300,000 reserve fund, and an agreement that in exchange the state's major banks would form regional corporations that would agree to lend $2 million. The structure and management of the program encountered problems that are extremely instructive in terms of the problems we will face in developing a similar program.

The Cal-Jobs program was based on an agreement among the major banks to hold individually, but to share a reserve. The problem which could and did arise was what was to happen if losses exceed the amount in the reserve. Is the loss pro-rated to each lender under the program, or is the loss paid in full to the first failures, and if there is an excess of loss, are the other failures covered at all? If there is a "sharing" concept, pro-rating the loss, does this mean that no loss can be paid out until all liabilities are fully realized, or are the losses paid, with a claim at a later date against the beneficiary of earlier insureds.

In the case of Cal-Jobs, the solution was creative, if not directly applicable. The banks become actively involved politically and were able to get appropriations to increase the reserve fund in excess of the amount necessary to cover the fund needs.

Another more practical approach is likely to be the pooling of a group of bonds and negotiations with a single bond buyer of some size to agree to purchase a group of bonds with an agreed upon reserve value. For example, a major bond purchaser like Bank of America may agree to buy $25 million of bonds backed by a $5 million reserve, with certain conditions as to acceptance of the individual projects that make up the portfolio. The conservatism of the bond buyer regarding project selection would presumably vary with the size of the reserve.

The insurance fund would require initial funding, but could eventually be self-supporting, and might even pay back the original funding. The bonds sold may well involve an insurance fee. There is considerable interest savings between a taxable bond and a tax exempt bond.

A modest insurance fee could raise a substantial insurance fund over the life of the bond and yet still yield a total interest cost lower than would be the case with a taxable bond or other private financing.

Again, taking our original example, a $25 million pool of bonds with an average life of approximately 20 years, and the total outstanding aggregate amount, year by year, equal to about 12 times the face amount of the loan, would yield a 12% reserve, before additional interest income, over the 20-year life of the bond with a 1% insurance fee. The reserve fund would be available to fund the next set of bond sales, as would the initial $5 million reserve once the initial set of bonds are paid. There is additional income from interest, and a possibility of setting up the agreement so that the reserve could be reduced on the initial portfolio a few years down the road. If success suggests that the reserve isn't necessary, again an example may best explain the potential. The $5 million reserve for the $25 million in bonds might be set up to allow for a reduction by $200,000 each year, either by use to cover a loss, or by returning the funds to a bond insurance pool for future use for other bonds. If, for example, after five years, there were no losses in the portfolio, the required loss reserve would be reduced to $4 million, freeing up to $1 million for new projects. If on the other hand, losses had been $800,000, for example, only $200,000 would be freed up for other reserves.

The program could also allow for some flexibility in the insurance rate based on actual performance of the participating borrowers. If necessary to cover losses, the insurance rate could be raised to as much as 2% on the loans from the base 1%.

The manager of the insurance program would need to have the capacity to negotiate these conditions under fairly flexible guidelines to meet the needs of the bond marketplace and still provide an important financial advantage to the borrowers. The participation by borrowers is voluntary, so terms can be left flexible assuming that each borrower will determine whether the insurance is in their best interest.

The concept of an insurance pool program for direct heat geothermal development, to be effective, needs to have a mangement and technical assistance capability as well. For this reason, and given the newness of the technology, a private insurance program would most likely not meet the needs in the short term. It is possible that private insurance might be feasible later on. If effective, ten or twenty years down the road, that state could seek bids by insurers to purchase the insurance program and continue the activity free of any government role. Except for the funding to get the program started, no long-term subsidy is anticipated, and there are no specific tax advantages to the state being the insurer rather than a private entity.

There may well be a need for ongoing subsidy for the management and technical assistance aspects of the insurance fund, during the early years of the program. Given the broad authority and range of energy issues that will come before the California Alternative Energy Source Financing Authority (AB 2324), it is unlikely that there will be focused geothermal direct heat expertise. Even if that were the case, bonds may be issued by other entities, especially local governments, and they would have no direct relationship with The Alternantive Energy Source Financing Authority. The insurance program is the logical place to locate the technical assistance.

The management and technical assistance arm of the program could initially be supported by seeking both state and federal funding, and eventually may be supported by the excess income from the reserve fund. The theory that successful projects can afford to provide a subsidy to overcome management and technical assistance costs and elements of risk involved with broader development of geothermal energy and in support of the insurance program is fair in that the existence of the insurance program will likely provide substantially cheaper financing than would be the case without the insurance, especially if the only alternative is private development with conventional financing.

It is important to point out that, with the exception of the short-term profit to the private risk-taking developer during the first two phases of development, the tax exempt bond financing and insurance program will generally favor the concept of passing along the benefit of lower priced energy to the consumer. The consumer, through access to the low-interest financing, can control the costs and ownership of the resource (usually through a local governmental structure) and, therefore, reap the benefit of the lower cost. One can assume that if this profit were passed on completely to the developers, developers would be able to translate the higher potential profit into a willingness to pay for more exploration, take more risk, and even to promoting use through management and technical assistance to potential users. If the public bond market and public ownership take a greater share of the "profit" (the difference between conventional energy costs and geothermal energy costs), it is imperative that they turn some of the profit back into longer term development of the resource for other users. Government must make up for the incentive that has been taken away from the private sector by absorbing the bulk of the long-term benefit in stage three of geothermal development.

While the use of tax exempt bond financing can reduce interest costs approximately one-third and be a major benefit to geothermal development, two other aspects of the program are, in fact, more important. First, the system of centralized permanent management and technical assistance to advise potential users, especially public agencies. As long as each local agency needs to learn from the beginning enough about geothermal energy to make independent decisions, the process of project development will be slow and painful, and lag far behind the real economics of geothermal direct heat use. Second, the insurance program or a change of policy by federal authorities regarding guaranteeing tax exempt bonds, will enable local agencies heretofore incapable of taking any risks to pursue direct heat projects by spreading the risks involved.

<u>3. Establish a State Geothermal Finance Authority</u>

For a good part of the contract, the inclination was to suggest the formation of a state geothermal finance authority capable of issuing bonds for both local governments and for private projects. The Geothermal

Finance Authority would encompass the same "insurance" characteristics as the insurance program now given priority over a Geothermal Finance Authority, but with the added capabililty of issuing bonds directly with new legislative authority to issue such bonds.

Probably for good reason, the state is reluctant to establish too many state bonding agencies for fear of losing control of the quality and volume of tax exempt bond issues. Thus, given the other options available with the passage of AB 2324 and AB 74, a Geothermal Finance Authority at this time does not seem to have such significant advantage so as to justify its selection in the face of predicted political opposition.

Nevertheless, a Geothermal Finance Authority is certainly one of the major options that should at least be understood, if not favored at this time.

A State Geothermal Finance Authority, issuing bonds through its own bonding authority, would still face much of the same difficulty that suggests the need for an insurance program. Individual bonds for individual projects would face the same potential project by project risk that make the bonds difficult to sell. The Authority, to be successful at issuing bonds, would require some initial funding to provide a loss reserve and would require an insurance program to generate a larger future cushion in order to continue to add to the number of projects covered by the Authority. Except for the fact that the Authority would issue bonds directly rather than supporting the issuance of other public agencies, the costs would be similar to the insurance program.

The Geothermal Finance Authority would also need to provide the management and technical assistance that is already suggested for the insurance program. The only major difference would be the need of the latter to coordinate between bond issues and the insurance program rather than than having full control of the bonds and the insurance. However, given the more attractive political prospects of the insurance program rather than the Geothermal Finance Authority, it seems that this is a small price to pay in return for much brighter prospects of implementation.

## B. Disincentives to Direct Heat Geothermal Development Resulting from State Public Utilites Regulation

### 1. Change the Scope of Activites Regulated by the Public Utilities Commission in Section 216 of the Public Utilites Code

The current definition of activities regulated by the PUC technically includes indirect sales to the public such as sales of heat by private operators to public entities which then distribute to the public. The spectre of this regulation could discourage private involvement at the development stage, where for tax purposes discussed earlier, there would be a lease or a deferred sale of the district heating plant by the developer to a public entity, but with an interim supplier relationship. Conversations with the PUC staff indicate that the PUC has no interest in regulating these sorts of activities, particularly if it will stifle the development of a direct heat geothermal industry. Under current law, the PUC does not regulate the use of cogeneration technology where sales of electricity, or of waste heat from a power plant are involved (PU Code Sections 216(d); 218.5). In addition, the PUC does not exercise jurisdiction over electric plants which are leased or sold to a public agency (PU Code Section 246). Current practice is that sales of surplus steam from resources developers in the Geysers to PG&E are not regulated. (This may well be that since electric power sales resulting from geothermal steam plants of under 50 megawatts are not regulated, it would be counterproductive from a policy point of view to regulate heat sales which result in electric power.) Thus, it appears that such supply sales from the private direct heat developer to a public entity are well within the philosophy of non-regulation expressed by these laws and practice, and that it would be reaching to call them indirect sales to the public. However, the mere possibility of regulation could make valuable tax incentives less effective by requiring early sale, and may deter some private development altogether. Section 216 of the Public Utilities Code should be amended to clarify that it does not apply to sales of geothermal heat by a developer to a public entity, or leasing arrangements to a public agency.

2. The Public Utilites Code Should be Amended to Provide for Excluding the Rate of Return Basis for Regulating Direct Heat Geothermal Energy Sales to the Public if They are Below a Certain Threshold Number of Either Therms or Households Supplied, and if the Heating Plant is Financed with Bonds Backed by the State-Sponsored Insurance Fund (Discussed infra)

The private sector (utility or developer) will not become involved in distribution of geothermal energy if his rate of return is based upon his costs. We believe that as long as these charges do not exceed the cost of other conventional energy, the consumer is protected, and there remains an incentive for the private sector to take part. This exemption will not remove the reluctance of the typical geothermal developer to get involved in the unfamiliar business of public distribution, nor will it change the economies of scale that have kept some utilities from considering participation. However, it will remove a major cloud from development of direct heat geothermal energy, and, when combined with possible access to tax exempt financing under the new state laws, might just provide the stimulus for some developers and utilities that were on the fence.

There is a valid concern that total elimination of PUC rate regulation would leave the consumer unprotected. That is why we have recommended that the exemption be granted only where the state has leverage in the contract to provide service, i.e., where the effort is in some way financed and insured by the public (infra), and that the basis for this leverage be the cost of other energy. Thus, a necessary part of this recommendation would be PUC approval of an initial service contract based upon not exceeding the costs of conventional energy, before any public bond refinancing.

## C. Federal Tax Law: Questionable Tax Exempt Status for Certain Geothermal Projects

### Amend Section 103 of the Internal Revenue Code

Whenever the more than 25% output of a direct heat geothermal project is used either industrially or commercially, as may be an economic necessity, the tax exempt status of any bond issued by a public entity to finance it is called into question. There are exemptions, of course, if it can be called part of the development of an industrial park, or if the project is less than $1 million or less than $10 million over a nine-year period is bestowed upon the same user.

There may be projects that do not fit within these exceptions. Were they similar local electric, gas, or water projects, the bonds issued to finance them would be tax exempt. Direct heat geothermal was not considered a viable means of supplying energy at the time of the drafting of this section of the tax code; with proper tax treatment it could be now. The State of California should lobby for equal treatment of this form of alternative energy. The best way would be a clean change in Section 103 of the Tax Code. If this would take too long, or if it were politically infeasible, the lobbying efforts should be focused on changing, by regulation, I.R.S. Ruling 78-12 which excludes steam (and perhaps, derivatively hot water) from the exemption granted interest on bonds financing water supply and delivery systems from taxation, even if more than 25% of the output is used for trade or business purposes.

## D. State Law: The Problem of Lack of Authority of Local Governments to Issue Revenue Bonds

### Amend AB 74, AB 2324 , and Enact Geothermal Heating District Legislation

As we discussed previously, only charter cities which have almost limitless powers with regard to municipal affairs have the unequivocal authority to issue revenue bonds for direct heat geothermal distribution systems under state law. AB 74 now provides a means for local agencies (cities or counties) to issue revenue bonds for a variety of small private projects to include energy projects (Section 91503(a)(2)). It does not include distribution of energy, and specifically excludes distribution of electric energy and gas. (Section 91503(b)(5)). Whether this excludes distribution of direct heat geothermal energy in many or all cases is not clear, since there are other uses of this bonding authority (such as all phases of industrial and agricultural processing) which are allowed. Any clean-up legislation for AB 74 should make it clear that distribution of direct heat geothermal energy is a permitted bonding activity.

Even if AB 74 were to clearly apply to distribution of direct heat geothermal energy, it would not solve the problem for non-charter local entities who wished themselves to finance and operate a direct heat geothermal energy distribution system. AB 74 applies only to private projects. A similar difficulty seems to obtain where AB 2324, the California Energy Source Financing Authority Act, is concerned. Its definition of "participating party" (Section 26003(c)) does not specifically include government entities among those whose energy projects can be financed out of the $200 million in revenue bond authority given this state body. While a case could be made that such entities are covered, conversations with legislative staff indicate that this was not the thrust of the bill. This philosopy should be rethought since local public entities may be the only institutions willing to distribute the very viable alternative energy technology of direct heat geothermal applications, and AB 2324 should be amended to specifically include public agencies as among those institutions whose projects can be financed.

Even with a state alternative energy finance authority, local agencies should have the flexibility to finance distribution of direct heat geothermal energy on their own. There are two ways in which this would be achieved, one would be to amend the State Revenue Bond Act(s) and include distribution of direct heat geothermal energy as a permissible enterprise for local government to fund through revenue bonds.

The other would be the passage of new state legislation authorizing the creation of geothermal heating districts which would have the power to issue revenue bonds to finance a variety of direct heat geothermal operations. We favor the latter approach since a geothermal heating district authorization can be tailored to grant a variety of other powers necessary to deal with a variety of situations peculiar to direct heat geothermal energy.

All of the above recommended changes in bonding authorities assume that the bonds issued by the local entities would be covered under the insurance program recommended earlier.

## V. BROAD ISSUES REGARDING ENERGY POLICY IN CALIFORNIA

### A. Fuel Alcohols and Other Complimentary Energy Developments

One of the most immediately promising uses of geothermal direct heat is for alcohol fuel plants. The single most important input for alcohol conversion in terms of energy use is the substantial amount of heat to process the biomass to fuel alcohol. In fact, many people believe that the heat energy required to process biomass to fuel alcohol is so great that fuel alcohol will not be a significant source of energy. But if instead, the heat comes from a renewable source of energy such as geothermal energy, the liquid energy produced is much more efficient. As an example of the interest in these projects, of the 22 direct heat applications received for grants at the Oakland office of DOE, 17 are related to fuel alcohols programs.

Developers of geothermal and fuel alcohols programs are going to be involved in a variety of attractive financial options. Federal loan guarantees are available for 90% guarantees of loans equal to as much a 90% of the total project cost for a fuel alcohol plant compared to a 100% guarantee for a loan equal to 75% of the project cost for a geothermal development. There is nothing to prevent seeking assistance from both programs. Both have similarly attractive investment tax credit provisions.

The important aspect of fuel alcohol plant development is the fact that the industry is just beginning. The location of plants, in addition proximity to a feed stock source, can be altered to conform to sources of low cost heat energy. Heat energy is an extremely important part of the energy and overhead requirement to run a plant, and a location remote from population centers is generally not a disadvantage because the product (alcohol fuel) and the by-products are generally marketable in farming locations. In fact, since there is often a transportation cost for fuels processed in urban locations, the competitive advantage to rural locations can be better than for urban locations.

The complimentary relationship of direct heat geothermal energy to fuel alcohols, which is likely to dominate early development of direct heat use raises the important question of what divisions are best to encourage development. A possible institutional mix could be that of fuel alcohols, direct heat geothermal energy, and generic district heating. There is an organized set of proponents for the concept of district heating. District heating can utilize any initial heat source including geothermal, gas, oil, or coal and often uses cogeneration as a source of heat. This concept is characterized by a central heating facility rather than a home by home or building heating program. District heating is used extensively in planned Socialist economies, and often means that a power plant is located in the center of large cities. In many respects, direct heat geothermal development, from a financing and organizational perspective, rather than a technical perspective, will be more closely related to district heating, and even to fuel alcohol than it will be to geothermal electric generation.

At this point, we recommend that geothermal direct heat be dealt with seperately, with, for example, an insurance program only for geothermal direct heat use, but if in fact the category is too narrow to be compatible with short-term potential development, rather than lumping direct heat geothermal with electric geothermal development, a better combination would result by developing a financing insurance program for geothermal direct heat, fuel alcohols, district heating and other geothermal or cogenerated secondary but direct uses of heat energy.

## B. Tax Exempt Financing for Guaranteed Loans

Direct heat geothermal development is going through a transformation not unlike a variety of other alternative energy options. There is increasing evidence that the money spent by DOE on demonstrations and research, the rapidly rising prices of conventional energy, and the attractive subsidies, mostly in the form of tax incentives, make more and more potential geothermal direct heat project economically feasible. "Economically feasible" basically means that an economist or accountant can show that use of geothermal direct heat would be less expensive, given our best forecasts on costs and options, than continuation of traditional heat energy sources. The issue increasingly becomes one of financial and institutional barriers rather than technical and economic barriers.

It is appropriate that the California Energy Commission, the Department of Conservation, the California PUC, and the Business and Transportation agency are effectively ahead of the federal government in placing greater emphasis on breaking down the financial and institutional barriers to energy conversion and conversation rather than continuing an almost exclusive focus on technical and economic factors. With this basic perception of the problem in mind, the several observations seem important.

Inasmuch as local political entities, cities, counties, special districts, etc., are the logical focus of a variety of alternative energy programs such as geothermal heat, district heating, wind powered water pumps, garbage conversion, sewage conversion, cogeneration, etc., it is important that these entities have adequate financial tools available to them. The political impossibility of general obligation bond financing and the marketability problems of traditional revenue bond financing documented in this paper with regard to direct heat geothermal energy are also applicable in spades to other forms of alternative energy.

There are several possible solutions to this problem. On the state level, the insurance concept suggested for tax exempt Geothermal Direct Heat project bonds could be expanded to cover a variety of other technologies. Whether a coordinated program combining different technologies into a single insurance agency or formation of a series of insurance agencies would be most effective, is hard to determine, but either approach should include dividing the insurance management in groups of specialists in each area so that the Management and Technical Assistance is combined with source of insurance.

On a federal level, a possible solution is provided by a change in policy concerning guarantees of tax exempt issues. There are two types of bonds that could be supported by such a guarantee program. One would be to guarantee revenue bonds for publicly-owned projects. The other would be to guarantee tax exempt industrial revenue bonds. Getting federal acceptance of the first option is much mor likely than the second, but either would have to be pursued not only at the Department of Energy, but at the Treasury as well. The Treasury Department, especially in the Carter administration has shown a great aversion to encouraging tax exempt financing, especially of privately owned projects as is the case with industrial revenue bonds. The argument to Treasury must suggest that the lost revenues from tax exempts being issued would be more than offset by the rapid pace of alternative energy development that would result, possibly leading to a more expansive economy and increased overall tax revenues. This is obviously a complex issue with many ramifications, but it is hard to identify a more important issue to alternative energy commercialization.

A key issue to the success of the programs with both a business and a broader socio-economic purpose, is defining the proper objectives for success of the program. Private businesses are blessed with a simple objective, which is to make as much money as possible consistent with running an ethical business and with an understanding of both short-and long-term profit objectives. For an agency such as a Geothermal Insurance Fund, the objectives are more complex. On the one hand, there is a desire to be profitable, but on the other, there is a desire to accomplish a social goal by encouraging as much energy conversion as possible. Managing the Geothermal Insurance Fund, like management of the new solar BIDCO, for example, will require that the state, the directors, the management, and the users all have some clear concept of what the basic objectives and criteria for success will be. For example, will the new BIDCO be successful if it turns out to be profitable, but to do so, assumes a very conservative financing position, taking little risk, supporting little innovation, and possibly stealing away investment opportunities from the private sector. Or would it be more successful if it showed less profit or even a loss, but managed an aggressive and innovative portfolio, passed on proven investment opportunities to the private sector once its participation was no longer absolutely necessary, and continued to seek out and encourage new start-ups and other creative forms of business that entail greater risk? The natural tendency will be for the new BIDCO to accept the first path, opting for a conservative and profit-oriented approach since this will generally assure the least risk on the part of the BIDCO management.

For our State Geothermal Insurance Program, a similar dilemma will exist. The bond market will force a conservative approach to risk taking and bond sales, but the management and technical assistance provided, the use of funds from one project to help another, and the aggressiveness of the agency dealing with bond markets will all become important elements of whether the geothermal insurance program is truly successful, or is successful only in respect to avoiding financial difficulty.

## C. Mandating Alternative Energy

We continue to suggest the inertia that prevents geothermal use even if it is economically feasible. This is part of a more complex set of issues involving the requirements to get alternative energy implemented when it is economically competitive, but when institutional factors militate against its use. For example, a developer of a housing tract or an industrial complex may only consider alternative energy if forced to do so by government authorities, even if the economics are good. The developer is not the one who will pay an energy bill over the ensuing decades and may very well not want the bother of exploring energy alternatives. He may or may not consider the user and certainly will ignore the drain on resources available to other users. The residents of the development may also have access to average-priced energy that hides the true economic costs of using conventional energy compared to the use of alternative energy, including geothermal energy.

A condominium development project in Mammouth Lakes may go up using electric heat and air-cooled fireplaces. Electric heat is cheap to install and air-cooled fireplaces, although inexpensive to install, don't provide any heat. There are very possibly significant geothermal heat resources that could be economically developed in Mammouth Lakes. Such development would reduce electric demand, and reduce the need for oil to provide the electricity for these units, which are mostly high-cost luxury vacation condominiums. Others share in the cost of the electric heat for the condominiums, by having to divide what low-cost electric energy is available, from hydro and geothermal resources, with a larger number of users.

Consideration should be given to effective state or local restrictions that would at the very least require such developments to utilize alternative energy if it were economically competitive, with the economics based on true costs rather than on the biased costs of the developer. Certainly, these are complicated issues, already much discussed by the Energy Commission, among others, but it would be remiss not to point out that this activity would do much to speed energy conversion and overcome the bias of average-price power sales.

## D. State Land Use Policy

We have mentioned at the beginning of this paper that the location of low-heat geothermal resources away from population centers need not be a disadvantage. Rural unemployment problems and high-energy prices, coupled with demographic trends, nearness to agricultural production areas, availability of buildable space, and favorable community attitudes combine to make rural communities with low-heat geothermal resources ideal for certain types of industrial development where heat is a major part of the process. This includes industries such as agricultural processing and fuel alcohols production.

It is important that the state and local governments recognize this in any business development or environmental planning efforts that are ongoing or will occur in the future. Should the state ever again consider industrial siting or agricultural land use legislation, emphasis should be given to the location of agricultural processing and other heat demanding plants near geothermal resources susceptible of direct heat use. Government should also consider incentives or requirements that result in the utilization of the waste heat from such plants for residential, institutional, and commercial space conditioning.

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
420 CHIPETA WAY, SUITE 120
SALT LAKE CITY, UTAH 84108
TELEPHONE 801-581-5283

October 29, 1980

Mr. George S. Budney
Project Manager - Geothermal Programs
Energy Technology Engineering Center
Energy Systems Group - Rockwell International
P.O. Box 1449
Canoga Park, CA 91304

Dear Mr. Budney:

In response to your letter dated September 23, 1980, to Phillip M. Wright, I would like to express interest in becoming an active participant on the District Heating Product Team. As requested in your letter, I am providing you with the following information:

1) Areas of Expertise

The Earth Science Laboratory is a multidiscipline group of approximately 30 geoscientists, active in geothermal exploration and research. Most of our geothermal work is funded by the U.S. Department of Energy and focuses upon geothermal resource assessment in the western U.S. We are currently involved in numerous DOE-sponsored geothermal programs, including a technical assistance program. This technical assistance program operates on a request basis, and provides up to 100 professional hours of geotechnical advice to potential users and developers of geothermal energy. The information furnished by this program commonly includes preliminary geothermal resource assessment of a site or sites specified by the requestor.

2) Bibliographic Information

Enclosed is a current list of Earth Science Laboratory publications.

3) Other Sources of Technical Assistance

The Earth Science Laboratory is closely coordinated with many other groups capable of providing either technical assistance or geothermal resource information. We work closely with the geothermal engineering technical assistance programs at EG&G Idaho, Inc. and the Oregon Institute of Technology. In addition, we remain in constant contact with the DOE-funded State Coupled Geothermal Resource Assessment Teams and the State Commercialization Teams.

Please let me know if you need additional information about the Earth Science Laboratory or our geothermal activities. I look forward to hearing from you.

Sincerely yours,

Debra Struhsacker

Debra Struhsacker
Associate Geologist

DS:gim

Encl.

cc: P. M. Wright
User Assistance File

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell International

81ETEC-DRF-2975

July 28, 1981

Multiple Addressees
(See Enclosed List)

Subject: Geothermal District Heating Technical Assistance Team

References: 1) Letter, Western Energy Planners, Ltd., R. T. Meyer to C. G. Lawson, ORNL, "Technical Assistance Requests from DOE for Santa Ana Pueblo District Heating and Cooling System Feasibility Study," July 17, 1981 (DRF-2907)

2) Letter 81ETEC-DRF-2029, G. S. Budney to Multiple Addressees, "Geothermal District Heating Technical Assistance Team," May 15, 1981

Dear Team Member:

Enclosed is a copy of the Reference 1) letter from Western Energy Planners, Ltd.
requesting technical assistance for the Santa Ana Pueblo District Heating and
Cooling System feasibility study. Specific requests are directed to New Mexico
Energy Institute, EG&G Idaho, Inc., and the University of Utah Research Institu
Earth Science Laboratory on the Geothermal District Heating Technical Assistan
Team, as well as to other organizations. As noted in the letter, Western Ene
Planners, Ltd. (WEPL) will be contacting Team Members shortly. Team Members
requested to cooperate with organizations participating in the HUD DH/C fea
study program consistent with their DOE contract requirements.

Copies of the ETEC-compiled Geothermal District Heating Technical Assista
Information Resources Handbook are being provided by ANL and ORNL to the
listed in Reference 2). Updated information received from Team Members
being forwarded to the communities. The Handbook was compiled from in
developed by ETEC and Team Members. A copy of the Title and Contents
enclosed for information.

The WEPL letter also solicits information on other sources of techn
that may be required and is available. Team Members recognizing a
of their expertise are requested to advise the ANL or ORNL Technic
Representative (TSR) and coordinate their contact with the commun
the TSR. TSR's are familiar with the communities' proposals and
should be able to respond to Team Members questions or provide
answers.

WESTERN ENERGY PLANNERS, LTD.

☐ P.O. Box 993. Idaho Falls. Idaho 83401 (208) 522-7546
☒ 11111 E. Mississippi Ave., Suite 208 (303) 363-7205
Aurora, Colorado 80012

July 17, 1981

RECEIV
JUL 21 1981
DRF 2907

Mr. C. George Lawson
Technical Support Representative
Oak Ridge National Laboratory
Building 3550
Oak Ridge, Tennessee 37830

Re: Technical Assistance Requests from DOE for Santa Ana Pueblo District Heating and Cooling System Feasibility Study

Dear Mr. Lawson:

Per our telephone conversation on July 7, 1981, I am herein itemizing our requests for technical assistance from the several prospective DOE national laboratories and contractors.

A. Oak Ridge National Laboratory

1. Technological information on cogeneration systems, biomass conversion systems, community solid waste, conversion systems, thermal storage systems, and hot water distribution systems pertinent to small community district heating systems.

2. Technical information on the energy contents of biomass and community solid waste materials.

3. Copies of the following reports by Ray Harrigan of Sandia National Laboratory:

   a. SAND-75-0542, December 1975.

   b. SAND-78-0449, April 1978.

Bronsman (615) 574-5947

4. Telephone communications from Ben Bronsman, ORNL, regarding supplemental study funds from the Bureau of Indian Affairs.

B. Sandia National Laboratories, Albuquerque

1. Technical information on geothermal drilling technologies and costs.

2. Technical information on applications of wind technologies to district heating and cooling systems.

3. Engineering and economic data on small community solar heating and cooling technologies.

4. Access to use of applicable computer programs for energy demand profile analysis and matching of supply and demand characteristics.

5. Tour of Sandia Lab solar, wind and geothermal facilities for the Santa Ana Assessment Work Group.

C. Los Alamos Scientific Laboratory

1. Geothermal resource assessment data and evaluation assistance for Santa Ana Pueblo reservation lands.

2. Technical assistance with evaluation and design of salt-gradient ponds for heating and cooling.

3. Solar economic data and/or evaluations for space heating and domestic hot water applications.

4. Technical information on applications of biomass and solid waste to community scale energy systems, from the DOE Technology Assessment of Solar Energy Systems Program.

5. Participation of John Altseimer, LASL S-4 Group, on the Santa Ana Pueblo DHC Assessment Work Group.

6. Tour of LASL solar and geothermal facilities, including the Hot Dry Rock Project at Fenton Hill and possibly the Union Oil hydrothermal project at Baca Location No. 1.

D. Solar Energy Research Institute, Golden

1. Design of community solar energy systems.

2. Wind and biomass technologies.

3. Research and development assistance on salt-gradient ponds.

4. Thermal energy options with photovoltaics.

E. New Mexico Energy Institute at New Mexico State University

1. Geothermal resource assessment data and evaluation for Santa Ana Pueblo reservation lands.

2. Economic analyses of geothermal direct heat and heat pump heating districts.

To: Mike Wright 8/29/81
From: Dick Meyer
Santa Ana Pueblo would like your participation at their Assessment Work Group meeting on Monday evening, November 16. Can you do so?





3. Tour of NMSU solar, wind and geothermal facilities at Las Cruces and area.

F. EG&G Idaho, Inc.

1. Technical information on biomass and geothermal technologies.

2. Engineering evaluations of geothermal district heating systems.

3. Presentation by Ed Dibello, Geothermal Program Manager, on geothermal direct heat applications to Santa Ana Pueblo Tribal Council and DHC Assessment Work Group.

G. University of Utah Research Institute, Earth Science Laboratory

1. Geothermal resource assessment data for New Mexico.

2. Presentation by Mike Wright, Deputy Director, on the geothermal resources of the United States and the World to Santa Ana Pueblo Tribal Council and DHC Assessment Work Group.

H. New Mexico Institute of Mining and Technology

1. Geothermal resource assessment data for Santa Ana Pueblo reservation lands.

I. Others To Be Determined

I have already made contacts with personnel at Sandia, LASL and SERI regarding the above assistance services. I shall be proceeding shortly with the others.

Please advise me if there are other DOE sources or types of technical assistance which you believe we should use in our specific project for Santa Ana Pueblo.

Sincerely yours,

WESTERN ENERGY PLANNERS, LTD.

R T Meyer

Richard T. Meyer, Ph. D.
President

RTM/jb
cc: Mary E. Garcia, Santa Ana
Clyde Leon, Santa Ana
Jerry Tuttle, WEPL
George Budney, Rockwell International ✓

pmw

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
420 CHIPETA WAY, SUITE 120
SALT LAKE CITY, UTAH 84108
TELEPHONE 801-581-5283

MEMORANDUM

March 15, 1981

TO: Eric Peterson, DOE/HQ
George Budney, ETEC

FROM: Debbie Struhsacker and Bob Blackett

RE: Prioritized List of Sites Suitable for Near-Term Development of Geothermal District Heating Systems for the DOE/HUD District Heating Project

The sites listed and described below are those areas thought to have the greatest near-term potential for development of geothermal district heating systems. This list has been developed for the DOE/HUD District Heating and Cooling Program. Since this program has very limited funding for resource confirmation, this list is restricted to those geothermal sites which 1) require little or no exploration and drilling and 2) are close to a city. This list is not intended to include all sites with potential for development of geothermal district heating systems. This list should be reviewed by the State Coupled Resource Assessment Team and State Planning and Commercialization Team in each state.

Definitions:

Priority 1 Area

A city in which there is a presently operating geothermal district heating system, or one that has operated in the past; the existing systems have room for expansion. Expansion efforts may or may not require drilling.

Priority 2 Area

Cities in which there are thermal spring(s) and/or existing well(s) that could be used to support a district heating system, but which aren't currently being used for this purpose. No significant exploration is needed, some drilling may be needed.

Priority 3 Area

Cities in close proximity to known thermal features which have received some geothermal exploration, but which would require significant additional exploration and drilling prior to confirmation of a resource capable of supporting a district heating system.

PRIORITY 1 AREAS

CALIFORNIA
    Susanville

COLORADO
    Pagosa Springs

IDAHO
    Boise
    Hailey
    ketchum

NEVADA
    Reno

OREGON
    Klamath Falls

PRIORITY 2 AREAS

CALIFORNIA
- Calistoga
- Mammoth Lakes

COLORADO
- Glenwood Springs
- Ouray

IDAHO
- Twin Falls

MONTANA
- Bozeman

NEVADA
- Elko
- Hawthorne
- Caliente

NEW MEXICO
- Las Cruces
- Truth or Consequences

OREGON
- Lakeview
- Vale

UTAH
- Monroe
- Newcastle

WYOMING
- Thermopolis

PRIORITY 3 AREAS

ARIZONA
- Safford

CALIFORNIA
- San Bernardino
- El Centro

COLORADO
- Steamboat

IDAHO
- Preston
- Weiser
- Challis
- Fairfield
- Mountain Home
- Nampa
- Caldwell
- Stanley

MONTANA
- Hot Springs
- Baker
- White Sulfur Springs

NEVADA
- Carlin
- Gabbs
- Carson City
- Wells

UTAH
- Salt Lake city area

WASHINGTON
- North Bonneville

WYOMING
- Midwest

The following is a brief description of the geothermal potential of the areas listed above.

PRIORITY 1 AREAS

CALIFORNIA:

Susanville; Preliminary tests from exploration and production drilling for a field demonstration project for space heating 14 public buildings indicate that a district heating project is viable. Fluid temperatures near 74°C and adequate flow rates (300-500 gpm) have been encountered at depths between 108 and 116 m.

Reference: Benson, S., Goranson, C., Nobel, J., Schroeder, R., Corrigan, D. and Wollenberg, H., 1980, Evaluation of the Susanville, California Geothermal Resource, Lawrence Berkeley Laboratory, Univ. of Ca. report, 41p.

COLORADO:

Pagosa Springs; Thermal waters are currently utilized for space heating in commercial and public buildings. The system is under expansion. The main spring discharges 58°C water at 250 gpm. Nearly 30 wells have been drilled for space heating and recreational purposes. Most wells are less than 150 m deep, and produce water ranging in temperature from 54° to 77°C.

Reference: Pearl, R.H., 1979, Colorado's Hydrothermal Resource Base-an assessment. Colorado Geological Survey Resource Series 6, 144 p.

IDAHO:

Boise; Thermal water in use since 1893 currently heats 200 homes and the state health laboratory complex. 76°C water is pumped from two wells that provide the Warm Springs Water District with thermal water for space heating. The Idaho Office of Energy and the Idaho Departments of Administration and Water Resource recently drilled a 640 m well to space heat the Capitol Mall area. This well produces up to 750 gpm of 71°C water.

Reference: Anderson, J.E., 1981, verbal communication.

Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, Geothermal Resources of Idaho, Idaho Department of Water Resources, Water Information Bulletin 30, Part 9, 396 p.

Hailey; Thermal water from the Hailey Hot Spring area used to be piped 3 km to the town of Hailey to heat a hotel before the hotel was destroyed by a fire. The surface temperature and flow rate of the springs is 55°C, and 530 gpm respectively. The pipeline is still presumably in working order.

Reference: Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, Geothermal Resources of Idaho, Idaho Department of Water Resources, Water Information Bulletin 30, Part 9, 396 p.

Burke, J., 1981, verbal communication.

Ketchum; Thermal water from Guyer Hot Springs presently heats numerous homes and businesses. The heating system is old and could be upgraded. The Guyer Hot Springs issue 70°C water at approximately 1000 gpm.

Reference: Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, Geothermal Resources of Idaho, Idaho Department of Water Resources, Water Information Bulletin 30, Part 9, 396 p.

NEVADA:

Reno; The Moana Hot Springs located in the Truckee Meadows near Reno, Nevada are currently being used for space heating in 66 homes, 3 commercial buildings and a church. Numerous wells drilled into the system have encountered temperatures from 22° to 95°C.

Reference: Trexler, D.T., Koenig, B.A., and Flynn, T., 1980, Geothermal Resources of Nevada and their Potential for Direct Utilization; Nevada Bureau of Mines and Geology, map: scale 1:500,000.

The Mitre Corporation, 1980, Geothermal Progress Monitor Report No. 4, U.S. Dept. of Commerce (NTIS) report 112 p.

Garside, L.J. and Schilling, J.H., 1979, Thermal Waters of Nevada, Nevada Bureau of Mines and Geology Bulletin 91, 163 p.

OREGON:

Klamath Falls; With the largest concentration of direct use applications in the country, Klamath Falls uses thermal water from 400 wells to heat private residences, public schools, the Oregon Institute of Technology campus, a hospital, and commercial buildings. Geothermal wells produce water with temperatures ranging from 21° to 121°C. Well depths range from 40 to 550 m.

Reference: Justus, D., 1979, Geothermal Energy in Oregon: Site Data

Base and Development Status, Oregon Institute of Technology--Geo-Heat Utilization Center Report, 438 p.

PRIORITY 2 AREAS

CALIFORNIA:

Calistoga; The geothermal system at Calistoga has been used for many years as a health spa. Many thermal wells are known within the city limits; some produce boiling water.

Reference: Higgins, C.T., and Martin, R.C., 1980, Geothermal Resources of California, Division of Mines and Geology, California Department of Conservation Map, scale - 1:750,000.

Mammoth Lakes; A district heat demonstration project has been delayed due to lack of funding. The resource is not fully defined. Spring temperatures range from 68° to 93°C.; one well has encountered a 178°C temperature at a depth of 326 m.

Reference: Higgins, C.T., and Martin, R.C., 1980, Geothermal Resources of California, Division of Mines and Geology, California Department of Conservation Map scale - 1:750,000.

COLORADO:

Glenwood Springs; Twelve to fifteen springs collectively known as Glenwood Hot Springs are located adjacent to the town of Glenwood Springs, Colorado. The temperature and flow rate of the largest spring is 51°C at 2263 gpm respectively. A study is underway to determine the feasibility of using this resource for space heating of government buildings and for sewage treatment.

Reference: Pearl, R.H., 1979, Colorado's Hydrothermal Resource Base-an Assessment, Colorado Geological Survey-Department of Natural Resources Report, 144 p.

_____, (1980) Geothermal Resources of Colorado, Colorado Geological Survey Map, scale 1:500,000.

Ouray; Water at a temperature of 69°C discharges from Pool Hot Spring at a rate of 200 gpm and is used to heat a swimming pool. Thermal water from Uncompahgre Hot Spring and Weisbaden Motel Hot Spring flow at much lower rates with lower temperatures. Waters reportedly exceed EPA limits for radium. Ouray is the site of a detailed geothermal study by the Colorado Geological Survey.

Reference: Pearl, R.H., 1979, Colorado's Hydrothermal Resource Base-an Assessment, Colorado Geological Survey-Department of Natural Resources Report, 144 p.

IDAHO:

Twin Falls; Water wells in the vicinity characteristically produce warm (approximately 37°C) artesian water at a rate of up to 1000 gpm from depths of 305 to 396 meters. Many of these wells are within the city limits. Thermal fluids are thought to result from deep circulation along faults.

Reference: Mitchell, J.C., L.L., Anderson, J.E., 1980, Idaho Department of Water Resources, Water Information Bulletin #30, Part 9, 396 p.

MONTANA:

Bozeman; Bozeman Hot Springs located 11 km west of the city of Bozeman, Montana issues at a rate of 30 gpm with a surface temperature of 55°C from unconsolidated valley sediments. A few water wells have also encountered hot water in the area but little is known about this resource which is thought to be controlled by faulting within underlying Precambrian rocks. A recently drilled well produces approximately 1000 gpm of 55°C water. The ultimate production potential of this well is currently under investigation.

Reference: Brown, K.E., 1979, Geothermal Energy in Montana: Site Data Base and Development Status, Oregon Institute of Technology--Geo Heat Utilization Center report, 269p.

Sonderegger, J., 1981, verbal communication.

NEVADA:

Elko; Several hot springs with surface temperatures ranging from 56° to 88°C and one warm well (24°C) are located a short distance (2.5 km) southeast of the community of Elko, Nevada. The resource is thought to be fault controlled. Recent thermal gradient test well drilling has encountered temperatures up to 71°C at a depth of 170 m.

Reference: Trexler, D.T., Koenig, B.A., and Flynn, T., 1980, Geothermal Resources of Nevada and their Potential for Direct Utilization; Nevada Bureau of Mines and Geology map, scale 1:500,000.

Hawthorne; Several water wells in the Hawthorne area have reported water temperatures of 24° to 51°C. A recently drilled 312 m well approximately 1.6 km southwest of town produces up to 900 gpm of 99°C water. The owners of this well hope to utilize the resource for space heating of a casino and some public buildings. The resource appears to be associated with the frontal fault on the east side of the Wassuk Range, since wells closer to the fault are warmer.

Reference: Garside, L.J., and Schilling, J.H., 1979, Thermal Waters of Nevada, Nevada Bureau of Mines and Geology Bulletin 91, 163 p.

Caliente; The Caliente Hot Springs, which no longer flow, reportedly had surface temperatures up to 48°C and were located along the trace of a fault in Tertiary volcanic rocks. Water wells in the vicinity have encountered temperatures up to 63°C at depths less than 60 m.

Reference: Garside, L.J., and Schilling, J.H., 1979, Thermal Waters of Nevada, Nevada Bureau of Mines and Geology Bulletin 91, 163 p.

NEW MEXICO:

Las Cruces; Geothermal wells have encountered temperatures of 63°C at depths less than 305 feet. Development plans include space heating and agriculture process heat for facilities at New Mexico State University.

Reference: Swanberg, C.A., 1980, Geothermal Resources of New Mexico, New Mexico Energy Institute map scale 1:500,000.

Truth or Consequences; Numerous warm springs and warm artesian wells with temperatures from 40° to 45°C occur within the city limits. Current uses of the resource include spas, mineral baths, and space heating. Fluids are thought to be heated as a result of deep circulation along a reverse fault.

Reference: Swanberg, C.A., 1980, Geothermal Resources of New Mexico, New Mexico Energy Institute Map, scale 1:500,000.

OREGON:

Lakeview; The alignment of thermal springs 4 km north and 3.6 km south of the town of Lakeview suggest a fault controlled resource. Surface temperatures of the springs vary from 88° to 96°C and flow at approximately 500 gpm. Chemical geothermometers indicate reservoir temperatures of about 160°C. Several small-scale direct-heat applications are underway.

Reference: Justus, D., 1979, Geothermal Resources in Oregon: Site Data Base and Development Status, OIT Geo-Heat Utilization Center report, 438 p.

Vale; Estimated by the USGS to have the second highest geothermal reservoir potential in the state of Oregon. Surface spring temperatures are 97°C while geochemical data suggest a reservoir temperature between 140° and 160°C. Shallow wells drilled adjacent to the hot spring area encounter temperatures up to 119°C. Reservoir rocks are thought to be fractured basalt flows at depths between one and two kilometers. Limited use is presently being made of this geothermal resource.

Reference: Justus, D., 1979, Geothermal Resources in Oregon: Site Data Base and Development Status, OIT Geo-Heat Utilization Center report, 438 p.

UTAH:

Monroe; A test well completed under a cooperative agreement between the city of Monroe and DOE was drilled to a depth of 450 meters. Water was produced at a temperature of 75°C and a flow rate of 600 gpm. The city of Monroe is eager to develop a use for these fluids. Union Oil Company has recently announced plans for geothermal exploration in the area.

Reference: Murphy, P.J., 1980, Geothermal Resources of Utah, Utah Geological and Mineral Survey map, scale 1:500,000.

Newcastle; A well drilled to a depth of 150 meters produces water at a temperature of 96°C and a flow rate of 1700 gpm. This water is used to space heat a greenhouse. The area has no surface manifestations of thermal water, but has very high measured heat flow values.

Reference: Murphy, P.J., 1980, Geothermal Resources of Utah, Utah Geological and Mineral Survey map, scale 1:500,000.

WYOMING:

Thermopolis; Several hot springs are located within a state park form one of the largest thermal systems in the U.S. The largest spring issues thermal water at 56°C and a flow rate of 2908 gpm. Three privately owned wells in the area, which have been used for space heating and swimming pools, have a combined flow rate of approximately 2400 gpm at temperatures from 52° to 54°C.

Reference: James, R.W., 1979, Geothermal Energy in Wyoming: Site Data Base and Development Status, OIT Geo-Heat Utilization center report, 101 p.

PRIORITY 3 AREAS

ARIZONA:

Safford; The town of Safford, Arizona is located within a deep sedimentary basin (+3km) and is surrounded by numerous hot springs with temperatures ranging from 33° to 47°C. The geothermal potential of the Safford area is under investigation by the Arizona Bureau of Mineral Technology.

Reference: Western Energy Planners and Griffith, J.L., 1979, State Geothermal Commercialization Programs in Ten Rocky Mountain States, Semi-Annual Progress Report, Dept. of Energy Report DOE/ID/12101-1, 306 p.

CALIFORNIA:

San Bernardino; Temperatures between 32° and 90°C from shallow water wells in the area indicate a potential resource within 60 m from the surface. Geothermometers place wallrock equilibration temperatures near 137° C.

Reference: Higgins, C.T., and Martin, R.C., 1980, Geothermal Resources of California, Calif. Dept. Conserv., Div. of Mines and Geol. map, scale 1:750,000.

El Centro; Several wells in the vicinity of El Centro have encountered low temperature resources (27-77°C) at shallow depths. In addition, the Heber geothermal field is less than 5 km to the southeast. Wells in the Heber field have produced 160 C° brines (20,000 mg/l TDS) from depths of 1370 m. El Centro is the site of a DOE-funded PON project to demonstrate the use of geothermal fluids for space heating and cooling.

Reference: Higgins, C.T. and Martin, R.C., 1980, Geothermal Resources of California, Calif. Dept. of Conserv., Division of Mines and Geology, map scale 1:750,000.

COLORADO:

Steamboat Springs; Hot springs occur both within the town of Steamboat Springs itself and 10 kilometers north of the city limits. Heart Hot Spring, located on the southeast edge of town, is used to heat a swimming pool. Heart Hot Springs discharges water at a temperature of 39°C and a rate of 140 gpm. Other springs occur in and near the town and have surface temperatures from 20 to 26°C. Routt Hot springs, 10 km north of Steamboat Springs, consists of a group of five unused thermal springs with surface temperatures ranging from 51° to 64°C and a total discharge rate of approximately 80 gpm. All hot springs appear to be associated with a major north-south trending fault.

Reference: Pearl, R.H., 1979, Colorado's Hydrothermal Resource Base-an Assessment, Colorado Geological Survey report, 144 p.

IDAHO:

Preston; Two hot springs and two hot wells are located less than 8 km to the northwest of the town of Preston, Idaho. The temperatures of the springs and wells vary from 63° to 84° C with total discharge of nearly 1000 gpm.

Reference: Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, Geothermal Resources of Idaho, Idaho Dept. of Water Resources, Water Information Bulletin No. 30, Part 9, 396 p.

Weiser; The Weiser geothermal area is located five kilometers to the northwest of the town of Weiser, Idaho. Geothermal waters are produced from Miocene basalt flows of the western Snake River Plain. Geosolar Growers Well #1 produces 70°C water at a rate of 1465 gpm from a depth of 121 m. Several other geothermal test wells have been drilled in the area.

Reference: Mitchell, J.C., <u>op cit.</u>.

Challis; Beardsley Hot Springs located 8 km northeast of Challis, Idaho produce 43°C water at a rate of 1465 gpm. A warm water well adjacent to the Challis city limits was drilled to a depth of approximately 2300 m and later was blocked at 600 m. This well produces 40°C water at a rate of 50 gpm. Expansion due to a new mining development in the area has generated considerable community interest in utilizing geothermal energy for space heating.

Reference: Mitchell, J.C., <u>op cit.</u>

Fairfield; Located within the Camas Prarie Geothermal Area, Fairfield, Idaho is less than 16 km northeast from the Barron's Hot Spring area. Here several hot springs and wells occur in Quaternary alluvium near

Tertiary silicic volcanic rocks. Thermal wells and springs typically yield water temperatures from 45° to 75°C and flow rates less than 50 gpm. The Fairfield City Well produces slightly anomalously warm water.

Reference: Mitchell, J.C., <u>op lit.</u>

Mountain Home; The town of Mountain Home is located approximately 16 km west of the Mountain Home KGRA where large volumes of water at a temperature of 67°C is pumped from numerous wells in Pliocene and Pleistocene sediments.

References: Mitchell, J.C., <u>op cit.</u>

Nampa; Thermal water (31°C) from Pliocene and Pleistocene sediments of the Snake River Plain are used from Nampa City Well #2 for public water supply and aquaculture. Water is pumped at a rate of about 500 gpm from a depth of 37 m.

Reference: Mitchell, J.C., <u>op cit.</u>

Caldwell; Thermal water (29-40°C) is produced from Pliocene and Pleistocene lake sediments from depths ranging from 400 to 2000 feet and used for space heating (with heat pumps) de-icing roadways, and aquaculture.

Reference: Mitchell, J.C., <u>op cit.</u>

Stanley; Several hot springs are located a short distance to the northeast of Stanley, Idaho along the Salmon River. Surface temperatures range from 35° to 58°C and discharge rates vary from about 50 to 200 gpm. The nearest spring, Stanley Hot Spring, has a surface temperature and flow rate of 41°C and 98 gpm respectively.

Reference: Mitchell, J.C., op cit.

MONTANA:

Hot Springs; A well was recently drilled near Camas Hot Springs to a depth of 305 m. The location of the well is approximately 6 km from the town of Hot Springs, Montana. Although the sustained yield of warm water (50°C) from the well is questionable, the pumped flow rate upon testing was 800 gpm. The source of the thermal water is from a gravel aquifer at a depth of 76 m.

Reference: Sonderegger, J.L., 1981, verbal communication.

Baker; The town of Baker, Montana is studying th direct application possibilities of using geothrmal fluids from two "holes of opportunity" donated to the town by an oil company. One well would be used for injection and the other for production of geothermal fluids from the Madison Formation at a depth of 1220 m.

Reference: Chapman, M., 1981, verbal communication.

White Sulfur Springs; Thermal water at a temperature of 46°C and at depths less than 76 m has been used for space heating of a bank in White Sulfur Springs, Montana. The resource site is located adjacent to the town.

Reference: Brown, K.E., 1979, Geothermal Energy in Montana: Site Data Base and Development Status, OIT Geo-Heat Utilization Center report, 269p.

NEVADA:

Carlin; The Carlin Area Hot Springs are located about 5 km southwest of Carlin, Nevada. The measured surface temperatures are reported from 79°C to boiling. The discharge rates are from 300 to 400 gpm.

Reference: Trexler, D.T., Koenig, B.A., and Flynn, T., 1980, Geothermal Resources of Nevada and Their Potential for Direct Utilization; Nevada Bureau of Mines and Geology map, scale 1:500,000.

Gabbs; Many water wells drilled for the water supply at Basic, Inc.'s mine/mill complex near Gabbs, Nevada have temperatures as high as 68°C. Thermal water is thought to be associated with deep circulation along the westward frontal fault of the Paradise Range.

Reference: Garside, L.J., and Schilling, J.H., 1979, Thermal Waters of Nevada, Nevada Bureau of Mines and Geology Bulletin 91, 163p.

Carson City; Carson Hot Springs (49°C at 75 gpm) located on the north edge of Carson City, Nevada is used to heat a swimming pool. One hot spring and a number of warm wells occur adjacent to the southeast side of the community near the old state prison and in the Pinyon Hills Subdivision.

Reference: Garside, L.J., op cit.

Wells; Three areas with ten individual hot springs are located within a distance of 8 km north of the town of Wells, Nevada. The springs are situated along a typical Basin and Range fault with surface temperatures reported as high as 61°C. Estimates of reservoir temperature using the Na-K-Ca geothermometers are as high as 184°C. The largest of the springs flows at a rate of 50 gpm with a discharge temperature of 37°C. A 150 m well just north of the city produces 49°C water. A nearby 1220 m petroleum test well has a bottom hole temperature of 113°C.

Reference: Garside, L.J., op cit.

UTAH:

Salt Lake City Area; Along the eastern margin of Salt Lake City two hot springs and numerous warm water wells produce thermal water from deep circulation along the Wasatch Fault. Two DOE-sponsored demonstration projects; a geothermally heated greenhouse and space heating at the Utah State Prison, have proven the usefulness of direct heat applications in the Salt Lake City Area. The most recent geothermal well drilled near Crystal Hot Spring encountered water temperatures of 88°C with a flow rate of 150 gpm at a depth of 125 m.

References: Murphy, P.J., 1980, Geothermal Resources of Utah, Utah Geological and Mineral Survey map, scale 1:500,000.

WASHINGTON:

North Bonneville; Surface manifestations of a structurally controlled geothermal system are present at the northwest perimeter of the town of North Bonneville, Washington at Moffetts Hot Springs. The springs have a surface discharge temperature of 32°C. Thermal gradient drilling is scheduled for the future. The town hopes to develop the resource for space heating.

Reference: Nielson, D.L. and Moran, M.R., 1980, Geologic Interpretation of the Geothermal Potential of the North Bonneville Area, ESL/UURI Open File Report.

WYOMING:

Midwest; Geothermal fluids from the Madison Formation are presently used for water flooding of the nearby Salt Creek Oil Field. Hot geothermal brine consisting of 93°C water with 2500 ppm total dissolved solids is gathered from water wells with artesian flow of 14,583 gpm. The depth to the Madison Reservoir is approximately 2000 m.

Reference: James, R.W., 1979, Geothermal Energy in Wyoming: Site Data Base and Development Status, OIT Geo-Heat Utilization Center report, 101 p.

# GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

- HUD/DOE SOLICITATION
- TEAM OBJECTIVES
- TEAM RESPONSIBILITIES
- INFORMATION FLOW
- TENTATIVE SCHEDULE
- HANDOUT PACKAGE

# HUD SOLICITATION

- ANNOUNCEMENT: FEDERAL REGISTER, OCTOBER 17, 1980
- PROPOSAL FOR IDENTIFYING POTENTIAL DISTRICT HEATING AND COOLING (DH/C) SYSTEM PROJECTS.
- COMMUNITY DH/C SYSTEM DEFINED AS "AN ENERGY SYSTEM...TO SERVICE A NUMBER OF BUILDINGS AND CUSTOMERS WITH THERMAL SERVICES THROUGH A PIPING DISTRIBUTION NETWORK..."
- GEOTHERMAL AS WELL AS OTHER ENERGY HEAT SOURCES MAY BE UTILIZED.
- PROPOSAL DUE DATE: JANUARY 21, 1981
- AWARDS: APPROXIMATELY 20-35
- FUNDING: APPROXIMATELY $1.5 MILLION TOTAL
- OTHER RESOURCES:

    DOE TECHNICAL SUPPORT

    ARGONNE NATIONAL LABORATORY

    OAK RIDGE NATIONAL LABORATORY

    PACIFIC NORTHWEST LABORATORIES

    GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

## DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

## OBJECTIVES

1. TO ORGANIZE AND COORDINATE TECHNICAL ASSISTANCE TO PROPOSERS OF GEOTHERMAL DISTRICT HEATING AND COOLING PROJECTS.

2. TO DISSEMINATE TO POTENTIAL USERS INFORMATION ON THE BENEFITS AND POTENTIAL PITFALLS OF GEOTHERMAL DISTRICT HEATING AND COOLING SYSTEMS.

## ETEC RESPONSIBILITIES

1. ORGANIZE THE DISTRICT HEATING TECHNICAL ASSISTANCE TEAM.

2. DETERMINE, WITH TEAM MEMBERS, THE BEST WAY OF ASSISTING GEOTHERMAL DH SYSTEM PROPOSERS.

3. ORGANIZE TEAM MEETING WITH GEOTHERMAL DH SYSTEM PROPOSERS.

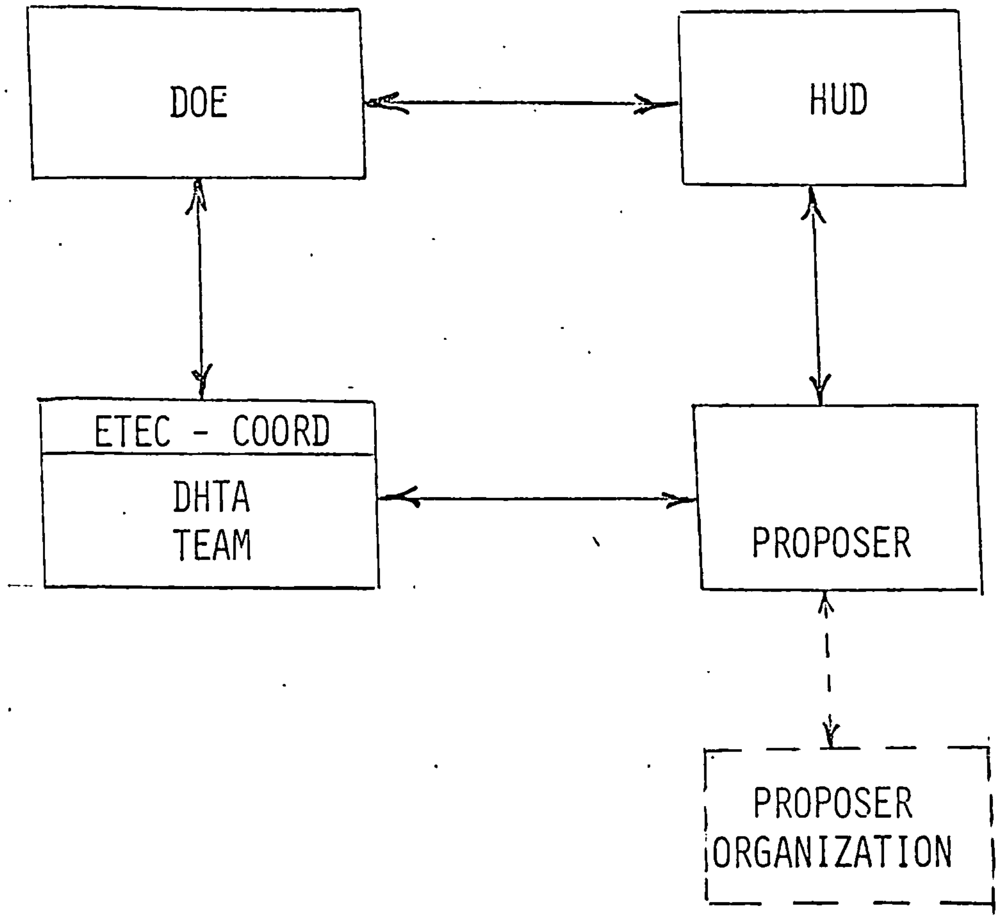
# DOE CONTRACTOR TEAM MEMBERS RESPONSIBILITIES

(RESOLVE FUNDING FOR THESE ACTIVITIES)

(ASSESS POTENTIAL CONFLICT OF INTEREST)

1. ESTABLISH A LEADER AND BACKUP CONTACT FOR THIS ACTIVITY.
2. ASSEMBLE DOCUMENTS AND REFERENCES OF POTENTIAL INTEREST.
3. ATTEND AND PARTICIPATE IN TEAM MEETINGS.
4. PARTICIPATE IN SEMINAR WITH GEOTHERMAL DH SYSTEM PROPOSERS.
5. RESPOND IN A TIMELY MANNER TO REQUESTS FOR ASSISTANCE.
6. IDENTIFY POTENTIAL DISTRICT HEATING SYSTEM USERS.

INFORMATION FLOW



# GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE ACTIVITIES SCHEDULE

| ACTIVITY | 1980 SEP | 1980 OCT | 1980 NOV | 1980 DEC | 1981 JAN | 1981 FEB | 1981 MAR | 1981 APR | 1981 MAY | 1981 JUN | 1981 JUL | 1981 AUG | 1981 SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HUD ANNOUNCEMENT | | ▼ | | | | | | | | | | | |
| HUD PROPOSALS DUE | | | | | ▽ | | | | | | | | |
| ETEC INVITATION | ▼ | | | | | | | | | | | | |
| DOE INVITATION | | ▼ | | | | | | | | | | | |
| ETEC PRE-SEMINAR MEETING | | | | | | | | ▽* | | | | | |
| ETEC/TEAM SEMINAR | | | | | | | | | ▽ * | | | | |
| TEAM MEMBERS ASSISTANCE | | | | | | | | | * ━━━ | ━━━ | ━━━ | ━━━ | ━━━ |

* TENTATIVE

# HANDOUT PACKAGE

- VIEWGRAPHS
- ETEC LETTER
- RESPONSES
- DOE LETTER
- RESPONSES
- HUD/DOE APPLICATION KIT
  - STATEMENT OF WORK
  - FACTORS FOR AWARD
  - DEFINITIONS
  - TECHNICAL SUPPORT
  - COMMUNITY DEVELOPMENT BLOCK GRANT
  - APPLICATION INSTRUCTION

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

September 23, 1980 80ETEC-DRF-3987

Multiple Addressees
(See Attached List)

Subject: U. S. Department of Energy, Division of Geothermal Energy, District Heating Product Team

Gentlemen:

The U. S. Department of Energy (DOE) is in the process of forming a District Heating Product Team. The purpose of the team is to:

1. Draw together various district heating activities funded by DOE/Division of Geothermal Energy.

2. Coordinate DOE funded technical assistance activities with other federally funded programs.

3. Promote district heating on a national basis with various prospective users, and working on the local level with commercial teams.

Organizations interested in becoming active participants in this program are requested to so indicate in their replies.

An immediate objective of the District Heating Product Team is to support the national HUD/DOE district heating solicitation to be published in the Federal Register in early October 1980. Technical assistance will be a strong component of the program with support to DOE from ANL and ORNL. ETEC, as the principle coordinator for the team, will be responsible for identifying the technical assistance needs of the prospective solicitation winners proposing geothermal energy heat sources and seeing that these needs are met by the appropriate elements of DOE's technical assistance and outreach programs. State commercialization teams will have a strong input into this process. It is expected that HUD will fund 5-10 geothermal district heating feasibility studies in this first solicitation.

In order to obtain information abour services available to communities and organizations contemplating geothermal district heating, we require the following information from prospective team participants by October 10, 1980.

1. Summary outlining areas of expertise.

2. Bibliography of documents that may assist solicitation winners.

3. List of other organizations such as state energy commissions, governmental agencies, etc., that may be able to provide assistance to the solicitation winners.

Costs that are incurred in responding to this and related letters and for providing technical assistance to solicitation winners are to be taken from existing DOE budgets. If this is not possible, the addressee should contact his DOE contracting officer and/or Mr. Eric Peterson, Program Manager, DOE, Washington, D.C., for further direction before proceeding. Participation in this program by non-DOE funded organizations is on a voluntary basis.

If you have any questions, please call me at ETEC on extension 6474.

Sincerely yours,

G.S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

cc: J. K. Hartman, ETEC PO

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

Multiple Addressees

The U. S. Department of Energy (DOE) is in the process of forming a District Heating Team. The purpose of the team is to:

1. Draw together various district heating activities funded by DOE/Division of Geothermal Energy.

2. Coordinate DOE funded technical assistance activities with other federally funded programs.

3. Promote district heating on a national basis with various prospective users, and working on the local level with state commercialization teams.

An immediate objective of the District Heating Team is to support the national HUD/DOE district heating solicitation which has been announced in the Federal Register (copy of announcement attached). Technical assistance will be a strong component of the program with support to DOE from the Argonne National Lab (ANL) and Oak Ridge National Lab (ORNL). For the geothermal district heating team the Energy Technology Engineering Center (ETEC) will be responsible for identifying technical assistance needs of the prospective solicitation winners proposing geothermal energy heat sources and seeing that these needs are met by the appropriate elements of DOE's technical assistance and outreach programs. State commercialization teams will have a strong input into this process. It is expected that HUD will fund 5-10 geothermal district heating feasibility studies in this first solicitation.

Assuming a feasibility study is awarded for a project in your state, what is your interest in participating in the District Heating Team? If you are interested, please submit the following information by November 14, 1980, so that we can be prepared to assist organizations contemplating geothermal district heating:

1. Summary outlining areas of expertise.

2. Bibliography of documents that may assist solicitation winners.

3. List of other organizations such as state energy commissions, governmental agencies, etc., that may be able to provide assistance to the solicitation winners.

Please provide your response to George Budney. Energy Technology Engineering Center, Energy Systems Group, P.O. Box 1449, Canoga Park, Calif. Before making any commitments to this team, please coordinate your involvement with Mike Tucker.

If you have any questions about this program, please call me (415-273-7943) or George Budney (213-341-1000, extension 6474).

Sincerely,

Hilary Sullivan

Hilary Sullivan
Program Coordinator
Geothermal Energy Division

Attachment:
As Stated

cc: Mike Tucker, DOE, ID
George Budney, ETEC
Eric Peterson, DGE

GEOTHERMAL DISTRICT HEATING TECHNICAL ASSISTANCE TEAM

| Individual/Organization | Comments |
|---|---|
| Hilary Sullivan<br>Program Coordinator, Geothermal Energy Division<br>U. S. Department of Energy<br>San Francisco Operations Office<br>1333 Broadway<br>Oakland, California 94612<br>Telephone: (415) 273-7943 | |
| George S. Budney<br>Project Manager, Geothermal Programs<br>Energy Technology Engineering Center<br>P. O. Box 1449<br>Canoga Park, California 91304<br>Telephone: (213) 341-100, Ext. 6474 | Geothermal Distric Heating Team Coordination. |
| Eric A. Peterson<br>Program Manager - Division of Geothermal Energy<br>U. S. Department of Energy<br>12th & Pennsylvania Avenue, N.W.<br>Washington, D. C. 20451<br>Telephone: (202) 633-8760 | |
| Mike Tucker<br>Idaho Operations Office<br>U. S. Department of Energy<br>550 Second Street<br>Idaho Falls, Idaho 83401<br>Telephone: (208) 526-3180 | |
| Jim B. Cotter<br>Nevada Operations Office<br>U. S. Department of Energy<br>P. O. Box 14100<br>Las Vegas, Nevada 89114<br>Telephone: (702) 734-3424 | |
| Jess Pascual<br>Building 214, Engineering Division<br>Argonne National Laboratory<br>9700 South Cass Avenue<br>Argonne, Illinois 60439<br>Telephone: (312) 972-5249 | Conceptual Design and Performance Specs for information and Data Acquisition Systems. Computer Code Application. Report review and modification. |

| Individual/Organization | Comments |
|---|---|
| Ms. Ann. W. Reisman<br>Energy Systems Analysis<br>Department of Energy and Environment<br>Brookhaven National Laboratory<br>Associated Universities, Inc.<br>Upton, L.I. New York 11973<br>Telephone: (516) 345-2666 | |
| Dr. Ishai Oliker<br>Project Manager, District Heating Projects<br>Burns and Roe, Inc.<br>800 Kinderkamack Road<br>Oradell, New Jersey 07649<br>Telephone: (201) 265-2000, Ext. 2702 | |
| E. Ross Deter, Manager<br>Office of Small Power Producers<br>Development Division<br>California Energy Commission<br>1111 Howe Avenue<br>Sacramento, California 95825<br>Telephone: (916) 924-2497 | Institutional, Environmental, Economics, and Technical aspects of Geothermal Development. |
| Mr. Michael Gersick, Deputy Director<br>Department of Conservation<br>1416 9th Street<br>Sacramento, California 95825 | |
| J. C. Austin<br>$CH_2M$ Hill, Boise Office<br>P. O. Box 8748<br>Boise, Idaho 83707<br>Telephone: (208) 345-5310 | Environmental Planning.<br>Institutional and Legal problems.<br>Technical assistance in Direct Use Applications, Corrosion, etc. |
| Richard E. Pearl, Project Coordinator<br>Geothermal Commercialization and Planning Project<br>Colorado Geological Survey<br>715 State Centennial Building<br>1313 Sherman Street<br>Denver, Colorado<br>(303) 839-2611 | All phases of Geothermal Energy planning and commercialization. |

| Individual/Organization | Comments |
| --- | --- |
| John Nimmons<br>Earl Warren Legal Institute<br>University of California<br>Berkeley, California 94726<br>Telephone: (415) 642-8305 | No current funding. |
| Mr. Robert Van Horn, Executive Director<br>GRIPS Commission<br>2628 Mendocino Avenue<br>Santa Rose, California 95401<br>Telephone: | No response. |
| Mr. Jim Woodruff<br>Department of Planning and Economic Development<br>P. O. Box 2359<br>Honolulu, Hawaii 96804<br>Telephone: | No response. |
| William Toth<br>Hydrothermal Energy Commercialization Division<br>EG&G Idaho, Inc.<br>Idaho National Engineering Laboratory<br>P. O. Box 1625<br>Idaho Falls, Idaho 83401<br>Telephone: (208) 526-9217 | Engineering and System Design.<br>Project Management.<br>Environmental, Health and Safety Economics. |
| Mr. Bill Eastlake<br>Office of Energy<br>Statehouse<br>Boise, Idaho 83720<br>Telephone: | No response. |
| Mr. Dave Pierson, Director<br>Public Works Department<br>Imperial County<br>The Courthouse<br>El Centro, California 92243<br>Telephone: | No response. |

| Individual/Organization | Comments |
|---|---|
| Richard E. Eckfield, Director<br>Institute for the Development of Urban Arts and Sciences<br>U. S. Conference of Mayors<br>1620 Eye Street, N.W.<br>Washington, D. C. 20006<br>Telephone: (202) 293-7318 | No response. |
| Dr. Fletcher C. Paddison<br>Johns Hopkins University - Applied Physics Laboratory<br>Johns Hopkins Road<br>Laurel, Maryland 20810<br>Telephone: (301) 953-7100 | Institutional problems. Economic Computer Model ("GRITS"). |
| Mr. John Orndorff<br>Energy Planning Division<br>Montana Department of Natural Resources<br>32 South Ewing<br>Helena, Montana 59601<br>Telephone: | No response. |
| Earl Butler<br>National Association of Home Builders<br>15th and M Street, N.W.<br>Washington, D. C. 20005<br>Telephone: (202) 452-0200 | No response. |
| Doug Sacarto<br>National Council of State Legislatures<br>1125 - 17th Street, Suite 1500<br>Denver, Colorado 80202<br>Telephone: (303) 623-6600 | State Policies, Laws, Controls, Taxation, Regulation, etc. |
| Dennis Bass<br>National League of Cities<br>1301 Pennsylvania Avenue, N.W.<br>Washington, D. C. 20004<br>Telephone: (202) 626-3000 | No response. |

| Individual/Organization | Comments |
|---|---|
| Mr. Noel Clark, Director<br>Nevada Department of Energy<br>1050 East Williams, Suite 405<br>Carson City, Nevada 89710<br>Telephone: | No response. |
| Dr. Larry Icerman<br>Box 3 EI<br>New Mexico Energy Institute<br>New Mexico State University<br>Las Cruces, New Mexico 88003<br>Telephone: (505) 646-1745 | All areas of Research and Commercialization. |
| Mr. George Scudella<br>New Mexico Energy and Mineral Department<br>P. O. Box 2770<br>Santa Fe, New Mexico 87501<br>Telephone: | No response. |
| Mr. Bruce Gaugler<br>State Energy Office<br>State Capitol<br>Bismarck, North Dakota 58501<br>Telephone: | No response. |
| Debra Justus<br>Geothermal Specialist<br>Oregon Department of Energy<br>102 Labor and Industry Building<br>Salem, Oregon 97310<br>Telephone: | Geothermal Resources.<br>Legal, Institutional, and Environmental problems.<br>State Regulations.<br>Marketing. |
| Gene Culver<br>Geo-Heat Utilization Center<br>Oregon Institute of Technology<br>Ortech Branch Post Office<br>Klamath Falls, Oregon 97601<br>Telephone: (503) 882-6321 | Planning, Estimating.<br>Public Relations.<br>Environmental and Legal considerations. |

| Individual/Organization | Comments |
|---|---|
| Dr. Gordon Reistad<br>Department of Mechanical Engineering<br>School of Engineering<br>Oregon State University<br>Corvallis, Oregon 97331<br>Telephone: (503) 754-2575, Ext. 3441 | Conceptual Design.<br>Thermal Analysis.<br>Optimization Studies.<br>Design evaluation of<br>Heat Pump Systems. |
| C. H. Bloomster, Linda Fassbender<br>Manager, Advanced Energy Analysis<br>Pacific Northwest Laboratories<br>P. O. Box 999<br>Richland, Washington 99352<br>Telephone: (509) 946-2442 | Modeling and Analysis.<br>Economics.<br>Computer Model "GEOCITY". |
| Marshall Conover<br>Radian Corporation<br>P. O. Box 9948<br>Austin, Texas 78766<br>Telephone: (512) 454-4797 | No current funding. |
| N. Richard Friedman<br>Resource Dynamics Corporation<br>962 Wayne Avenue<br>Silver Springs, Maryland 20910<br>Telephone: (703) 356-1300 | Technical and Economic<br>Feasibility.<br>Legislation. |
| Phil Lidel, Director<br>Geothermal Program<br>Office of Energy Policy<br>Capitol Lake Plaza<br>Pierre, South Dakota 57501<br>Telephone: (605) 773-3603 | Information Dissemination<br>Center. |
| Mr. Stanley Green<br>Utah Department of Natural Resources<br>Division of Water Rights<br>200 Empire Building<br>231 East 400 South<br>Salt Lake City, Utah 84111<br>Telephone: | No response. |

| Individual/Organization | Comments |
|---|---|
| Phillip M. Wright, Debra Struhsacker<br>Associate Director, Earth Sciences Laboratory<br>University of Utah Research Institute<br>Research Park<br>420 Chipeta Way, Suite 120<br>Salt Lake City, Utah 84108<br>Telephone: (801) 581-5283 | Geothermal Exploration and Research.<br>Site evaluation. |
| William Isherwood<br>U. S. Geological Survey<br>345 Middlefield Road<br>Menlo Park, California 94025<br>Telephone: (415) 323-8111, Ext. 2841 | Geology.<br>Resource evaluation.<br>Exploration and Development.<br>Environmental Assessment.<br>Status of lands and leases. |
| Dr. R. Gordon Bloomquist<br>Washington State Energy Office<br>400 East Union Street<br>Olympia, Washington 98504<br>Telephone: | Geology.<br>Geothermal Utilization.<br>Municipal Systems. |
| Dr. R. T. Meyer<br>Western Energy Planners, Ltd.<br>2180 South Ivanhoe, Suite 4<br>Denver, Colorado 80222<br>Telephone: (303) 758-8206 | Economic and Engineering Assessment.<br>Government Interactions (taxes, regulations).<br>Energy Transportation.<br>Planning and Project Management. |
| Dr. E. Gerald Meyer<br>Vice President of Research<br>University of Wyoming<br>P. O. Box 3825<br>Laramie, Wyoming 82071<br>(307) 766-5445 | System Studies, Optimization.<br>Modeling. |

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

RECEIVED
NOV 21 1980
DRF 5625

November 17, 1980

OFFICE OF THE ASSISTANT SECRETARY
FOR ADMINISTRATION

IN REPLY REFER TO:

REQUEST FOR COOPERATIVE AGREEMENT APPLICATION
NO. 6500
ACCESS DISTRICT HEATING/COOLING SYSTEMS
POTENTIAL IN COMMUNITY DEVELOPMENT
BLOCK GRANT ELIGIBLE COMMUNITIES

To Whom It May Concern:

This Request for Cooperative Agreement Application (RFCAA) solicits applications to assist in an effort of the U.S. Department of Housing and Urban Development (HUD) and the Department of Energy (DOE) to assess District Heating/Cooling Systems (DHC) potential where such systems would enhance the communities' abilities to use Community Development Block Grant (CDBG) funds to meet community development national and local objectives. (A more complete explanation of the CDBG program is provided in Attachment E).

APPLICATIONS MUST BE RECEIVED BY HUD NOT LATER THAN 4:00 P.M., JANUARY 21, 1981 LOCAL TIME, AT THE APPROPRIATE PLACE DESIGNATED FOR RECEIPT OF APPLICATIONS IN ACCORDANCE WITH THIS RFCAA.

This application kit consists of this cover letter and six (6) attachments as follows:

ATTACHMENT A. STATEMENT OF WORK

Attachment A provides an introduction explaining the HUD and DOE interest in DHC. In addition, background material on the history of DHC, the relationship of DHC to CDBG programs, and the technical components of DHC systems is provided to enable the applicant to have a better understanding of the types of applications we desire and the type of assistance we intend to provide. Finally, the work tasks to be performed by successful applicants are explained.

ATTACHMENT B. FACTORS FOR AWARD

Attachment B outlines the process and criteria, including the factors for award, that HUD will use to review appliations.

ATTACHMENT C. DEFINITIONS

Attachment C contains a definition of terms.

ATTACHMENT D. TECHNICAL SUPPORT

Attachment D sets forth the types and kinds of technical support available to selected applicants.

ATTACHMENT E. COMMUNITY DEVELOPMENT BLOCK GRANTS

Attachment E explains the community Development Block Grant program.

ATTACHMENT F. APPLICATION INSTRUCTIONS

Attachment F provides detailed instructions for completing the application. Please take the time to read this section carefully and comply with its instructions. It may make the difference between receiving or not receiving a cooperative agreement.

Applications must be received at the following location no later than 4:00 P.M., January 21, 1980:

Office of Procurement and Contracts
Community Services Division (ACC-CL)
711-14th Street, N.W., Room 902
Washington, D.C.

Applications may be hand carried to this address; however, there is no direct mail delivery to the Office of Procurement and Contracts. Mailed applications must be mailed to the following address:

MAILED DELIVERIES

Department of Housing and Urban Development
Office of Procurement and Contracts
Room B-133 (711 Bldg.) (ACC-CL)
451 - 7th Street, S.W.
Washington, D.C. 20410

You should allow for the extra mailing time that results because mailed applications are received in the HUD Central mail room and then delivered by shuttle to the Office of Procurement and Contracts. Our policy of not considering applications which are delivered to the Office of Procurement and Contracts late will be strictly enforced. See Attachment F, Section V for further details.

To prevent opening by unauthorized individuals, your application should be identified on the envelope or wrapper as follows:

Application submitted in response to
Request for Cooperative Agreement
Application 6500
Due date: January 21, 1980
4:00 P.M. Local Time

If you have any questions concerning the Request for Cooperative Agreement Application, please contact Mr. Christopher Lee, Cooperative Agreement Officer, Office of Procurement and Contracts (202) 724-0027.

Sincerely,

Christopher Lee

Christopher Lee
Cooperative Agreement Officer

encl to DRF 5125

ATTACHMENT A

STATEMENT OF WORK

## INTRODUCTION

The U. S. Department of Housing and Urban Development (HUD) and U. S. Department of Energy (DOE) are interested in promoting the use of district heating cooling systems (DHC) in communities where such systems would enhance the communities' abilities to use Community Development Block Grant (CDBG) ( Attachment E , CDBG) funds to meet community development national and local objectives. They are seeking proposals to assist in this effort. For purposes of this cooperative agreement, DOE and HUD are defining a "community district heating/cooling system (DHC) as an energy system that generates thermal energy from one or more central plants to service a multiple number of buildings and customers with thermal services through a piping distribution network and, where possible, a storage facility", (Attachment C, Definitions). The piping system may extend throughout an entire urban area, or may be limited to a single neighborhood. These systems can contribute significantly to the ability of CDBG communities to achieve the objectives of Title I of the Housing and Community Development Act of 1974 by lowering energy costs, reducing environmental pollution, and expanding local economic opportunities, particularly for persons of low- and moderate-income.

The purpose of the cooperative agreement is to assist cooperating parties to identify potential DHC projects which will contribute to CDBG communities' achievements of national and local community development objectives, to assess their feasibility, to develop community consensus on whether to proceed with a project, and to develop and initiate implementation of a plan of action for developing a DHC.

Any public or private entity may respond to this solicitation though no fee or profit will be allowed to the applicant. Where the applicant is not a CDBG-elegible community (see 24 CFR 570.3 (u)(v)), the application must include a letter from the chief executive of a unit of general local government which is undertaking or planning to undertake a CDBG program indicating that: (a) the applicant's proposed activities under the cooperative agreement are for the purpose of assisting the governmental unit to plan, develop, or administer its community development program, and (b) the unit of general local government will provide representation to, and fully participate in, the local DHC Assessment Work Group.

## BACKGROUND

### History of District Heating/Cooling Systems (DHC)

The history of U. S. DHC can be traced to the late nineteenth century. By 1890, DHC systems were being installed in New York and numerous smaller cities. Most of these systems utilized waste steam from reciprocating steam engines that were used to generate electricity. As turbines replaced reciprocating engines for electric generation and as technological advances decreased electric transmission losses, electric generating plants grew and were relocated away from urban areas. In the process, DHC systems lost their supplies of cheap waste heat and were required to meet substantially higher fuel costs. By the late 1920's, economically-failing systems began to close; this decline continued through World War II.

In many European countries, the application of DHC is much more widespread than in the U. S. Principal reasons for this difference include: (1) fewer domestic energy supplies necessitating better fuel utilization; (2) higher fuel prices, in recent years; (3) scarce land for sanitary landfill operations; (4) fewer governmental and institutional barriers; and, (5) frequent government sponsorship for implementation

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(1) Reduced heating costs. Through the use of currently discarded heat and increased equipment efficiency, DHC systems often can offer thermal energy at lower prices than can conventional heating systems. When used in conjunction with CDBG Neighborhood Strategy Area Programs and/or neighborhood rehabilitation and energy conservation activities, they can contribute to meeting the housing needs of households eligible for housing assistance and in implementing block grant neighborhood rehibiltation programs.

(2) Improved urban economic development and commercial revitalization opportunities. DHC systems can provide high temperature water and steam for industrial process or commercial applications at lower prices than conventional heating systems, offering communities an opportunity to enhance block grant economic development and commercial revitalization programs.

(3) Improved air quality. DHC systems offer the potential for improvements in air quality by replacing a large number of uncontrolled sources of emission (individual boilers, furnaces and other heat sources) with a single or small number of heat sources whose emissions can be controlled by using (a) more efficient equipment, (b) better-maintained equipment, and (c) increased application of pollution-control equipment. Experience in Sweden proved that substantial reductions in sulfur dioxide concentrations can occur in cities employing DHC.

(4) Reduced land requirements for sanitary landfills. Through the application of municipal waste incineration with heat recovery, the volume of waste requiring disposal can be greatly reduced. If metals and glass are recovered and fly-ash and clinker are used in road building, the volume of wastes requiring disposal can be reduced dramatically. Scarcity of land available for landfill operations has been the primary impetus behind the application of heat-recoverable incineration in several European countries.

Components of District Heating/Cooling System (DHC)

Three major components make up a DHC system. The first component is the set of heat production plants that take a primary fuel such as coal, urban waste, oil, gas, industrial waste heat or nuclear fuel and convert it to thermal energy. When possible, heat that is being "thrown away" is put to use. Sources of waste heat include electric generating stations (which normally discard 70% of the energy content of the fuel they consume) and municipal incinerators (which usually burn trash and throw away 100% of the heat). The central plant or other sections of the DHC may include facilities for storing heat energy. This stored energy, normally hot or chilled water, is used to meet peak demands and allows some system components (such as boilers and chillers) to be smaller and less expensive than they would be without storage. The second component is the transmission and distribution system, which conveys energy to consumers. Heat is usually piped to consumers in the form of hot water or steam. Chilled water also may be distributed. The third component of the DHC system is the equipment in buildings buying the heat. Typically, a heat exchanger forms the connection between the distribution network of the DHC system and the individual buildings.

Construction of these systems can be complex depending on size, local conditions and state laws. With relatively long and capital-intensive front-end periods, they must hurdle a number of economic, institutional, and legal barriers.

Departments of Housing and Urban Development HUD, and Energy DOE

The Departments of Housing and Urban Development and Energy wish to aid CDBG communities in identifying potential district heating projects which will contribute to the achievement of national and local community development objectives, developing community consensus on whether to undertake them, and overcoming the economic, institutional, and legal barriers that may impede their development. The funds being made available for local assessment and organizational activities are one aspect of this assistance. Applicants receiving funds under awards from this cooperative agreement will also be eligible for technical support from DOE.

HUD will provide assistance through its fields offices to communities in carrying out their assessments if the communities request it. The assistance can involve assessing potential DHC projects in terms of their qualifications for use of Community Development Block Grant and Action Grant funds.

Upon request, on-site technical support to the local DHC Assessment Work Group will be arranged by a DOE Project Manager. This technical support can be used by the DHC Assessment Work Group analyzing the particular aspects of the community's situation and in assessing DHC projects it may want to examine carefully. The DOE Project Manager will also provide information on the specialized technical support resources which DOE can make available. For example, energy managers from the National Laboratories and others can advise on heat source possibilities (including industrial waste heat sources in the community, geothermal sources, incinerator waste heat sources, etc.), alternative piping systems, heat storage systems, cost considerations, financing mechanisms and alternatives, etc. The type and amount of technical support will vary from community to community depending on local circumstances and desires. (See Attachment D which discusses the type and availability of technical support.)

Importance of the DHC Assessment Work Group

A comparative analysis of the DHC systems in Europe and the United States indicates that a major barrier to the development of DHC in this country is the lack of an appropriate institutional framework for developing consensus and mobilizing resources to implement a system. The DHC Assessment Work Group (Attachment C, Definitions) can be used to develop such a framework, and should be regarded, therefore, as a critical element in the applicant's work plan.

An applicant should involve all major relevant entities and individuals who might be required to undertake or be significantly affected by a DHC. Because of the need for consensus, the DHC Assessment Work Group's activities should be focused on developing community awareness and consensus on the issue of DHC as well as on the technical and financial aspects of the system.

Additional Support for Pre-Construction Activity

It is anticipated that DOE will make additional funding available on a cost sharing basis for the detailed design study and other pre-construction activities needed to bring cost-effective and feasible DHC projects to the construction phase. Subsequent requests for cooperative agreements for these additional efforts are anticipated for early FY 1981. Subsequent cooperative agreements will not be limited to applicants chosen under this request for cooperative agreement. Applicants not submitting proposals for funding under this request may choose to submit a proposal for the subsequent requests.

## OBJECTIVES

The objectives of this request for cooperative agreement are to:

1. promote the concept of DHC systems in communities where such systems have the potential to improve and develop rehabilitation activities, or are helping to meet the housing needs of households eligible for housing assistance;

2. develop the capacity of local DHC Assessment Work Groups to assess the economic, technical, regulations, and institutional feasibility of DHC projects;

3. aid a number of CDBG-eligible communities (estimated at 20 to 35) in identifying DHC projects which are cost-effective, feasible, and capable of enhancing the communities' abilities to use CDBG funds to meet community development national and local objectives;

4. aid communities in providing information and assistance to interested community groups in assessing the costs and benefits of potential DHC projects and in developing community consensus on whether to proceed with such projects; and,

5. aid communities in developing and undertaking plans of action for carrying out cost-effective and feasible DHC projects on which consensus has been achieved.

WORK TASKS

Task 1: Management/Work Plan

1. Within thirty (30) calendar days of an award, the applicant will prepare and submit to the Project Manager ten copies of a detailed management/work plan. The plan will:

   a) indicate the work hours and key personnel for each task;

   b) describe the functions of the DHC Assessment Work Group, indicating its composition, role, schedule of meetings and tasks to be carried out collectively and by each member

The role of the DHC Work Group is crucial to the analysis of the feasibility of DHC projects and the applicant will place considerable emphasis on ensuring the full participation and cooperation of local persons and organizations which might be involved in or affected by the development of a DHC. Those DHC Assessment Work Group members which have data crucial to other phases of the project should identify that data to the applicant;

c) indicate the cooperating party's requirements for DOE Technical Support during the project period. The DOE Project Manager will provide detailed information on the scope and amount of services available from the DOE Technical Support program. While the Project Manager will make recommendations on the use of these services, the decision to use them, and the extent they will be used rests with the cooperative party; and

d) indicate the expected completion dates of interim or sub-tasks or work products and the allocated budget and other resource commitments, by month for each task.

2. Prior to submission to the DOE Project Manager, the applicant will ensure that the management plan is reviewed and approved by the DHC Assessment Work Group.

3. The management plan will be reviewed and either returned to the applicant with comments or approved by the DOE Project Manager within thirty (30) calendar days after receipt.

Task 2: Identification of Potential DHC Projects

The applicant will identify major potential sources of thermal energy in the community and the heat loads in potential service areas. Using data from DOE, the local electric generating company and other sources, the applicant shall indicate the extent to which heat sources, such as geothermal, industrial plants and electric generating plants, provide heat which could be tapped. This includes assessing such factors as the amount and reliability of the heat, as well as the feasibility of developing new centralized heat sources. The applicant will indicate potential service areas, developing load profiles on the basis of assumed floor areas, building occupancy patterns, climatological data, etc.

Task 3: Assessment of Economic and Technical Feasibility of Alternative DHC Projects; the Relationship of the Projects to the Localities' Community Development National and Local Program Objectives.

Using the Task 2 data, the cooperating party will identify and assess the DHC projects which appear to have the greatest economic, technical and institutional feasibility of being started within the next 1-3 years and the greatest ability to contribute to the CDBG communities' ability to achieve national and local community development objectives. That assessment will include an analysis of: a) the feasibility of DHC in relatively high heat load commercial and industrial areas; b) the feasibility of neighborhood DHC in the highest heat load/moderate heat load, low- and moderate-income residential areas; c) costs versus benefits of incorporating state-of-the-art thermal storage sub-systems; d) the relative merits of high ($100^{o}$-$165^{o}$ C) moderate ($100^{o}$ C), and low-temperature DHC systems in the potential service areas; e) the environmental costs and benefits of potential DHC systems; f) the costs and benefits of the potential DHC systems in generating or retaining jobs in the community, particularly for those of low- and moderate-income; g) the impact on the economic feasibility of DHC of different levels of energy conservation programs in the community, with particular emphasis on programs currently planned or underway; and, h) the contribution each DHC could make to improving and developing city/county capacities for undertaking block grant economic development, commercial revitalization, neighborhood rehabilitation activities or for helping to meet the housing needs of households eligible for housing assistance.

The feasibility analysis will identify the appropriate costs of the alternative DHC projects (capital and operating costs), their revenue generating potential (under varying assumptions) and the fuel and other savings which would result over varying time periods up to 20 years.

Task 4: Assessment of Institutional Factors

The cooperating party will identify major institutional factors impeding or enhancing development of the most feasible projects and identify actions which might be taken to overcome the most significant constraining factors. Of particular concern are Federal, state and local regulations, the role of local utilities, rate and pricing considerations, hook-up policies and laws affecting the ability of DHC assessment Work Group members to proceed with the project.

Task 5: Public Meeting to Discuss Alternative DHC Projects

Upon completion of Tasks 2, 3 and 4, the cooperating party will hold a public meeting of the DHC Assessment Work Group, with notice of the meeting to be announced in newspapers of local general circulation and distributed to all local organizations involved in the development or planning or implementation of a Community Development Block Grant (CDBG) program, as applicable, to discuss the feasibility of the alternative DHC projects and hear the views of the public. The cooperating party will prepare a summary description of alternative projects for use at the meeting, outlining their costs and benefits, environmental impacts, etc.

Task 6: DHC Assessment Work Group Plan of Action

Upon completion of Task 5, the cooperating party will prepare a report stating the conclusions of the DHC Assessment Work Group about the feasibility of undertaking DHC projects which would enhance the ability of the community to use CDBG funds to meet community development national and local objectives.

Where the DHC Assessment Work Group concludes that such projects are or may be feasible and appropriate, it will outline a plan of action for implementing the projects within the next 2-3 years, indicating each of the steps to be taken, the participants and the schedule.

Task 7: Providing Technical Support in DHC to Other CDBG-Eligible Communities

The cooperating parties will participate in a regional or national conference on DHC at the end of their cooperative agreement period to share the results of their experiences with other cooperating parties and communities that participated in this program. Upon completion of Task 6, the cooperating party shall also be prepared for one year to respond to inquiries and visits from communities involved in, or considering the possibility of being involved in, assessing the feasibility of DHC.

FACTORS FOR AWARD

I. Mandatory Factors

The following factors are mandatory for all applicants. Only applicants meeting all mandatory factors will be considered for funding.

1. Relationship of Proposal to CDBG Program

The applicant must demonstrate a clear relationship between its proposal and a CDBG-eligible community's existing or proposed CDBG program. The proposal must clearly demonstrate that it would increase the effectiveness with which an eligible block grant community can use CDBG funds to meet community development national and local program objectives for either an existing CDBG program or one which is planned. The poposed must address one or more of the following national priorities:

(A) Development of city and county capacities to undertake block grant urban economic development and commercial revitalization;

(B) Development of city and county capacities to implement block grant neighborhood rehabilitation and urban homesteading programs;

(C) Promotion of effective citizen participation in the block grant program and improvement of the capacity of neighborhood and nonprofit organizations to carry out community development and housing programs;

(D) Assistance to fair housing groups, housing agencies and local governments to provide housing in a manner which promotes spatial deconcentration of low- and moderate-income families, implements block grant Housing Opportunity Plans and Housing Assistance Plans or helps to meet the housing needs of households eligible for housing assistance;

(E) Improvement of the administrative capacity of smaller block grantees to effectively carry out community development and housing programs;

(F) Improvement of the technical capability of block grant grantees to meet environmental review requirements;

(G) Assistance to upgrade block grant environmental review requirements;

2. Relationship of the Applicant to the CDBG-Eligible Community

Any public or private entity may respond to this request for cooperative agreement. No profit or fee will be allowed to the applicant, however. Where the applicant is not a CDBG-eligible community (see 24 CFR 570.3 (u), (v)), it must include a letter from the chief executive of a unit of general local government which is undertaking or planning to undertake a CDBG program indicating that: (a) the applicant's proposed activities under the cooperative agreement are for the purpose of assisting the governmental unit to plan, develop, or administer its community development program; (b) the unit of general local government will provide representation to, and fully participate in, the local DHC Assessment Work Group.

## II. Evaluation Factors and Weight

Applicants which meet the mandatory factors will be evaluated and selected on the basis of the information provided in the request for cooperative agreement. Once selected for funding under this request for cooperative agreement the applicant will be considered a cooperating party ( Attachment C, Definitions).

The score for each factor will be based on the quality of the procedures or methods employed in handing each areas as demonstrated by the applicant's response. The factors and corresponding weights are as follows:

1. Quality of Applicant's Capability and Commitment (30 points)

   a. Extent to which the applicant demonstrates a capability for assessing DHC potential (15 points).

   b. Extent to which the applicant demonstrates a capacity for continuing with DHC activities once the assessment is completed. (15 points) Since this first phase assessment is expected to be the first of several phases of activity which could lead to the construction and operation of a district heating system, it is important that the applicant shows a willingness to commit sufficient staff resources component to handle the assessment tasks and the applicant has the institutional capability to commit to an on-going DHC program of detailed design study planning and implementation of a DHC if the DHC Assessment Work Group's conclusions call for further activities once the assessment is completed. A complete explanation will be provided for the management strategy proposed and types of tasks to be completed by various staff or consultant personnel.

Any use of outside consultants will be described in full, with an indication of the tasks to be carried out by consultants and those to be carried out by staff. Where a significant use of consultant services is proposed, the applicant will place special emphasis on showing its ability to make an institutional commitment to the continuation of a DHC program. The applicant should identify the person(s) who prepared the response to the solicitation and the role they will play, if any, in carrying out the program of activities. Evidence of the experience of staff and consultant personnel will be provided.

2. <u>The DHC Assessment Work Group (30 points)</u>

Extent to which the applicant demonstrates that the principal local persons, firms, governments and other organizations which would be required to plan and implement a DHC system have agreed to participate in the DHC Assessment Work Group and collectively have the necessary capacity to implement any projects on which they may agree. The number of points assigned will be based on HUD and DOE's assessment of both the breadth of participation and level of the commitment to participate by individual persons and organizations in the DHS Assessment Work Group.

a. Breadth of participation as indicated by such thing as the extent to which the DHC Assessment Work Group is composed of:
(1) potential suppliers of DHC services, including firms, governments and other organizations which would be required to plan and implement a DHC, (2) potential consumers who ultimately will have to "hook up" if any project is to be viable, and (3) other groups or institutions who will be significantly impacted by the projects being assessed or who are otherwise involved in the CDBG program (15 points).

b. Level of commitment as evidenced by people and financial resources committed by the DHC Assessment Work Group members relative to the size and capacity of the community. (15 points)

3. <u>Opportunities for District Heating/Cooling Systems (DHC) (20 points)</u>

Extent to which the applicant demonstrates awareness of the existence of physical and economic opportunities for undertaking a cost-effective and feasible DHC system. The applicant will provide a narrative statement of the types of opportunities for DHC it believes may exist in the community, including both heat sources (e.g., significant industrial waste heat, utility cogeneration capability, geothermal, etc.) and potential service areas.

4. <u>Distress of the CDBG-Eligible Community (10 points)</u>

The applicant will indicate whether the community in which the DHC assessment activities are to occur meets the standards of physical and economic distress listed in the <u>Federal Register</u> Notices of October 30, 1979 (Pages 62424- 62440) or February 20, 1980 (Pages 11448-11450). Applications on the behalf of communities which meet the standards will be awarded ten points.

5. Clarity and Conciseness (10 points)

Quality of the proposal in terms of its clarity and conciseness will be a factor used in the evaluation (10 points).

POLICY FACTORS

HUD and DOE reserve the right to make adjustments in the rankings to assure an adequate mix of cooperating parties from different geographic regions of the country, communities of different sizes and degree of environmental distress, different types of probable DHC system opportunities and different types of cooperating parties.

DEFINITIONS

1. Community District Heating/Cooling System (DHC) - An energy system that generates thermal energy from one or more central plants to service a multiple number of buildings and customers with thermal services through a piping distribution network and where possible, a storage facility.

2. Thermal Services - Space heating, space cooling, domestic hot water, process commercial or industrial heat.

3. Service Area - The area to be served by the Project. For purposes of this Program, the Project shall provide a significant portion of the DHC requirements for buildings within the Service Area by a thermal distribution system.

4. DHC Program - The activities and projects resulting from and associated with this request for cooperative agreement.

5. DHC Assessment Work Group - A DHC Assessment Work Group consists of the party or parties necessary to carry out the provisions of the cooperative agreement and bring a project to the stage of construction. Parties comprising the DHC Work Group may include, but are not limited to:

units of local governments or their agencies; neighborhood groups; citizen groups and local organizations involved with local CDBG programs; utility companies; industrial companies; state energy offices or public utility commissions; joint public/private entities; and private enterprises.

6. Technical Support - DOE and/or HUD provided technical back-up arranged at the request of the DHC Assessment Work Group. This consists of the delivery of precise technical advice or technical information tailored to DHC Assessment Work Group need, enabling the Group to decide how to structure the assistance portion of the work management plan and of technical support provided during the execution of that plan.

7. DHC Project - The aggregate of equipment (for the central plants(s), transmission and distribution system, storage system, if any, the end-use system, others), and all the institutional and contractual agreements required: (a) to utilize, as is, or modify and utilize one or more existing central plants and/or construct/operate one or more new central plants(s); (b) to utilize, as is, or modify and utilize an existing distribution network and/or construct and operate a new distribution/storage network; (c) to establish cost allocations; (d) to operate the system; (e) to serve end-use customers.

8. <u>Applicant</u> - Any public or private entity applying for funds under this request for cooperative agreement.

9. <u>Cooperating Party</u> - Public or private entities receiving funds under this request for cooperative agreement.

# TECHNICAL SUPPORT

## INTRODUCTION

This attachment sets forth the types and kinds of technical support available to applicants chosen to undertake development of small or large scale DHC systems pursuant to this request for cooperative agreement. Success in this effort requires an understanding of the technical, legal, organizational, financial, regulatory and environmental issues associated with existing energy supply, energy delivery, and energy consumption practices.

At present, most community energy needs are supplied by single-source utilities or fuel jobbers. These supply sources, delivery networks, and consumption practices are not generally integrated into a community's general development planning. This separation in functional responsibility is reflected in community infrastructures, which have been planned with little or no consideration of overall community energy needs, and with little attention to energy conservation.

PROJECT DEVELOPMENT REQUIREMENTS

Large or small DHC, unlike traditional energy supply sources, can be developed successfully only by configuring such systems to present and projected community energy needs. This requires more than careful consideration of how potential energy sources, end-uses, and the intervening transmission and distribution networks can be made compatible with the existing and future community structure. It also requires ensuring compatibility of this alternative energy supply system with the existing legal and organizational framework in a community. In addition, it requires assuring that any such DHC system can be configured in a manner that assures reliable service at prices which will be acceptable to end-users, yet high enough to assure commercial feasibility.

Hence, assessing the feasibility of developing a DHC is akin to undertaking a new business venture. It entails:

1. organizing the parties of interest to such an undertaking;

2. establishing the technological and economic feasibility of such an undertaking;

3. developing the required contractual relationships required for the undertaking;

4. assuring the legal and environmental compatibility of the system;

5. establishing ownership arrangements for the system;

6. developing a financial plan to undertake construction of the system; and

7. ensuring reliable operation and maintenance of the system.

Although logically separable, these tasks are highly interrelated. Each must be addressed in the early stages of project development to assure success. Since communities rarely have staff with the organizational, technical, economic, financial, legal, regulatory, and environmental experience required to address all these issues, this request for cooperative agreement application is offering technical support as well as financial assistance. The technical support will help communities chosen pursuant to this cooperative agreement application to investigate the local application of DHC.

TECHNICAL SUPPORT

In general, technical support is available for dealing with all issues underlying the above seven tasks. However, cooperating parties should note that this technical support is meant to supplement, rather than substitute for, community efforts. The Department of Energy's (DOE) objective in supplying technical support is to enhance the cooperating parties' capacity to handle all the cooperative agreement requirements either: (a) with their own resources; or (b) through supplemental information obtained from DOE sources. DOE has no wish to direct the cooperating parties' efforts. The relationships between cooperating parties and the DOE technical support services is based upon the following four assumptions.

1. The "cooperating party knows best" about the needs of its energy users and how to meet those needs. Thus, technical support gives cooperating parties maximum flexibility to design and conduct their own community district heating programs.

2. Mutual trust is essential. Cooperating parties need to know that the DOE-sponsored technical support role includes supporting them in implementing their programs.

3. Technical support's major role will be in providing cooperating parties a "one-stop source" for obtaining answers to questions and help in solving problems.

4. Over the long-run, cooperating parties must build their own capability to solve problems they identify. When working on a request for technical support, the DOE must try to connect cooperating parties with appropriate resources they can call upon in the future in order to decrease dependence on DOE.

AVAILABILITY OF TECHNICAL SUPPORT

Technical support will be available during the period cooperating parties are developing their work management plans as well as during the study period. Since the work management plan establishes the agenda for determining feasibility, it also controls the breadth and direction, and therefore the possible outcome, of the feasibility study. Technical support during this phase can assure: (1) that the plan identifies all possibilities for applying DHC; (2) sets forth all the issues DHC applications raise; (3) and identifies the problems which, unless overcome, could prevent or hinder the use of DHC as a community conservation measure. Ultimately the DHC Assessment Work Group must bear responsibility for identifying the special circumstances or characteristics unique to their city which must be addressed to achieve a successful DHC cooperative agreement.

It is contemplated that each chosen community requesting technical support will be assigned a person experienced in DHC project development. This person will, in turn, be supported by a team of specialists knowledgeable in all aspects of DHC applications.

During the development of the work management plan, the technical support person can be used to help ensure the comprehensiveness of the work effort. The most important task is for applicants to use this period to organize the parties of interest whose cooperation is vital to carrying out the feasibility effort. A project team consisting of all these parties and pledged to help in developing and evaluating the information necessary for reaching a decision can only be put in place by the cooperative parties. The technical support person can provide information about the experiences of other projects and how they were organized; he/she cannot organize the project team for the cooperating party.

During the feasibility phase, the technical support person can be used as a resource to enhance local understanding of specific issues and to help the DHC Assessment Work Group develop capability for undertaking the technical analysis required for testing alternative DHC concepts. In particular, the technical support person can supply information on specific options, such as: 1) development of geothermal resources for DHC; (2) use of thermal storage in conjuction with DHC; (3) utilization of industrial waste heat as a DHC supply source; and (4) retrofitting existing power plants to cogenerate thermal energy for DHC.

Each technical option, in addition to raising engineering questions, may also raise legal, regulatory, economic, environmental and organizational issues. These institutional issues, the participants will find, tend to be more intractable than the technical ones. It is in this area that the technical support person may prove most valuable. DOE has sponsored extensive research in these areas, and many of the individuals involved in the technical support function have issue related experience. This experience will be available to each DHC Assessment Work Group which has the responsibility for identifying the local facets of these institutional issues. Despite accumulated research and experience, successful implementation demands site-specific solutions to site-specific problems.

The technical support role is aimed at developing cooperating party capability to undertake complex energy conservation project development. With this in mind, cooperating parties should plan their use of technical support to enhance their capability and increase their flexibility in undertaking energy conservation measures. They should not plan upon substituting technical support for local effort.

# COMMUNITY DEVELOPMENT BLOCK GRANTS

Federal grants promote sound community development, revitalize cities, reverse urban decay, promote programs for housing rehabilitation and stimulate economic growth to turn around distressed communities.

## Nature of Program

HUD allocates block grants to local governments to pay for a wide range of community development activities. A single, flexible-purpose program, the block grants finance most activities previously eligible under separate categorical grant programs: Urban Renewal; Neighborhood Development grants; Model Cities; Water and Sewers; Neighborhood Facilities; Public Facilities and Rehabilitation Loans; Open Space; Urban Beautification; and Historic Preservation.

Spending priorities are determined at the local level, but the law cites general objectives which the block grants are designed to fulfill, including adequate housing, a suitable living environment for all, and expanded economic opportunities for low and moderate income groups. Specifically, recipients are required to estimate and to plan to meet their lower-income housing needs in the overall community development plan they submit to obtain grants.

Applicant Eligibility

Metropolitan cities and urban counties with populations of at least 50,000 and 200,000 respectively, are called entitlement grantees. Their grants are based on need, objectively calculated by a formula that includes population, (25 percent); poverty, (50 percent); and overcrowded housing, (25 percent). In the 1977 Act, an alternative formula gives additional assistance to older, more heavily_distressed cities. The second formula weighs population growth lag, or rate of population growth compared with cities of similar size, 20 percent; poverty, 30 percent; age of housing (pre-1940), 50 percent. The metropolitan city or urban county is entitled to receive whichever sum is greater under either formula.

Smaller cities, not automatically entitled to funds, may receive funds on a competitive basis. They are encouraged to plan their housing and community needs in a more comprehensive manner. While single purpose, non-comprehensive activities are still eligible, multi-year applications emphasizing comprehensive approaches assure a major dependable source of funds more commensurate with existing needs. These are the so-called Discretionary Funds, for which any community may compete.

# APPLICATION INSTRUCTIONS

Applications must be prepared and submitted in accordance with the instructions outlined below and in the cover letter to this solicitation.

## I. Application Contents

Applications shall consist of the following:

A. Transmittal Letter

B. Standard Form 424

C. Abstract

D. Table of Contents

E. Proposal Narrative Statement

## II. Application Instructions

### A. Transmittal Letter

Prepare a brief letter transmitting the application in an original and two copies and identifying the name and telephone number of a person who may be contacted by HUD during the evaluation process to discuss the application. The transmittal letter should be signed by the chief executive officer of the applicant organizations.

### B. SF - 424

SF-424 is a standard form to be used as a face sheet for applications when applying for Federal assistance. Two copies are attached at the end of this attachment.

### C. Abstract

Prepare a one-page abstract of the project summarizing the proposal and its cost.

D. Table of Contents

Prepare a table of contents listing the major sections, subsections and appendices of the application.

E. Proposal Narrative

Prepare a narrative statement of the proposal, addressing the topics and issues outlined in the Factors for Award and following the format outlined below. (The number in parentheses identifies the corresponding Factor for Award.)

1. Relationship of the Proposal to the Community Development Block Grant (CDBG) Program

This section should identify the community in which the CDBG program is being or will be undertaken; briefly describe the nature of the CDBG program; identify the national priority(ies) the program will address (see the list of priorities in the first Factor for Award), and indicate how a district heating or cooling system could increase the effectiveness of the CDBG program in addressing the priority(ies).

When the community does not have a CDBG program currently underway, the application should describe the nature of the plans for such a program.

2. Relationship of the Applicant to a CDBG-Eligible Community

Where the applicant is not a CDBG-eligible unit of general local government as defined in 24 CFR 570.3(u), (v), the application should include a letter from the chief executive of a unit of general local government which is undertaking or planning to undertake a CDBG program indicating that: (2) the respondent's proposed activities under the cooperative agreement are for the purpose of assisting the governmental unit to plan, develop, or administer its community development program; (b) the unit of general local government will provide representation to, and fully participate in, the local DHC Assessment Work Group.

3. Quality of the Applicant's Capability and Commitment

(a) Capability

Describe the principal task or sub-projects to be undertaken in carrying out the project. Identify the personnel to be involved in each task, the roles they are to play, and the specific experience and qualifications they have for each task and/or project. Indicate which tasks are to be performed by consultants under contract to the applicant, which by the applicant's staff, and which by the satffs of local DHC Assessment Work Group members or others. Include resumes of key personnel.

Identify the person(s) who prepared the response to the solicitation and the role they will play, if any, in carrying out the program of activities.

(b) Commitment

Describe the applicant's capacity and commitment to carry out an on-going program of detailed study design, planning and implementation of a DHC if the Work Group's conclusions call for further activities once the assessment is completed.

4. The DHC Assessment Work Group

(a) Organization and Participation

Describe the extent to which the principal local persons, firms, governments and other organizations which would be required to plan and implement a DHC have agreed to participate on the local DHC Assessment Work Group. List those which have agreed to participate. Specifically note the members representing potential suppliers of heat to a DHC, potential users, and CDBG citizen and program interests. Identify any members having the legal capacity to undertake the activities involved in a DHC project (such as opening streets, laying pipe, making connections to buildings, manufacturing and selling heat, etc.) if a potential project is subsequently identified.

Describe how the Work Group is to be organized, chaired and staffed; identify any contractors and sub-contractors and the relationship they are to have to the Work Group; frequency of meetings; and other relevant information.

(b) Level of Commitment

Describe the commitment each organization on the Work Group has made to participate in the project. Indicate any tasks member organizations have agreed to carry out with their own staffs and/or other activities relevant to the Work Group. Note any resources or funds which member organizations have committed to the effort.

5. Opportunities for District Heating and Cooling Systems

Briefly describe the types of opportunities for District Heating and/or Cooling Systems which the applicant or Work Group believes may exist in the community. This description could include an identification of possible heat sources (e.g., industries with waste heat, utility power plants with a cogeneration potential, geothermal, municiapl waste, etc.) and possible residential, industrial, and/or commercial service areas. Note any special factors in the community which might enhance the feasibility of a potential DHC, such as weather conditions, economic conditions, density of areas, unusually high fuel prices, etc.

6. Distress of the CDBG-Eligible Community

Indicate whether the CDBG-eligible community in which the district heating and cooling assessment activities are to occur meets the standards of physical and economic distress listed in the Federal Register Notices of October 30, 1979 (pages 62424-62440) or February 20, 1980 (pages 11448-11450).

III. Project Budget

The project section consists of the Budget Information form and a supporting budget narrative. Two blank copies of the form are attached.

IV. Quarterly and Final Report

Briefly outline the format to be usd for the final report referred to in Task 6 (DHC Assessment Work Group Plan of Action) and quarterly progress reports.

V. LATE APPLICATIONS, MODIFICATIONS OF APPLICATIONS AND WITHDRAWALS OF APPLICATIONS

A. Any application received at the office designated in this solicitation after the exact time specified for receipt will not be considered unless it is received before award is made, and:

1. It was sent by registered or certified mail not later than the fifth calendar day prior to the date specified for receipt of applications (e.g., an application submitted in response to this RFCAA, H-6500, requiring receipt of applications by 4:00 P.M., local time January 21, 1981 must have been mailed by January 16, 1981) or;
2. It was sent by regular mail and it is determined by HUD that the late receipt was due solely to mishandling by the Government.

B. Any modification of an application is subject to the same conditions as in A.1 and A.2 of this provision.

C. The only acceptable evidence to establish:

1. The date of mailing of a late application or modification sent either by registered or certified mail is the U.S. Postal Service postmark on the wrapper or on the original receipt from the U.S. Postal Service. If neither postmark shows a legible date, the proposal or modification shall be deemed to have been mailed late. (The term "postmark" means a printed, stamped, or otherwise placed impression that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U.S. Postal Service).

2. The time of receipt at the HUD installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation.

# FEDERAL ASSISTANCE

1. TYPE OF ACTION (Mark appropriate box)
- ☐ PREAPPLICATION
- ☐ APPLICATION
- ☐ NOTIFICATION OF INTENT (Opt.)
- ☐ REPORT OF FEDERAL ACTION

2. APPLICANT'S APPLICATION — a. NUMBER — b. DATE Year month day 19

3. STATE APPLICATION IDENTIFIER — a. NUMBER — b. DATE ASSIGNED Year month day 19

*Leave Blank*

SECTION I—APPLICANT/RECIPIENT DATA

4. LEGAL APPLICANT/RECIPIENT
- a. Applicant Name :
- b. Organization Unit :
- c. Street/P.O. Box :
- d. City : e. County :
- f. State : g. ZIP Code:
- h. Contact Person (*Name & telephone No.*) :

5. FEDERAL EMPLOYER IDENTIFICATION NO.

6. PROGRAM (*From Federal Catalog*) — a. NUMBER — b. TITLE

7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT

8. TYPE OF APPLICANT/RECIPIENT
- A–State
- B–Interstate
- C–Substate District
- D–County
- E–City
- F–School District
- G–Special Purpose District
- H–Community Action Agency
- I–Higher Educational Institution
- J–Indian Tribe
- K–Other (*Specify*):

*Enter appropriate letter* ☐

9. TYPE OF ASSISTANCE
- A–Basic Grant
- B–Supplemental Grant
- C–Loan
- D–Insurance
- E–Other

*Enter appropriate letter(s)* ☐☐

10. AREA OF PROJECT IMPACT (*Names of cities, counties, States, etc.*)

11. ESTIMATED NUMBER OF PERSONS BENEFITING

12. TYPE OF APPLICATION
- A–New
- B–Renewal
- C–Revision
- D–Continuation
- E–Augmentation

*Enter appropriate letter* ☐

13. PROPOSED FUNDING

| | |
|---|---|
| a. FEDERAL | $ .00 |
| b. APPLICANT | .00 |
| c. STATE | .00 |
| d. LOCAL | .00 |
| e. OTHER | .00 |
| f. TOTAL | $ .00 |

14. CONGRESSIONAL DISTRICTS OF: a. APPLICANT — b. PROJECT

15. TYPE OF CHANGE (*For 12c or 12e*)
- A–Increase Dollars
- B–Decrease Dollars
- C–Increase Duration
- D–Decrease Duration
- E–Cancellation
- F–Other (*Specify*):

*Enter appropriate letter(s)* ☐☐☐

16. PROJECT START DATE *Year month day* 19

17. PROJECT DURATION *Months*

18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY ▶ *Year month day* 19

19. EXISTING FEDERAL IDENTIFICATION NUMBER

20. FEDERAL AGENCY TO RECEIVE REQUEST (*Name, City, State, ZIP code*)

21. REMARKS ADDED ☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT ▶

a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached:

| | No response | Response attached |
|---|---|---|
| (1) | ☐ | ☐ |
| (2) | ☐ | ☐ |
| (3) | ☐ | ☐ |

23. CERTIFYING REPRESENTATIVE — a. TYPED NAME AND TITLE — b. SIGNATURE — c. DATE SIGNED *Year month day* 19

SECTION III—FEDERAL AGENCY ACTION

24. AGENCY NAME

25. APPLICATION RECEIVED *Year month day* 19

26. ORGANIZATIONAL UNIT

27. ADMINISTRATIVE OFFICE

28. FEDERAL APPLICATION IDENTIFICATION

29. ADDRESS

30. FEDERAL GRANT IDENTIFICATION

31. ACTION TAKEN
- ☐ a. AWARDED
- ☐ b. REJECTED
- ☐ c. RETURNED FOR AMENDMENT
- ☐ d. DEFERRED
- ☐ e. WITHDRAWN

32. FUNDING

| | |
|---|---|
| a. FEDERAL | $ .00 |
| b. APPLICANT | .00 |
| c. STATE | .00 |
| d. LOCAL | .00 |
| e. OTHER | .00 |
| f. TOTAL | $ .00 |

33. ACTION DATE ▶ *Year month day* 19

34. STARTING DATE *Year month day* 19

35. CONTACT FOR ADDITIONAL INFORMATION (*Name and telephone number*)

36. ENDING DATE *Year month day* 19

37. REMARKS ADDED ☐ Yes ☐ No

38. FEDERAL AGENCY A-95 ACTION

a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part 1, OMB Circular A-95, it has been or is being made.

b. FEDERAL AGENCY A-95 OFFICIAL (*Name and telephone no.*)

SECTION IV—REMARKS *(Please reference the proper item number from Sections I, II or III, if applicable)*

## GENERAL INSTRUCTIONS

This is a multi-purpose standard form. First, it will be used by applicants as a required facesheet for pre-applications and applications submitted in accordance with Federal Management Circular 74–7. Second, it will be used by Federal agencies to report to Clearinghouses on major actions taken on applications reviewed by clearinghouses in accordance with OMB Circular A–95. Third, it will be used by Federal agencies to notify States of grants-in-aid awarded in accordance with Treasury Circular 1082. Fourth, it may be used, on an optional basis, as a notification of intent from applicants to clearinghouses, as an early initial notice that Federal assistance is to be applied for (clearinghouse procedures will govern).

## APPLICANT PROCEDURES FOR SECTION I

Applicant will complete all items in Section I. If an item is not applicable, write "NA". If additional space is needed, insert an asterisk "*", and use the remarks section on the back of the form. An explanation follows for each item:

*Item*

1. Mark appropriate box. Pre-application and application guidance is in FMC 74–7 and Federal agency program instructions. Notification of intent guidance is in Circular A–95 and procedures from clearinghouse. Applicant will not use "Report of Federal Action" box.

2a. Applicant's own control number, if desired.

2b. Date Section I is prepared.

3a. Number assigned by State clearinghouse, or if delegated by State, by areawide clearinghouse. All requests to Federal agencies *must* contain this identifier if the program is covered by Circular A–95 and required by applicable State/areawide clearinghouse procedures. If in doubt, consult your clearinghouse.

3b. Date applicant notified of clearinghouse identifier.

4a–4h. Legal name of applicant/recipient, name of primary organizational unit which will undertake the assistance activity, complete address of applicant, and name and telephone number of person who can provide further information about this request.

5. Employer identification number of applicant as assigned by Internal Revenue Service.

6a. Use Catalog of Federal Domestic Assistance number assigned to program under which assistance is requested. If more than one program (e.g., joint-funding) write "multiple" and explain in remarks. If unknown, cite Public Law or U.S. Code.

6b. Program title from Federal Catalog. Abbreviate if necessary.

7. Brief title and appropriate description of project. For notification of intent, continue in remarks section if necessary to convey proper description.

8. Mostly self-explanatory. "City" includes town, township or other municipality.

9. Check the type(s) of assistance requested. The definitions of the terms are:

A. Basic Grant. An original request for Federal funds. This would not include any contribution provided under a supplemental grant.

B. Supplemental Grant. A request to increase a basic grant in certain cases where the eligible applicant cannot supply the required matching share of the basic Federal program (e.g., grants awarded by the Appalachian Regional Commission to provide the applicant a matching share).

C. Loan. Self explanatory.

*Item*

D. Insurance. Self explanatory.

E. Other. Explain on remarks page.

10. Governmental unit where significant and meaningful impact could be observed. List only largest unit or units affected, such as State, county, or city. If entire unit affected, list it rather than subunits.

11. Estimated number of persons directly benefiting from project.

12. Use appropriate code letter. Definitions are:

A. New. A submittal for the first time for a new project.

B. Renewal. An extension for an additional funding/budget period for a project having no projected completion date, but for which Federal support must be renewed each year.

C. Revision. A modification to project nature or scope which may result in funding change (increase or decrease).

D. Continuation. An extension for an additional funding/budget period for a project the agency initially agreed to fund for a definite number of years.

E. Augmentation. A requirement for additional funds for a project previously awarded funds in the same funding/budget period. Project nature and scope unchanged.

13. Amount requested or to be contributed during the first funding/budget period by each contributor. Value of in-kind contributions will be included. If the action is a change in dollar amount of an existing grant (a revision or augmentation), indicate only the amount of the change. For decreases enclose the amount in parentheses. If both basic and supplemental amounts are included, breakout in remarks. For multiple program funding, use totals and show program breakouts in remarks. Item definitions: 13a, amount requested from Federal Government; 13b, amount applicant will contribute; 13c, amount from State, if applicant is not a State; 13d, amount from local government, if applicant is not a local government; 13e, amount from any other sources, explain in remarks.

14a. Self explanatory.

14b. The district(s) where most of actual work will be accomplished. If city-wide or State-wide, covering several districts, write "city-wide" or "State-wide."

15. Complete only for revisions (item 12c), or augmentations (item 12e).

| Item | |
|---|---|
| 16. | Approximate date project expected to begin (usually associated with estimated date of availability of funding). |
| 17. | Estimated number of months to complete project after Federal funds are available. |
| 18. | Estimated date preapplication/application will be submitted to Federal agency if this project requires clearinghouse review. If review not required, this date would usually be same as date in item 2b. |
| 19. | Existing Federal identification number if this is not a new request and directly relates to a previous Federal action. Otherwise write "NA". |
| 20. | Indicate Federal agency to which this request is addressed. Street address not required, but do use ZIP. |
| 21. | Check appropriate box as to whether Section IV of form contains remarks and/or additional remarks are attached. |

## APPLICANT PROCEDURES FOR SECTION II

Applicants will always complete items 23a, 23b, and 23c. If clearinghouse review is required, item 22b must be fully completed. An explanation follows for each item:

| Item | |
|---|---|
| 22b. | List clearinghouses to which submitted and show in appropriate blocks the status of their responses. For more than three clearinghouses, continue in remarks section. All written comments submitted by or through clearinghouses must be attached. |
| 23a. | Name and title of authorized representative of legal applicant. |
| 23b. | Self explanatory. |
| 23c. | Self explanatory. |
| Note: | Applicant completes only Sections I and II. Section III is completed by Federal agencies. |

## FEDERAL AGENCY PROCEDURES FOR SECTION III

If applicant-supplied information in Sections I and II needs no updating or adjustment to fit the final Federal action, the Federal agency will complete Section III only. An explanation for each item follows:

| Item | |
|---|---|
| 24. | Executive department or independent agency having program administration responsibility. |
| 25. | Self explanatory. |
| 26. | Primary organizational unit below department level having direct program management responsibility. |
| 27. | Office directly monitoring the program. |
| 28. | Use to identify non-award actions where Federal grant identifier in item 30 is not applicable or will not suffice. |
| 29. | Complete address of administering office shown in item 26. |
| 30. | Use to identify award actions where different from Federal application identifier in item 28. |
| 31. | Self explanatory. Use remarks section to amplify where appropriate. |
| 32. | Amount to be contributed during the first funding/budget period by each contributor. Value of in-kind contributions will be included. If the action is a change in dollar amount of an existing grant (a revision or augmentation), indicate only the amount of change. For decreases, enclose the amount in parentheses. If both basic and supplemental amounts are included, breakout in remarks. For multiple program funding, use totals and show program breakouts in remarks. Item definitions: 32a, amount awarded by Federal Government; 32b, amount applicant will contribute; 32c, amount from State, if applicant is not a State; 32d, amount from local government if applicant is not a local government; 32e, amount from any other sources, explain in remarks. |
| 33. | Date action was taken on this request. |
| 34. | Date funds will become available. |
| 35. | Name and telephone no. of agency person who can provide more information regarding this assistance. |
| 36. | Date after which funds will no longer be available. |
| 37. | Check appropriate box as to whether Section IV of form contains Federal remarks and/or attachment of additional remarks. |
| 38. | For use with A–95 action notices only. Name and telephone of person who can assure that appropriate A–95 action has been taken—If same as person shown in item 35, write "same". If not applicable, write "NA". |

### *Federal Agency Procedures—special considerations*

A. *Treasury Circular 1082 compliance.* Federal agency will assure proper completion of Sections I and III. If Section I is being completed by Federal agency, all applicable items must be filled in. Addresses of State Information Reception Agencies (SCIRA's) are provided by Treasury Department to each agency. This form replaces SF 240, which will no longer be used.

B. *OMB Circular A–95 compliance.* Federal agency will assure proper completion of Sections I, II, and III. This form is required for notifying all reviewing clearinghouses of major actions on all programs reviewed under A–95. Addresses of State and areawide clearinghouses are provided by OMB to each agency. Substantive differences between applicant's request and/or clearinghouse recommendations, and the project as finally awarded will be explained in A–95 notifications to clearinghouses.

C. *Special note.* In most, but not all States, the A–95 State clearinghouse and the (TC 1082) SCIRA are the same office. In such cases, the A–95 *award* notice to the State clearinghouse will fulfill the TC 1082 award notice requirement to the State SCIRA. Duplicate notification should be avoided.

AMENDMENT NUMBER 1 TO
REQUEST FOR COOPERATIVE AGREEMENT APPLICATION
NO. 6500
ACCESS DISTRICT HEATING/COOLING SYSTEMS
POTENTIAL IN COMMUNITY DEVELOPMENT
BLOCK GRANT ELIGIBLE COMMUNITIES

To Whom It May Concern:

This is amendment number one (1) to RFCAA No. 6500.

Enclosed are the following forms which must be completed and submitted with your application:

Assurances
Budget Form

The following clarification is made to the RFCAA, task 3, pages 14 and 15. The purpose of these assessments and estimates of savings, cost and benefits is for comparing different candidate District Heating/Cooling Projects. The assessments and estimates of savings, costs and benefits should be of a level of sophistication consistent with that of the data produced in task 2. (Task 2 says on page 13, in part, "The applicant will indicate potential service areas, developing local profiles on the basis of assumed floor areas, building occupancy patterns, climatological data, etc.")

HUD and DOE anticipate approximately $1,500,000 will be available to fund approximately 25 to 35 applications or the average funding available will be approximately $50,000 per cooperative agreement. We expect actual awards to vary around this average award value. Applicants who submit funding requests substantially higher than $50,000 may be required as a condition of award to obtain funding from sources other than HUD/DOE.

Offerors are reminded to follow strictly the format for applications included in the original instruction.

The date for receipt of applications remains unchanged.

Applications must be received at the following location no later than 4:00 P.M., January 21, 1980:

Office of Procurement and Contracts
Community Services Division (ACC-CL)
711-14th Street, N.W., Room 902
Washington, D.C.

Applications may be hand carried to this address; however, there is no direct mail delivery to the Office of Procurement and Contracts. Mailed applications must be mailed to the following address:

<u>MAILED DELIVERIES</u>

Department of Housing and Urban Development
Office of Procurement and Contracts
Room B-133 (711 Bldg.) (ACC-CL)
451 - 7th Street, S.W.
Washington, D.C. 20410

You should allow for the extra mailing time that results because mailed applications are received in the HUD Central mail room and then delivered by shuttle to the Office of Procurement and Contracts. Our policy of not considering applications which are delivered to the Office of Procurement and Contracts late will be strictly enforced.

To prevent opening by unauthorized individuals, your application should be identified on the envelope or wrapper as follows:

Application submitted in response to
Request for Cooperative Agreement
Application 6500
Due date: January 21, 1980
4:00 P.M. Local Time

If you have any questions concerning the Request for Cooperative Agreement Application, please contact Mr. Christopher Lee, Cooperative Agreement Officer, Office of Procurement and Contracts (202) 724-0027.

Sincerely,

Christopher Lee

Christopher Lee
Cooperative Agreement Officer

OMB Approval No. 80-R0186

# PART III – BUDGET INFORMATION

## SECTION A – BUDGET SUMMARY

| Grant Program, Function or Activity (a) | Federal Catalog No. (b) | Estimated Unobligated Funds: Federal (c) | Estimated Unobligated Funds: Non-Federal (d) | New or Revised Budget: Federal (e) | New or Revised Budget: Non-Federal (f) | New or Revised Budget: Total (g) |
|---|---|---|---|---|---|---|
| 1. | | $ | $ | $ | $ | $ |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. TOTALS | | $ | $ | $ | $ | $ |

## SECTION B – BUDGET CATEGORIES

| 6. Object Class Categories | – Grant Program, Function or Activity (1) | (2) | (3) | (4) | Total (5) |
|---|---|---|---|---|---|
| a. Personnel | $ | $ | $ | $ | $ |
| b. Fringe Benefits | | | | | |
| c. Travel | | | | | |
| d. Equipment | | | | | |
| e. Supplies | | | | | |
| f. Contractual | | | | | |
| g. Construction | | | | | |
| h. Other | | | | | |
| i. Total Direct Charges | | | | | |
| j. Indirect Charges | | | | | |
| k. TOTALS | $ | $ | $ | $ | $ |
| 7. Program Income | $ | $ | $ | $ | $ |

OMB Approval No. 80-R0186

## PART III - BUDGET INFORMATION

### SECTION A - BUDGET SUMMARY

| Grant Program, Function or Activity (a) | Federal Catalog No. (b) | Estimated Unobligated Funds: Federal (c) | Estimated Unobligated Funds: Non-Federal (d) | New or Revised Budget: Federal (e) | New or Revised Budget: Non-Federal (f) | New or Revised Budget: Total (g) |
|---|---|---|---|---|---|---|
| 1. | | $ | $ | $ | $ | $ |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. TOTALS | | $ | $ | $ | $ | $ |

### SECTION B - BUDGET CATEGORIES

| 6. Object Class Categories | Grant Program, Function or Activity (1) | (2) | (3) | (4) | Total (5) |
|---|---|---|---|---|---|
| a. Personnel | $ | $ | $ | $ | $ |
| b. Fringe Benefits | | | | | |
| c. Travel | | | | | |
| d. Equipment | | | | | |
| e. Supplies | | | | | |
| f. Contractual | | | | | |
| g. Construction | | | | | |
| h. Other | | | | | |
| i. Total Direct Charges | | | | | |
| j. Indirect Charges | | | | | |
| k. TOTALS | $ | $ | $ | $ | $ |
| 7. Program Income | $ | $ | $ | $ | $ |

## Assurances

The Applicant hereby assures and certifies that it will comply with regulations, policies, guidelines and requirements, as they relate to the application, acceptance and use of Federal funds for this federally assisted project. As used below, the phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance. The applicant assures and certifies that:

1. It will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), and in accordance with Title VI of the that Act, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the applicant receives Federal financial assistance and will immediately take any measures necessary to effectuate this agreement.

2. It will comply with the Age Discrimination Act of 1975 (P.L. 94-135) which prohibits all age discrimination in all Federally assisted programs.

3. It will comply with requirements of the provisions of the Uniform Relocation Assistance and Real Property Acquisitions Act of 1970 (P.L. 91-646) which provides for fair and equitable treatment of persons displaced as a result of Federal and federally assisted programs.

4. It will comply with the minimum wage and maximum hour provisions of the Federal Fair Labor Standards Act, as they apply to employees.

5. It will establish safeguards to prohibit employees from using their positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties.

of the project are not listed on the Environmental Protection Agency (EPA) list of violating facilities and that it will notify HUD of the receipit of any communication from the Director of the EPA Office of Federal Activities indicating that a facility to be used in the project is under consideration for listing by the EPA.

7. It will comply, to the extent applicable, with all the requirements of Section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et. seq., as amended by Public Law 91-604) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1251 et. seq, as amended by Public Law 92-500), respectively, relating to inspection, monitoring, entry, report, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder.

8. It will comply with the flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973, Public Law 93-234, 87 Stat. 975, approved December 13, 1976. Section 102(a) requires, on and after March 2, 1975, the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquisition purposes for use in any area that has been identified by the Secretary of the Department of Housing and Urban Development as an area having special flood hazards.

9. It will assist HUD in its compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (16 U.S.C. 470), Executive Order 11593, and the Archeological and Historic Preservation Act of 1966 (16 U.S.C. 469a-1 et seq.) by (a) consulting with the State Historic Preservation Officer on the conduct of investigations, as necessary, to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Part 800.8) by the activity and notifying the Federal grantor agency of the existence of any such properties, and by (b) complying with all requirements established by HUD to avoid or mitigate adverse effects upon such properties.

10. The applicant agrees that it will comply with Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794, P.L. 93-112), and all requirements imposed by or pursuant to the regulations of the Department of Health, Education and Welfare (45 C.F.R. Parts 80, 81, and 84), promulgated under the foregoing statute. The applicant agrees that, in accordance with the foregoing requirements, no otherwise qualified handicapped person, by reason of handicap, shall be excluded from participapton in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance, and assures that it will take any measures necessary to effectuate this agreement.

11. It will comply with Title VIII of the Civil Rights Act of 1968 (P.L. 90-284) which prohibits discrimination on the basis of race, color, religion, sex, or national origin in the sale or rental of housing, including dwellings provided by Federal assistance programs, including guaranteed or insured loans, and dwellings situated on property developed, redeveloped or cleared with the use of Federal funds.

12. It will comply with the provision of Executive Order 11990 relating to protection of wetlands.

13. It will comply with the provisions of Executive Order 11988 relating to floodplain management.

14. It will comply, to the extent applicable, with Title IX of the Education Amendments of 1972, 20 U.S.C. 1681 et. seq., which provides that no person in the United States shall, on the basis of sex, be excluded from participation in, be denied the educational program or activity receiving Federal financial assistance.

15. It will comply with the equal opportunity clause prescribed by Executive Order 11246, amended, and will require that its subrecipients include the clause in all contracts and subcontracts which have or are expected to have an aggregate value within a 12-month period exceeding $10,000, in accordance with Department of Labor requirements at 41 CFR Part 60.

16. It will include, and will require that its subrecipients include, the provision set forth in 29 C.F.R. 5.5(c) pertaining to overtime and unpaid wages in any nonexempt nonconstruction contract which involves the employment of mechanics and laborers (including watchmen, guards, apprentices, and trainees) if the contract exceeds $2,500.

Additional Assurances for Construction Projects

If the proposed project involves construction, the applicant hereby assures and certifies that:

17. It will comply with the Architectural Barriers Act of 1968, as amended (42 U.S.C. 4151 et. seq.) and the standards issued pursuant to the Act. The applicant will be responsible for seeing that facilities are designed and constructed in accordance with applicable standards and for conducting inspections to ensure compliance with these specifications by the contractor.

18. It will comply, when required by the Federal program legislation, with the Davis-Bacon Act (40 U.S.C. 276a to a-7) and as supplemented by Department of Labor regulations (29 C.F.R, Part 5). This applies to all construction contracts and subcontracts awarded by the recipients and subrecipients of more than $2,000. Under this Act contractors and subcontractors shall be required to pay wages not less than once per week. The recipient or subrecipient shall place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation and the award of a contract or subcontract shall be conditioned upon the acceptance of the wage determination. The recipient shall report all suspected or reported violations to the Federal sponsoring agency.

19. When Federal program legislation provides that the Davis-Bacon Act applies, it will comply with the "Copeland 'Antikick' Back Act" (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 C.F.R. Part 3). This applies to all construction and repair contracts and contracts of recipients and sub-recipients in excess of $2,000. It provides that each contractor or subcontractor shall be prohibited from inducing by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he/she is otherwise entitled. The recipient shall report all suspected or reported violations to the Federal sponsoring agency.

20. It will comply with sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-33) as supplemented by the Department of Labor regulations (29 C.F.R. Part 5). This applies to contracts awarded

by recipients or subrecipients for construction in excess of $2,000 and in excess of $2,500 for other contracts that involve the employment of mechanics or laborers.

The person or persons whose signature(s) appear(s) below is/are authorized to sign this application, and to commit the applicant to the above provisions.

Name and Address of Organization

Title of Official | Telephone Number

Signature of Official | Date

*U.S. GOVERNMENT PRINTING OFFICE : 1979 O-311-300/177

1-2 weeks effort for ESL.

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

DEC 15 1980

Dr. Phillip M. Wright
Associate Director, Earth Science Laboratory
University of Utah Research Institute
Research Park
420 Chipata Way, Suite #120
Salt Lake City, Utah 84108

SUBJECT: Geothermal District Heating - Technical Assistance Program

Dear Mike:

This letter confirms the conversation between Ms. Debbie Struhsacker of the University of Utah Research Institute (UURI) and George S. Budney of the Energy Technology Engineering Center (ETEC) in which the technical assistance program ETEC is coordinating for DOE was discussed. DOE has decided that it would be desirable to establish a priority for cities having hydrothermal district heating potential. Such a list could be used to advise city authorities, utilities and energy district heating systems and the technical assistance and federal government programs available to assist them in developing geothermal district heating systems.

Several studies have been performed identifying cities with hydrothermal potential. The results of these studies are summarized in the following reports:

1. Allen, E. and Shreve, J. - Preliminary Inventory of Western U. S. Cities with Proximate Hydrothermal Potential; Vol I Report, August 1980; Vol II State Mass.

2. Addendum - Preliminary Inventory of Western U. S. Cities with Proximate Hydrothermal Potential.

3. Science Application, Inc. - List of Cities for Geothermal District Heating.

4. P. O'Dea, et al, "Cities and Towns in the Rocky Mountain Basin and Range Region, Data Report, "NMEI 10-5, New Mexico Energy Institute, May 1979.

It was agreed that the University of Utah Research Institute could prepare a priority list of cities having hydrothermal potential using the cities identified in the above documents as a basis. If you are aware of additional cities having hydrothermal potential please include those in the results.

It is suggested that the priority list be segrated into three categories as follows:

I Cities near hydrothermal resources where the hydrothermal potential is fairly certain and development is economically attractive.

II Cities more distant from fairly certain hydrothermal resources (or near less attractive resources) with the potential for economic development.

III Cities more distant from hydrothermal resources where the potential for economic development, because of the unknown characteristics of the resource, is uncertain.

In addition to establishing the priority of cities with hydrothermal potential, it is desirable to summarize the characteristics of the resource for each of the cities. Sufficient data should be provided to form a basis for subsequent geothermal district heating system feasibility and economic studies by prospective developers.

It is requested that UURI prepare a plan and schedule for the proposed report and submit it to DOE (with a copy to ETEC) for comments by December 19, 1980. The plan should indicate the contents of the report.

Funding for this activity should be discussed and resolved with UURI's DOE Contracting Officer.

If any additional information is desired, please contact G. S. Budney of ETEC on (213) 341-1000, extension 6474.

Sincerely,

Wayne Bryan

for Hilary Sullivan
Program Coordinator
Geothermal Energy Division

File - Struhsacker

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
420 CHIPETA WAY, SUITE 120
SALT LAKE CITY, UTAH 84108
TELEPHONE 801-581-5283

October 29, 1980

Mr. George S. Budney
Project Manager - Geothermal Programs
Energy Technology Engineering Center
Energy Systems Group - Rockwell International
P.O. Box 1449
Canoga Park, CA 91304

Dear Mr. Budney:

In response to your letter dated September 23, 1980, to Phillip M. Wright, I would like to express interest in becoming an active participant on the District Heating Product Team. As requested in your letter, I am providing you with the following information:

1) Areas of Expertise

The Earth Science Laboratory is a multidiscipline group of approximately 30 geoscientists, active in geothermal exploration and research. Most of our geothermal work is funded by the U.S. Department of Energy and focuses upon geothermal resource assessment in the western U.S. We are currently involved in numerous DOE-sponsored geothermal programs, including a technical assistance program. This technical assistance program operates on a request basis, and provides up to 100 professional hours of geotechnical advice to potential users and developers of geothermal energy. The information furnished by this program commonly includes preliminary geothermal resource assessment of a site or sites specified by the requestor.

2) Bibliographic Information

Enclosed is a current list of Earth Science Laboratory publications.

3) Other Sources of Technical Assistance

The Earth Science Laboratory is closely coordinated with many other groups capable of providing either technical assistance or geothermal resource information. We work closely with the geothermal engineering technical assistance programs at EG&G Idaho, Inc. and the Oregon Institute of Technology. In addition, we remain in constant contact with the DOE-funded State Coupled Geothermal Resource Assessment Teams and the State Commercialization Teams.

Please let me know if you need additional information about the Earth Science Laboratory or our geothermal activities. I look forward to hearing from you.

Sincerely yours,

Debra Struhsacker

Debra Struhsacker
Associate Geologist

DS:gim

Encl.

cc: P. M. Wright
User Assistance File

Copy to Dclo S. inform

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell International

September 23, 1980

80ETEC-DRF-3987

Multiple Addressees
(See Attached List)

Subject: U. S. Department of Energy, Division of Geothermal Energy, District Heating Product Team

Gentlemen:

The U. S. Department of Energy (DOE) is in the process of forming a District Heating Product Team. The purpose of the team is to:

1. Draw together various district heating activities funded by DOE/Division of Geothermal Energy.

2. Coordinate DOE funded technical assistance activities with other federally funded programs.

3. Promote district heating on a national basis with various prospective users, and working on the local level with commercial teams.

Organizations interested in becoming active participants in this program are requested to so indicate in their replies.

An immediate objective of the District Heating Product Team is to support the national HUD/DOE district heating solicitation to be published in the Federal Register in early October 1980. Technical assistance will be a strong component of the program with support to DOE from ANL and ORNL. ETEC, as the principle coordinator for the team, will be responsible for identifying the technical assistance needs of the prospective solicitation winners proposing geothermal energy heat sources and seeing that these needs are met by the appropriate elements of DOE's technical assistance and outreach programs. State commercialization teams will have a strong input into this process. It is expected that HUD will fund 5-10 geothermal district heating feasibility studies in this first solicitation.

In order to obtain information abour services available to communities and organizations contemplating geothermal district heating, we require the following information from prospective team participants by October 10, 1980.

1. Summary outlining areas of expertise.

2. Bibliography of documents that may assist solicitation winners.

3. List of other organizations such as state energy commissions, governmental agencies, etc., that may be able to provide assistance to the solicitation winners.

Costs that are incurred in responding to this and related letters and for providing technical assistance to solicitation winners are to be taken from existing DOE budgets. If this is not possible, the addressee should contact his DOE contracting officer and/or Mr. Eric Peterson, Program Manager, DOE, Washington, D.C., for further direction before proceeding. Participation in this program by non-DOE funded organizations is on a voluntary basis.

If you have any questions, please call me at ETEC on extension 6474.

Sincerely yours,

G.S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

cc: J. K. Hartman, ETEC PO

MULTIPLE ADDRESSEES FOR LETTER 80ETEC-DRF-3987

PROSPECTIVE CANDIDATES FOR THE

DISTRICT HEATING PRODUCT TEAM

George S. Budney
Project Manager - Geothermal Programs
Energy Technology Engineering Center
Energy Systems Group - Rockwell International
P.O. Box 1449
Canoga Park, CA 91304
Phone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U.S. Department of Energy
12th & Pennsylvania Ave., N.W.
Washington, D.C. 20451
Phone: (202) 633-8760

Ms. Hilary Sullivan
Program Coordinator - Geothermal Energy Division
San Francisco Operations Office
U.S. Department of Energy
1333 Broadway
Oakland, CA 94612
Phone: (415) 273-7943

Mike Tucker
Idaho Operations Office
U.S. Department of Energy
550 Second Street
Idaho Falls, ID 83401
Phone: (208) 526-3180

Jim B. Cotter
Nevada Operations Office
U.S. Department of Energy
P.O. Box 14100
Las Vegas, NV 89114
Phone: (702) 734-3424

Dr. Fletcher C. Paddison
Johns Hopkins University - APL
Johns Hopkins Road
Laurel, MD 20810
Phone: (301) 953-7100

Ms. Ann W. Reisman
Energy Systems Analysis
Department of Energy and Environment
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I. NY 11973
Phone: (516) 345-2666

Phillip M. Wright
Associate Director, Earth Sciences Laboratory
University of Utah Research Institute
Research Park
420 Chipeta Way, Suite 120
Salt Lake City, Utah 84108
Phone: (801) 581-5283

Raymond M. Costello
Supervising Mechanical Engineer
Burns & Roe Industrial Services Corp.
650 Winters Ave
P.O. Box 667
Paramus, NJ 07652
Phone: (201) 262-8800

C. H. Bloomster
Manager, Advanced Energy Analysis
Pacific Northwest Laboratories
P.O. Box 999
Richland, WA 99352
Phone: (509) 946-2442

Gene Culver
Geo-Heat Utilization Center
Oregon Institute of Technology
Ortech Branch P.O.
Klamath Falls, OR 97601
Phone: (503) 882-6321

Dr. Gordon Reistad
Department of Mechanical Engineering
School of Engineering
Oregon State University
Corvallis, OR 97331
Phone: (503) 754-2575, -3441

Dr. Larry Icerman
Box 3 EI
New Mexico Energy Institute
New Mexico State University
Las Cruces, NM 88003
Phone: (505) 646-1745

Dave Gattun
Institute for the Development of Urban Arts and Sciences
U.S. Conference of Mayors
1620 Eye Street, N.W.
Washington, D.C. 20006
Phone: (202) 293-7523

Dr. Reid Stone
U.S. Geological Services
345 Middlefield Road
Menlo Park, CA 94025
Phone: (415) 323-8111

Ron Hilker
Hydrothermal Energy Commercialization Division
E.G.&G. Idaho Inc.
Idaho National Engineering Laboratory
P.O. Box 1625
Idaho Falls, ID 83401
Phone: (208) 526-9887

Ms. Syd Willard
California Energy Commission
1111 Howe Avenue
MS 66
Sacramento, CA 95825
Phone: (916) 924-2499

Marshall Conover
Radian Corp.
Box 9948
Austin, TX 78766
Phone: (512) 454-4797

Dr. R. T. Meyer
Western Energy Planners, Ltd.
2180 So. Ivanhoe, Suite 4
Denver, CO 80222
Phone: (303) 758-8206

J. C. Austin
$CH_2M$ Hill, Boise Office
P.O. Box 8748
Boise, ID 83707
Phone: ?

John Nimmons
Earl Warren Legal Institute
University of California
Berkeley, CA 94726
Phone: (415) 642-2670

Doug Sacarto
National Council of State Legislatures
1125 - 17th Street, Suite 1500
Denver, CO 80202
Phone: (303) 623-6600

Jess Pascual
Bldg. 214, Engineering Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
Phone: (312) 972-5249

N. Richard Friedman
Resource Dynamics Corp.
962 Wayne Avenue
Silver Springs, MD 20910
Phone: (301) 587-1540

Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell
International

Copy to Deb S.
return

September 23, 1980 80ETEC-DRF-3987

Multiple Addressees
(See Attached List)

Subject: U. S. Department of Energy, Division of Geothermal Energy, District Heating Product Team

Gentlemen:

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If you have any questions, please call me at ETEC on extension 6474.

Sincerely yours,

G. S. Budney

G. S. Budney, Project Manager
Geothermal Programs
Energy Programs
Energy Technology Engineering Center

cc: J. K. Hartman, ETEC PO

MULTIPLE ADDRESSEES FOR LETTER 80ETEC-DRF-3987

PROSPECTIVE CANDIDATES FOR THE

DISTRICT HEATING PRODUCT TEAM

George S. Budney
Project Manager - Geothermal Programs
Energy Technology Engineering Center
Energy Systems Group - Rockwell International
P.O. Box 1449
Canoga Park, CA 91304
Phone: (213) 341-1000, Ext. 6474

Eric A. Peterson
Program Manager - Division of Geothermal Energy
U.S. Department of Energy
12th & Pennsylvania Ave., N.W.
Washington, D.C. 20451
Phone: (202) 633-8760

Ms. Hilary Sullivan
Program Coordinator - Geothermal Energy Division
San Francisco Operations Office
U.S. Department of Energy
1333 Broadway
Oakland, CA 94612
Phone: (415) 273-7943

Mike Tucker
Idaho Operations Office
U.S. Department of Energy
550 Second Street
Idaho Falls, ID 83401
Phone: (208) 526-3180

Jim B. Cotter
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P.O. Box 14100
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Johns Hopkins University - APL
Johns Hopkins Road
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962 Wayne Avenue
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December 1980

Geothermal HQ Monthly Newsletter

To end the old year on the "right" foot we are going to try and send monthly reports to the field on the status of events in Washington, D.C. that may be of interest to you. Your comments will be appreciated but please be patient because I am having to carry the burden myself.

This information is provided for you of which all, if not so stated is public. You may use it in any manner that you feel will expidite the growth of geothermal utilization.

Eric Peterson
Editor

Memo to Files

Recent Federal District Heating Iniatives
by Eric Peterson

A Proposed National District Heating and Cooling Program Strategy has been prepared by DOE and HUD with input from several other federal agencies. The draft strategy was to be published in The Federal Register this fall but will likely be delayed for consideration by the new administration. Several aspects of the strategy however are being activated including The Interagency District Heating Coordinating Group and the HUD/DOE cooperative solicitations for district heating and cooling feasibility assessments.

One

The Interagency District Heating Coordinating Group (IDHCG) composed of 12 agencies of the federal government was established to promote the implementation of district heating on a wide scale as rapidly as possible. The IDHCG is chaired by The Deputy Secretary, U.S. Department of Energy. Membership in the IDHCG is at the Assistant-Secretary or Assistant Administrator level as appropriate from the following agencies:

Department of Energy

Department of Housing and Urban Development

Department of Commerce

Department of Defense

Department of the Treasury

Department of Health & Human Resources

Environmental Protection Agency

General Services Administration

Veterans Administration

The Department of Agriculture is expected to join the group.

In addition appropriate-level representation from the following organizations:

Council of Environmental Quality

President's Domestic Policy Advisor Office

of Management and Budget

The IDHCG will operate as an independent organization but will keep the Assistant Secretaries' Coordinating Committee appraised of program activities being recommended. Policy issues will be refered to the Energy Coordinating Committee (ECC) for resolution.

Functions of IDHCG include:

- establish a overall policy for Federal efforts to have district heating and cooling systems implemented on a wide scale in the U.S.
- establish the requirements for formal interagency agreements
- serve as a focal point for review of existing regulations and programs within the Federal establishment which can be used or possibly modified to assist in meeting the goals of the district heating and cooling (DHC) effort.
- develop a unified approach to supporting agency request for appropriations in furtherance of the DHC program
- serve as a focal point for development of legislation, if required, in support of the DHC program
- report to the President in Spring 1981 on the status and needs of a national district heating program

Two

The 1st HUD/DOE cooperative solicitation (Technical Assistance Potential District Heating and Cooling Projects) was published in the Oct. 17 Federal Register and Oct. 14 Commerce Business Daily. The objectives of this solicitation are to assist communities in:

- o *identifying DCC projects*
- o organizing team to carry through project
- o educate community (public hearings)
- o develop and implementation plan

The funding for the solicitation is $1.5 million with awards in the 20 to 30 thousand dollar range. Extensive technical assistance will be provided to the communities to help them during the study. The proposals are due Jan. 15, 1981.

Three

A second solicitation scheduled to be published in Feb. 1981 by DOE in cooperation with HUD will be directed at communities that have their DHC project identified and a team organized to carry through the project. The objectives include:

- o complete conceptual design
- o identify financial arrangements/options
- o clarify institutional arrangements
- o obtain user committments

The geothermal resource if not already confirmed must be confirmed during this phase.

The funding anticipated for this solicitation is $2.8 million with individual awards in the $50 thousand and up range. Proposals would be due in April with awards announced in July.

In order to coordinate our geothermal activities with the HUD/DOE initiatives and to place focus on our district heating activities DGE has formed a Geothermal District Heating Team. The initial activities of the DH Team include:

- o Establishing a bibliography of DH reports
- o Summary of DH activities
- o Coordinator for HUD Team activities
- o Analysis of DH program models
- o Organize DH Technical Blue Ribbon Panel
- o Organize DH User Panel

The chief coordinator is

George Budney
Energy Technology Engikneering Center
P.O. Box 1449
Canoga Park, Ca. 91304
Tele. (213) 341-1000 ext. 6474

The principal focus of IDHCG is preparing the Report to the President in Spring 1981. Subcommittee panels are being organized to address the various sections of the report. I will be reporting on their results in the next report. If you are interested, feel free to comment on the attached October Draft of the National DHC Strategy. Although it is not presently being officially published we do need a field perspective on the document. Eventually individual states may want to respond with their own strategy.

The DH Team is in the early stages of planning area conferences with state organization of the league of Cities developers and the regional offices of the American Gas Association. Once the contact and committments are fully established the state teams will be invited to participate in the detailed planning and running of the meetings.

ASHRAE (Am Society of Heating Ref. and Air Conditioning Engr.) will hold their Semi Annual Meeting in Chicago Jan. 25-29. The Geothermal Technical Committee 6.8 will sponsor a symposium, "Design and Cost of HUAC for Equipment Systems for Geothermal Applications" Sunday, Jan. 25. The Geothermal TC 6.8 will probably meet on Monday. I would like to encourage all engineering firms involved in geothermal projects to attend. The TC is planning a symposium on District Heating Systems for the June 28-July 2 Meeting in Cincinnati, Ohio.

ASTM Geothermal Committee E-45 Subcommittee 20 on utilization met recently in Reno. The next meeting will be in Phoenix, AZ May 13-14. The ASTM committee is working on standards (definition, testing, safety and performance) for the industry. Engineering firms with experience in geothermal design are encourage to attend.

For further information please contact any of the subcommittee officers.

| | | |
|---|---|---|
| Frank Childs | Chairperson, EG&G | (208) 526-9512 |
| Eric Peterson | Vice Chairperson, DOE | (202) 633-8760 |
| P.J. Karnoski | Secretary, Brown & Root | (713) 679-3454 |

The recent publications that should be of interest to anyone interested in Geothermal Engineering are:

"District Utilization of Geothermal Energy: A Technical Handbook"

Geothermal Resources Council

Special Report #7

"Direct Application of Geothermal Energy"

by Gordon M. Reistad to be published by ASHRAE and encorporated in the next publication of the ASHRAE "Applications Design Guide".

## Cities Targeted for Geothermal

The DH Team will be sending to the state teams for comment priority listing of cities for their comments. State Teams will be asked to indicate which communities by priorities should be the focus of several program efforts. This analysis will enable us in Washington to be specific on reaching the power on line goals.

## New Geothermal Loan Programs

by Hilary Sullivan

Title VI of the Energy Security Act (P.L. 96-294) authorizes DOE to provide direct loans for projects to confirm geothermal reservoirs, to conduct engineering and economic feasibility studies and to construct geothermal systems. DOE is also authorized to cancel a borrower's obligation to repay a drilling loan or a feasibility study loan if results show the project to be technically or economically infeasible.

Drilling loans can be made for up to 90% of the cost of a project primarily for space heating, cooling or process heat of an existing facility or one under construction; all other projects are limited to 50% loans. There is a $3,000,000 borrowing limit for each project.

Feasibility study loans are available for up to 90% of the cost to study the technical and economic feasibility of geothermal direct heat application projects. The construction loan program will provide 75% loans for the construction of direct heat application projects.

For all loan programs the interest rate is the rate in effect (at the time the loan is made) for projects under section 80 of the Water Resources Development Act of 1974.

For this fiscal year, $5,000,000 has been authorized for the drilling program and $5,000,000 for the feasibility study program, but no appropriations have been made yet. There has been no authorization or appropriation for the construction program.

Proposed regulations for the drilling and feasibility study loan programs are expected to be published in the Federal Register for a 60-day public comment period by January 1, 1981. Regulations for the construction loan program have not been scheduled for issuance as yet.

For more information, contact Hilary Sullivan, DOE-SAN, (415) 273-7943; Susan Prestwich, DOE-ID, (208) 526-1147; or Lachlan Seward, DOE-HQ (202) 633-8760.

## FERC Proposed Regulations
by David Lombard

The FERC recently has proposed rules implementing provisions of the Energy Security Act of 1980 which pertain to the production of electric power from geothermal resources. The Act authorizes FERC to exempt certain small power producing facilities from federal and state regulations, and would require utilities to purchase their power at "avoided cost". The proposed rules define small geothermal power plants as those with capacities of 80 MWe or less. The comment period on these proposed rules closed December 15, 1980.

# STATUS OF GEOTHERMAL LEGISLATION

During 1980, two of three major geothermal legislative initiatives were enacted, and the third was not acted upon. In April 1980, the Crude Oil Windfall Profits Tax Act (PL 96-223) was signed by the President. The law provides tax credit increases over those provided by the National Energy Act. The investment tax credit for geothermal equipment is increased to 15% in excess of the normal 10% and extended through 1985. The residential cedit is increased to 40% of the first $10,000 in expenditures for geothermal equipment, for a maximum of $4,000. Finally, a tax credit is provided equal to 10% of the cost of cogeneration equipment. Geothermal systems designed to tap waste heat or steam would qualify. IRS final regulations on the residential credit and draft regulations, (dated September 19, 1980) on the business credit have been objected to by DOE. DOE's objections are to (1) a minimum temperature limit of 50°C in both regulations, (2) a requirement that equipment be specially adapted or modified to qualify for the business investment credit, (3) disallowance of the credit if both geothermal energy and another source is used, and (4) disallowance of the credit for exploration and development expenses. (See IRS attachments including comments.)

The Energy Security Act (PL 96-294) was enacted in June 1980. Title VI, the Geothermal Energy Act of 1979, contains the following major provisions:

(1) An $85 million five-year program under which the Federal government will share the risks of drilling for commercially viable geothermal resources. Loans will cover 50% of the cost of surface exploration and drilling and 90% of the cost of a project to use geothermal for space conditioning or process

heat. The loans will be repayable out of project revenues and will be wholly or partially forgivable if a project is unsuccessful. Because the high economic risk perceived by drillers and developers is considered to be one of the major forces slowing development, the reservoir confirmation loan program is expected to accelerate the rate of exploration for and confirmation of geothermal reservoirs. Authorization is \$5 million for FY 1981 and \$20 million for each of fiscal years 1981 through 1985. Regulations are being prepared, but no moneys have been appropriated.

(2) A program authorizing DOE to grant low-interest forgivable loans to cover up to 90% of the cost of feasibility studies and regulatory applications and up to 75% of the construction costs of nonelectric systems. \$5 million is authorized for feasibility studies for FY 1981. Regulations are being prepared but no moneys have been appropriated yet.

(3) A DOE study and report to Congress by June 1981, to examine the need for and feasibility of a Federal reservoir insurance and reinsurance program. On the basis of the report, Congress will determine whether to authorize a program of insurance or reinsurance against the risk of reservoir failure after investment of at least \$1 million has been made in reservoir development and use. The direct insurance would be provided only where the developer could not obtain private insurance at reasonable premiums.

(4) Modification of Geothermal Loan Guaranty Program (GLGP). The law extends the life of the GLGP from 1984 to 1989 and provides an increased level of assistance under the program. Loan guarantees for loans to municipalities and public cooperatives will be increased from 75% to 90% of project

costs. PL 96-294 also includes provisions to expedite processing of loan guarantees; such reforms include a four-month deadline for processing applications, requirements to give faster consideration to applicants for non-electric projects, and a requirement to eliminate duplicative Environmental Impact Statements under NEPA for loan guaranty applications.

DRAFT

# PROPOSED NATIONAL DISTRICT HEATING AND COOLING PROGRAM STRATEGY

OCTOBER 1980

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## DIGEST

Objectives and principal areas for comment

This document outlines a proposed coordinated strategy for the development and implementation of a National District Heating and Cooling (DHC) program. The Department of Energy (DOE) seeks public comments and suggestions regarding this document, and will consider them in the preparation of a final strategy for the development and implementation of the national program.

The following three areas are of particular interest to the Department in establishing an effective plan:

(1) Utility of DHC as a community energy option: This draft document briefly describes the technology of DHC as a community energy option. The strategy document outlines the utility of DHC systems in terms of scarce fuel savings, and benefits in the environmental, social, and urban development areas for communities. DOE seeks comments and suggestions regarding the correctness and completeness of the approaches to achieve these benefits.

(2) Benefits of and Barriers to Adoption of DHC
This draft document identifies and discusses the benefits of successful DHC systems in the United States. The full potential of these benefits cannot be realized, however, without addessing, and in come cases alleviating as appropriate, barriers to DHC development. Therefore, this draft document also indentifies and discusses those barriers delaying or preventing the achievement of the full potential of DHC systems at the present time. DOE

seeks comments and suggestions regarding the accuracy of the identification of both benefits and barriers, the existence of others not identified in the text, and their ranking in order of significance.

(3) Acceleration of DHC Adoption: This draft document describes the program elements and activities that are perceived to be necessary to a national DHC implementation effort. The proposed program strategy has been designed to accelerate the adoption and expansion of DHC systems nationally and to address, where appropriate, the currently perceived barriers to the DHC development. The proposed strategy combines activities involving both the private and public sectors at the local, state, and Federal levels. DOE seeks comments and suggestions regarding the conceptual correctness of the strategy, its appropriateness, and the appropriate roles of Federal, state and local governments in helping to implement DHC installations and alleviating existing barriers.

- Technology description

District heating and cooling is a system that provides one or more of the major thermal services required by local communities such as space heating, space cooling, domestic hot water and process steam. The system consists primarily of a piping network that transfers heat (or cooling water) from one or more central points to buildings and industry throughout a community. The thermal energy is produced at central facilities and is transported to users in the form of steam or hot water. Thermal services within the buildings are provided through heat exchangers and absorption chillers.

The central sources that generate the steam or hot water could be electric power plants, industrial plants with large amounts of waste heat, new congeneration plants, municipal waste-recovery plants, a geothermal source (wells, or underground water), solar stations, or oil and gas boilers.

DHC systems can be classified according to the type of the areas they serve. Four typical DHC applications are:

(1) densely populated urban areas,

(2) high-density building clusters,

(3) low-density residential developments, and

(4) industrial complexes.

They can also be classified according to purpose. General-purpose systems are designed to serve the major downtown area of a community, but could be expanded to serve the entire community (see Appendix A, Section A.2.2). These systems generally utilize one or more existing element of a DHC network such as a plant and/or distribution network. Other types of systems are more limited in scope and are by design (and planning) suitable for a specific limited area such as a shopping center, a residential subdivision, or an industrial complex (see Sections A.2.3.-A.2.5). These generally involve a new system installed to serve an existing area or a new development. The required institutional arrangements, financing requirements and construction schedule differ for each type of application. The complexities and difficulties of the institutional arrangements required by a DHC system for densely populated urban areas are greatest; the simplest are for DHC systems serving an industrial complex or a high-density cluster. The impact of the DHC application on the energy, economic development, environmental and social aspects of the community varies with each type of application. DHC systems for densely populated urban areas have the greatest impact on all four aspects of concern for the community, whereas the other applications show varying degrees of limited impacts in one or more aspects.

Potential benefits

The potential benefits to a community from successful application of district heating and cooling are to:

(1) Conserve energy and resources by more efficiently using energy supply and enhancing present local conservation efforts,

(2) Reduce or eliminate energy supply and price uncertainties by substituting available and reliable resources (waste heat from existing plants, urban solid waste, coal, geothermal, and solar) for oil and gas,

(3) Stabilize and control thermal services costs as they affect the economic stability and growth of the U. S. commercial, residential and industrial sectors,

(4) Provide significant near-term employment opportunities for low-skilled and unskilled labor in the community, and

(5) Reduce environmental pollution through use of central plants having pollution controls.

Several studies, both generic and site-specific, indicate that the applicability and potential benefits of district heating and cooling are highly dependent on the characteristics of each community and its principal institutions (both in the public and private sectors). From a national perspective, because the space-heating and domestic hot water market alone represents about 15 quads* per year energy use, district heating and cooling will have a significant effect in national conservation efforts.

space heating + domestic $H_2O$ = 15 Quads/yr

Potential costs

The cost per unit of service ($/million Btu), and the capital cost of DHC are highly dependent on the arrangements that the various institutions will make in order to accommodate the needs and requirements of a successful application. Among the many factors that influence cost are state and Federal government regulations, local energy market conditions, and physical opportunities (availability of appropriate central sources, potential market densities, proximity to sources, etc.).

The cost of a unit of service provided today by existing district heating systems in the U.S. varies from $2 to $10 per million Btu for DHC applications of various kinds. Generic studies project cost ranges for new

* 1 quad = $10^{15}$ Btu, or the energy equivalent of 180 million barrels of oil (or 500,000 barrels of petroleum/day over a one-year period).

systems of between $5 and $20 per million Btu. Both of these cost ranges indicate that DHC systems can compete economically with conventional thermal fuels such as oil and gas, but the variation in cost estimates for DHC systems is greater because of the variations in site specific characteristics.

$20 M/MMBtu vs $11.10/MMBTU heating oil $6.50/MMBTU Nat. gas

The capital costs of DHC systems also vary from site to site and are influenced by the same factors as the cost per service unit. Careful planning and phased implementation are needed so that generated revenues will either totally or partially cover future expansions. Current typical estimates of capital costs based on site-specific analysis for large systems indicate $0.5 billion to $1 billion would be required for a major metropolitan area DHC system over 20 to 30 years of construction, with the typical first-phase cost ranging from $10 to $50 million. District heating systems(as described in Appendix A) require from a few million to several tens of millions of dollars.

Principal issues and barriers

Assessments and analyses together with demonstration programs for both general and special purpose district heating and cooling applications have indicated that the principal barriers to widespread DHC adoption are institutional, statutory, and regulatory rather than technical and physical. Before an entity (private or public) can undertake the implementation of DHC, arrangements must be made within the constraints of ownership, financing, operation, regulation, taxation, and permits. These various procedures involve Federal, state and local governments; financing institutions; utility companies, major customers; major commercial and industrial interests; local interest groups, and other. Anyone whose consent is necessary for the resolution of these issues can impede the progress of the DHC project. The greater the cooperation of the various entities involved, the greater the project's feasibility and the lower its effective cost -- both capital and operational. An example is the assistance of tax-exempt financing in lowering the cost of capital investments. The resolution of most issues involves a complex balancing of competing priorities, and can be achieved only through coordinated action among the parties involved. While most issues will be resolved at local, site-specific levels, some questions will demand general resolution at the Federal and/or State levels.

## Outline of a National DHC Program Strategy

The proposed national strategy reflects the initial experience regarding DHC potential, based on the research, demonstration, assessments and analyses performed to date. This work indicates strongly that DHC systems can become a significant means of reducing oil and gas consumption while meeting U.S. energy needs within the complex constraints of economic, environmental and social considerations. The Department of Energy (DOE), Department of Housing and Urban Development (HUD), and the Environmental Protection Agency (EPA), recognizing that such potential exists, have cooperated during the last year both in formulating a national strategy that includes five major elements and in coordinating related activities and programs.

DOE
HUD
EPA

5 elements

The first step in the proposed national strategy is the establishment of a Federal Inter-agency District Heating Coordinating Group (IDHCG). The IDHCG has been formed because a program to implement DHC systems will have a potential impact on, or be impacted by, other Federal agency programs and activities. The IDHCG is chaired by the Deputy Secretary of

DOE and includes appropriate representatives from HUD, EPA, the Treasury Department, the Department of Commerce, the Department of Health and Human Services, the Department of Defense, General Services Administration and Veterans Administration. In addition, representatives from the Office of Management and Budget, the Council on Environmental Quality, and the President's Domestic Affairs Advisor will participate as observers. This high-level interest in the potential of DHC systems, as expressed by the formation of the coordinating committee, signifies both the Federal Government's serious interest in DHC and the realization that many complex issues of a legal, regulatory, financial, and institutional nature need to be addressed in a coordinated fashion by the participating agencies. The IDHCG is responsible for coordinating the interests of both the public and private sectors in the national DHC effort.

The first proposed program element in the national strategy includes the possible development of appropriate Federal legislation and state plans addressing the legal and regulatory issues involved in DHC implementation (see Section 2.3.1.2). In a second element, the support of local teams to assess the potential of DHC in their communities and to organize toward implementation of promising DHC systems is proposed (see Sections 1.3 and 2.3.2). The third program element, implementation of DHC systems, recognizes that the Federal Government could provide assistance ranging from incentives and disincentives to direct financial assistance. However, the subject of Federal support for the construction of DHC systems is not treated specifically as a program element. The

1st element develope legislation

2nd element identify DHC sites

3rd element implementation aid + assistance most appropriate mix of incentives is uncertain at this time, and public comment and suggestions are sought to help define the appropriate role of the Federal Government in the future development of DHC. A fourth element proposes supportive technology R&D and the development of appropriate standards and codes. The fifth and final element is an active information dissemination activity. (see Sections 2.3.4 and 2.3.5).

4th Element
R+D

5th Element
Info Disseminat

Background

Historical perspective: District heating, while originally developed in the United States, is not nearly as popular here at present as it is in many European countries. European systems typically use hot water, rather than steam, which extends the potential for system expansion (see Appendix A). Many European DHC systems are partially subsidized by government agencies. By contrast, the typical American district heating system is 50 or more years old, steam-based, and is owned by a utility company whose major interest is in the supply of electricity and other services. The steam heat systems in the United States achieved their greatest growth between 1900 and 1930, when waste steam from electric power plants was plentiful and could be sold for the cost of distribution. As the obsolete electric/steam cogeneration plants which supplied the steam were replaced by large, remotely located electric plants, many of the steam systems were cut back and many others began using heat-only boilers, which raised costs (because the steam was no longer a byproduct of electric generation). Some of the existing steam systems have been preserved, but there has been no real incentive to expand or upgrade them since the time they were built (13).

Our current national energy needs make reassessment of DHC advisable, and may provide a reason for further development and expansion of district heating. In many locations, DHC can provide thermal energy services more efficiently and at a lower cost than conventional fuels. In addition, use of DHC heating can help lessen U. S. consumption of imported oil. To accomplish the goal of nationwide implementation of DHC, a major effort must be made to address existing economic, financing, regulatory, institutional, environmental and legal barriers.

Past analysis and assessments: The Department of Energy has been engaged in a research and development effort in DHC. In the course of this work, a number of topical reports covering legal, regulatory, financing, organizational, technological, environmental, and other aspects of DHC have been produced. Market assessments on a national and regional level, as well as for a number of large cities, have been performed. Generic and site-specific DHC environmental anslyses have been conducted which describe the impact of the systems on major pollutants. A series of technological evaluation reports covering major components of DHC systems has been completed, and research on storage subsystems suitable for DHC applications has been performed. Several program activities within the Department of Energy are supporting efforts by communities to pursue DHC applications, for example the Buildings and Community Systems, Industrial, Geothermal, Advanced Technologies, Urban Waste, Nuclear and other programs. The Utilities Program of the Economic Regulatory Administration is also engaged in an effort to address DHC economic and regulatory issues. DOE has been joined by HUD and EPA in some of these efforts. Copies of these analyses are available as reports, and can form thebasis for a public information dissemination program on DHC (see Section 2.3.5.3).

The demonstration program: A few demonstrations are now under way in which various types of DHC systems utilize reject heat from existing electric or industrial plants, the heat produced by urban waste plants, and the heat from geothermal wells. DHC systems for low-density residential applications have not yet been applied in the United States. A series of generic studies utilizing the heat-pump principle to provide DHC for small-density residential developments have been performed, and site-specific demonstration project has either performed or has under way a detailed comparative analysis of DHC versus other energy alternatives available to a community. These comparative analyses cover the impact of DHC and other alternative systems on a community in terms of energy, economic development, environmental impact, and social impact.

Alternatives to DHC systems: Assessments of potential alternatives to DHC for providing thermal services to a community require site-specific analysis. Because DHC can contribute to the resolution of energy, economic, environmental and social concerns at the local level, the definition and treatment of alternatives to DHC will depend on the local team, their priorities, local resource availability, environmental concerns and a variety of other factors that will vary from one location to another.
In general, considering DHC as primarily a thermal-services supply system, the potential alternatives to DHC are:

(1) Systems based solely on electricity, resulting in what is called today "all-electric buildings." Electricity produced near a source of coal is transfered by wire over long distances to the buildings and industry of the community where, through heat pumps and conventional systems, it provides heating and cooling services.

(2) Mixed fuel systems, in which oil and gas continue to dominate the thermal services market (especially space heating and hot water, which form the largest initial market potential for DHC).

(3) Solar and alternative fuels, incorporated with intensive efforts for building structure improvements, building systems equipment and appliance improvements and operational curtailments.

These alternatives have a variety of impacts and requirements in the four main areas of energy, economics, environment, and society. Only preliminary comparative data are available on these energy alternatives, particularly in terms of local non-energy impact. No attempt is made here to compare and rank these alternatives through a comprehensive cost-benefit analysis. An underlying assumption of all three alternative scenarios is that an optimum level of end-use energy conservation will be an integral part of each plan. End-use conservation in the building environment includes building structure improvements and use of more efficient heating/cooling equipment. The optimum level of end-use conservation will vary from scenario to scenario, but the third alternative is expected to involve the most intensive emphasis on end-use conservation.

## 1.0 INTRODUCTION

Our Nation's increasing energy demands, limited oil and natural gas resources, dependence on foreign oil supplies, and rapidly escalating energy costs necessitate a concerted effort by government and industry to increase energy conservation and reduce our dependence on natural gas and foreign oil. A recently released National Academy of Sciences report entitled "Energy in Transition" stressed that the highest priority in energy policy should be the reduction of future demand growth. The means to accomplish this goal should be through conservation; specifically, improved energy efficiency and fuel substitution. District heating and cooling has the potential to play a significant role in accomplishing this goal for the United States, thereby increasing our national security and improving our balance-of-payments status.

District heating and cooling (DHC) is a system that provides thermal energy from a central source to residential, commercial, and industrial users by way of a network of pipelines. DHC systems conserve scarce fuels by:

(1) substituting alternative forms of energy for oil and natural gas that are currently used in individual buildings; and
(2) utilizing energy resources more efficiently through the use of cogeneration power plants.

A major advantage of DHC systems is that they can be fueled by a variety of energy sources, including coal, nuclear fuels, industrial waste heat, solid waste, geothermal reservoirs, and solar radiation. The thermal energy produced is transported by pipelines to users in the form of steam or hot water. The energy is then transferred through a heat exchanger and used for space heating, process heat, domestic hot water, or cooling by absorption chillers. With such systems, it is possible to reduce dramatically the consumption of scarce fuels by conventional oil- and gas-fired heating systems. Additional background information on DHC systems, including a brief history of the technology and the current status of U. S. and foreign systems, is presented in Appendix A.

### 1.1 Benefits of District Heating and Cooling

Several studies (1-4)* have indicated the potential economic and energy-conservation benefits of DHC. Although the studies were based on varying assumptions, they all showed a large potential U. S. market for DHC, ranging from two to more than five quads** annually by the year 2000.

On a national basis, space and water heating currently account for almost 22 percent of the total U. S. energy demand of about 78 quads per year. Over 90 percent of this heat requirement (15 quads per year) is supplied by oil and natural gas, fuels which are subject to rapid price escalation and are limited in supply. DHC can provide a viable means, using currently available technology, to efficiently utilize domestically available resources such as coal, nuclear, and geothermal energy, for space heating and cooling, thereby substantially reducing consumption of oil and natural gas. Furthermore, because district heating and cooling is more efficient than individual furnaces, the

* Numbers in parentheses indicate references at the end of this paper.

** 1 quad = $10^{15}$ Btu = the energy equivalent of 180 million barrels of oil = 500,000 barrels of petroleum per day for a year.

amount of fuel burned to meet a given heating requirement can be reduced.

The overall conversion efficiency of an electric-only plant ranges from 30 to 40 percent; the remaining 60 to 70 percent of the energy is rejected to the environment through stack-gas losses and the plant's cooling system. By utilizing most of the rejected heat, a cogeneration plant can operate at an overall efficiency greater than 85 percent. This requires some reduction in electric output, but for each equivalent unit of electricity sacrificed, four to eight units of thermal energy are made available for district heating and cooling.

Widespread use of district heating and cooling can also improve air quality. The burning of fuels in individual buildings would be replaced by piped-in heat; thus, emissions from many uncontrolled sources of pollution would be replaced by emissions from a central plant, which is more likely to be equipped with a tall stack and stack-gas cleanup equipment, or by a non-polluting source such as geothermal, solar, etc. A recent study (5) assessing the effect of district heating and cooling with cogeneration on sulfur dioxide ($SO_2$) concentrations in the atmosphere in the Minneapolis-St. Paul area indicated that district heating and cooling can decrease pollutant concentrations in ambient air. Measurements taken in Sweden have actually shown a significant improvement in air quality in cities with district heating and cooling systems (6).

District heating and cooling with cogeneration reduces both thermal pollution and water requirements for steam-electric power plants. This is because heat from the cogeneration plant is used in the DHC system instead of being discharged to rivers or the atmosphere through cooling towers as is the case with conventional steam-electric generating plants.

One study indicated that "the annual water consumption required to generate each kilowatt-hour of electricity is reduced by 50 percent with cogeneration as compared to conventional power production" (7).

District heating and cooling offers several advantages to the consumer. These include the stabilization of rapidly rising prices for space and water heating, elimination of the need for an individual boiler and operators, and greater safety resulting from the absence of combustible fuels in buildings.

## 1.2 Barriers to District Heating and Cooling Implementation

Various economic, regulatory, legal, environmental, and institutional issues can impact DHC development. Many of these have been identified in a recent report (8) which discusses factors affecting ownership, operation, and growth of a large metropolitan DHC system. Table 1.1 presents a list of topics discussed in this report. Although this list is not complete, it provides a general idea as to the types of issues that must be considered.

High front-end costs

From an economic standpoint, one of the main constraints on expanding or developing a DHC system is raising funds for the large capital investment required. There may be several years of negative cash flow when new systems are implemented, resulting from the long lead time before the DHC system is placed into operation and begins to produce revenues, and from the gradual buildup of load over several years before substantial revenues can be generated. Hence, the perceived risk to investors is high. Interviews with electric utilities (3) have indicated unwillingness to invest in new district heating and cooling systems unless major uncertainties were resolved. For example, some states do not have a cost allocation methodology to determine rates for thermal energy from cogeneration power

Table 1.1 Issues which may affect development, ownership, and operation of district heating and cooling systems (8)

- Financing
  - Capital structure
  - Types of debt financing
- Taxation
  - Property tax
  - Sales Tax
  - Selective and excise tax
- Regulation
  - Regulation of the district heating and cooling company
  - Operating income regulation (revenue requirements) Start-up loss recovery
  - Fuel or heat source cost pass-through
  - Allowance for funds used during construction
  - Plant siting
  - Service area
  - Reliability and availability of service
- Pricing policy
  - Tariff classification
  - Pricing basis
  - Rate structure
- Allocation of costs and benefits between electrical generation and district heating and cooling for cogeneration power plants
- Capital investment recovery for building owners
- Displacement efforts on existing energy suppliers
- Hookup policy
- Permits and authorization
  - Franchising by cities
  - Plant siting
  - Start-up and construction

plants. Other regulatory issues and the market potential are also of concern. The report cited (3) recommends that the government provide incentives to overcome some of these uncertainties. The report concludes that, without such action, it is unlikely that the utility industry would risk large outlays for DHC.

Environmental impacts are also an important aspect of DHC system development. Because DHC installations will alter pollutant emissions at a large number of sources, the air pollution effects of the systems are complex. Groups considering district heating and cooling may perceive this complexity as an additional uncertainty in obtaining the necessary environmental permits prior to construction of the system. However, district heating and cooling systems will in fact usually improve air quality in the vicinity of the system, and future policies will encourage the development of such systems. For example, where installation of a DHC system reduces the amount of pollution emitted in an area, EPA's "bubble policy" would allow the system operator to increase pollution emissions from another source (one not included in the DHC system) as long as this restructuring of emission limits provides a net improvement in (or equicalent) air quality. EPA encourages states to apply this policy. EPA's role in the recently established Federal District Heating Coordination Group (see Section 2.3.1.1) will be to clarify this and other environmental policies, regulations, and effects, and thereby reduce the uncertainties associated with the environmental aspects of the systems.

Another concern is whether an urban area can be retrofitted for DHC without adverse local impacts during the time the system is under construction. European experience has shown that large urban areas can be retrofitted without major disruptions; with proper planning, it is likely that the same would be true for the United States.

1.3 Discussion of Alternatives to District Heating and Cooling

District heating and cooling will have implications for energy supply, economic development, environmental quality and social concerns at the local level. These four major areas could be affected to various degrees by the application of DHC in the community.

The program strategy discussed in Section 2 includes development of local teams to study DHC as an alternative energy option in their community. The priorities of the local team will most likely influence the definition of the competing options. If the emphasis of the team is to be on the social and economic development, then DHC will be compared with other investment alternatives, some of which may be entirely unrelated to energy (e.g.), a convention center or a subway system). If the team's emphasis is on energy, DHC is most likely to be compared with realistic alternatives to thermal services supply systems such as electric, synfuel, solar, and alternative fuel systems. If the emphasis of the local team is on the environment, DHC may be compared with all-electric systems from remote coal and nuclear plants or with all-solar and alternative fuels systems.

The priorities and composition of the local team will also define the methodology of their comparative analysis of DHC and alternatives under consideration. Cost of service is only one of the many factors that will influence this analysis. Other factors such as financing requirements, perceived uncertainty of market conditions, perceived needs to comply with requirements of law and regulation (especially environmental and social) and other local sensitivities will influence their methodology.

An important point is that the district heating alternative does not preclude use of coal in any of several forms or use of oil shale to serve the same market. Even when congeneration power plants use imported oil, the cogeneration system can save oil because it enhances the efficiency of heating services. Oil from coal or shale could be more efficiently used in the district heating system than by direct firing in buildings if the utilities refused to convert to coal. Where cities are served by district heating, their needs for synthetic fuels for thermal services will be lessened. Thus, the district heating system has the unique ability both to compete with, and to improve efficient use of, fossil fuel supplies.

Building improvements and use of solar energy are popular conservation alternatives. Potential energy savings are possible through building renovations and retrofitting such as insulation, window sealing, and improvements in end-use equipment (furnaces, water heaters, air conditioners, etc.). This potential is limited both economically and physically (space problems), and use of added insulation and weather stripping will not have as great an effect on energy conservation in large commercial buildings as in single-family residences. While building improvements <u>may</u> have potential in downtown buildings, one needs to be cautious about extrapolation of success of building improvements in the low-density residential market to the high-density commercial market.

Solar energy is a promising alternative to fossil fuels for heating. However, in the downtown areas of major northern U.S. cities where there is high density and low insulation, solar systems may have only limited potential.

Investment in conservation, such as insulation, may be a cost-effective alternative on supplement to DHC for displacing oil or gas used in space conditioning. In any case, the requirement for a heat source would still remain in spite of the implementation of such conservation measures. DHC would offer a logical means of meeting this requirement with little use of oil or gas.

1.4 Need for a National District Heating and Cooling Program

As indicated in Section 1.1, DHC can yield many significant national and local benefits. However, achieving these benefits requires combined government efforts at the Federal, state and local levels, and the sponsorship of new initiatives. This conclusion is based on the following facts:

(1) DHC (virtually all using steam rather than the more efficient hot water) currently supplies only about one percent of the total U.S. demand for space heating. The potential exists to expand this at least tenfold.

(2) The number of existing steam DHC systems is actually declining, and utilities are reluctant to invest capital for new systems or expansion of existing ones.

(3) There are a number of existing barriers to potential DHC projects, such as economic, regulatory, institutional, environmental, and legal issues, that need to be resolved in order to accelerate implementation of DHC.

## 1.5 Current Federal Government District Heating and Cooling Programs

### 1.5.1 Department of Energy Program

The Department of Energy's current programs in DHC (up to and including fiscal year 1980) consist of demonstration projects aimed at encouraging the implementation of the technology in several U.S. cities. Funding is limited to cost sharing of initial phases that could lead to implementation, with little financial assistance allocated for actual construction of large systems. Several cities are investigating the possibility of retrofitting existing steam-electric generating plants to provide heat for new or existing district heating and cooling systems. The cities, which range in population from 20,000 to over 1,000,000 people, include Detroit, Michigan; Moorhead and Red Wing, Minnesota; Piqua, Ohio; Newark, New Jersey; and Philadelphia, Pennsylvania. In addition, an assessment of the potential of DHC for the entire Minneapolis-St. Paul area has been completed (12). Results show that DHC is technically feasible, has great value for fuel conservation (85 percent reduction in the consumption of scarce fuels as compared with existing heating systems), and, with municipal financing, is economically viable. Planning is now under way to initiate a new hot-water cogeneration/district heating system in St. Paul.

Another project includes an assessment of using industrial waste heat from an aluminum plant to supply energy for a hot-water district heating system for the city of Bellingham, Washington. District heating and cooling is also part of an active geothermal direct-heat application program. Under this program, the cities of Boise, Idaho, and Klamath Falls, Oregon, and several smaller communities are constructing DHC systems using geothermal energy. Other projects which include cogeneration/DHC on a small scale include plans for construction of integrated community energy systems for university or office complexes at the University of Minnesota, Minneapolis; Clark University, Worcester, Massachusetts; Georgetown University, Washington, D. C.; and the City of Trenton, New Jersey.

### 1.5.2 DOE-HUD Joint Program

*

2 Phases

In the 1981 fiscal year, DOE and HUD will initiate a two-phase program of financial assistance aimed at assisting communities to identify potential DHC projects and facilitate their implementation.

Phase 1
HUD Procurement
20-40 communities
total cost =
$1.5M
10/17/80 - 1/15/81

The first phase of the joint DOE/HUD program will be a HUD procurement providing grants to 20 to 40 communities. The total amount of grants will be $1.5 million dollars. In addition, the communities will receive, if requested, up to 100 hours of technical assistance and consultation on relevant technical, legal, financial, and regulatory matters.

Phase II
$2.8 M
completion of
all technical
pre-construction
costs
2/81 - 4/81

The second phase of the program will be directed at communities that need assistance in completing various technical and non-technical pre-construction tasks required to develop the data necessary for a commitment for DHC system construction. Financial assistance under a Cooperative Agreement with DOE will be given to about 10 to 15 communities for this purpose. The second phase of the program is budgeted at $2.8 million dollars in the 1981 fiscal year.

includes resource configuration

### 1.5.3 Department of Housing and Urban Development Program

The Department of Housing and Urban Development (HUD) has issued guidance for funding energy-conservation projects in cities under its urban Development Action Grants Program (UDAG). Under this program, HUD funds could be applied to district heating and cooling construction in cities that qualify for UDAG grants.

UDAG Grants could fund construction

The Economic Regulatory Administration (ERA) is also engaged in an effort to address the institutional issues of DHC. For example, ERA is reviewing regulation under its control, such as the FUA and Natural Gas Curtainment Priority Plans for strategies to promote DHC. ERA will also be considering opportunities to present testimony in behalf of DHC before state utility commissions.

# 2.0 PROGRAM PLAN

## 2.1 Program Objective and Benefits

The basic objective of the proposed National District Heating and Cooling program is to accelerate the construction of a substantial number of DHC systems in U. S. cities, to attain maximum energy conservation and savings of scarce fuel in the shortest amount of time. The potential net energy and scarce fuel savings are in the range of 2.5 to 5.0 quads per year by the year 2000. At current OPEC oil prices of about $30 per barrel, each quad reduction in energy imports represents a gross savings in the United States of almost $5.5 billion annually. The value of the scarce fuel savings will be even greater as the cost of energy continues to escalate. Other benefits that would result from increased district heating and cooling development include improved environmental, economic and social conditions in communities.

## 2.2 Program Strategy

The basic components of this program strategy are:

(1) Development of a detailed national DHC program plan based on the current status of DHC in the United States and its future potential. This would be a flexible plan designed to permit reevaluation and reassessment, depending on how the market develops.

(2) Extensions of existing Federal Government conservation incentives to include DHC (tax credits for conservation,

shortened depreciation time for DHC equipment, etc.).

(3) Technical and financial assistance to communities, where appropriate, to stimulate implementation of a substantial number of DHC systems in U. S. cities.

(4) Incentives and removal of barriers in order to promote wide acceptance of DHC in the United States, reduce the perceived risks, and therefore minimize the need in the future for Federal support of DHC.

(5) Coordination of Federal activities involving DHC by means of communication and information exchange among the Federal Government, states, cities, and private industry.

(6) A strong DHC technology program to assure that the maximum potential benefits can be attained in the long term.

## 2.3 Program Elements

The District Heating and Cooling program recommended here consists of five major elements:

(1) Federal, state, local government, and industry coordination;

(2) site-specific assessments and implementation plans;

(3) implementation of systems;

(4) technology development; and

(5) information dissemination.

The basic elements are diagrammed in terms of fundamental program phases and activities in Figure 2.1, and an approximate program time line is indicated. Table 2.1 is an expansion of Figure 2.1 showing anticipated program accomplishments. Some program elements are new, while others build on or expand ongoing activities and existing programs discussed in Section 1.5.

### 2.3.1 Federal, state and local government and industry coordination

#### 2.3.1.1 Federal DH Coordinating Group

Cooperation and coordination between the public and private sectors, the creation of new legal or legislative incentives, and the removal of institutional and regulatory barriers, could significantly stimulate DHC growth. To deal with these issues effectively, a Federal District Heating Coordinating Group has been established. The role of this coordinating group is to:

(1) coordinate DHC activities and address specific issues identified here, and others that may arise, which involve more than one Federal department or organization;

(2) deal with key barriers that inhibit rapid development of DHC implementation, and recommended action to accelerate market penetration;

(3) provide an efficient and effective means of communication among organizations regarding DHC issues; and

| | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
|---|---|---|---|---|---|---|---|---|
| Program Phases | Site-specific assessments and implementation plans | | | | | | | |
| | | Implementation of systems | | | | | | |

| | |
|---|---|
| Program Activities | • Federal DH Coordination Group<br>• State DHC Plans<br>• Technology Development<br>• Standards and Codes<br>• Conferences, Workshops and Newsletters<br>• Technical and Financial Assistance in System Implementation |

Figure 2.1 District heating and cooling program structure

Table 2.1 District heating and cooling program activities and accomplishments

| Activity/phase | Approximate timing | Program accomplishments |
|---|---|---|
| Site-specific assessments | FY 80 (Continuing activity) | Establish technical and economic feasibility of DHC systems at specific sites |
| | | Complete site-specific environmental, institutional and financial assessments |
| | | Involve public and private sector decision-makers in DHC projects |
| Implementation of systems | Start FY 82* (Continuing activity) | Aid in Constructing DHC systems |
| | | Achieve benefits as discussed in Section 1.1 |
| Interagency District Heating Coordinating Group | Establish FY 80 | Coordinate DHC activities at Federal level |
| | | Recommend actions to overcome barriers that inhibit DHC development and suggest legislation to stimulate DHC development |
| State DHC plans | FY 81-82 | Develop state DHC plans |
| | | Recommend state legislation to stimulate DHC development |
| Technology development | Start FY 82 | Develop low-cost, reliable piping systems and installation techniques and retrofit piping for existing systems |
| | (Continuing activity) | Assess the feasibility of utilizing alternative energy sources for DHC |
| Standards and codes | FY 82 | Develop standards for DHC systems |
| Conferences, workshops, and newsletters | Start FY 80 | Disseminate information on significant developments in DHC |
| | (Continuing activity) | Facilitate communication between public and private sectors |

* The construction of projects initiated in existing DOE District Heating and Cooling and the Grid-Connected ICES demonstration programs began in 1979. The geothermal based systems sponsored by DOE are expected to be on line in 1980-1982.

(4) provide a contact point for DHC activities for the Federal Government and the public sector.

DOE chairs the DHC committee, which includes members from HUD, EPA, the Department of Commerce, the Department of the Treasury, and others as deemed necessary. The committee places a strong emphasis on contact and interactions with non-Federal organizations, including representatives of state and city governments, industry, and technical, professional, and trade associations.

The DHC committee will monitor progress made toward implementation of DHC systems, evaluate changes in program direction, review proposed legislation and regulations affecting DHC, and provide information and recommendations to interested parties regarding proposed legislation. Other recommended activities in this program plan will be closely linked to this coordination activity.

#### 2.3.1.2 State district heating and cooling plans

States will be encouraged to develop energy plans that include DHC. As part of this planning, states will consider existing Federal, state, and/or local legislation, or the lack of legislation, that may impede the implementation of DHC systems. State agencies could propose legislation to overcome these barriers and stimulate DHC. Federal legislation proposed under this or other programs could also provide assistance for development of state energy plans.

### 2.3.2 Site-specific assessments and implementation plans

Before any DHC system can be implemented, the community must assess its technical and economic feasibility, as well as the associated environmental, institutional, and financial issues. These issues will vary from one location to another. Therefore, a substantial number of site-specific assessments, in addition to the few already under way, will be initiated. The objectives of these assessments would be to:

(1) actively involve local participants in the public and private sectors in specific DHC projects;

(2) bring together organizations that have a decision-making role in the implementation of DHC;

(3) enhance public awareness of the merits of DHC in order to establish a favorable climate for decisions relating to the development of DHC; and

(4) provide accurate information on the potential market penetration for DHC on a state and national basis.

Once these assessments are completed, implementation plans would be prepared for those projects which appear to be viable. These plans, which would involve decision makers from all affected parties, should lead to actual construction of systems as discussed in Section 2.3.3. Close coordination among industry, cities, states, and the DHC Committee would be stressed during the preparation of implementation plans and the assessment phase of the program.

Site-specific assessments will begin as soon as possible. The Federal Government will provide, through cost sharing, some designated fraction (up to a maximum of 75 percent) of the total funds required for those assessments. Local and state participants would provide the remainder.

As a first step, HUD/DOE has issued a solicitation requesting proposals from cities, industry, utilities, etc., during FY 1981. This solicitation will fund initial assessments in a large number of cities. This solicitation represents another step and a major new initiative for DHC in the United States as a *continuation of district heating and cooling demonstration program* efforts. Where requested, the Federal Government could provide assistance in terms of technical support or general guidance in conjunction to financial assistance. Once begun, the assessments and construction plans for a city would be completed in about 18 to 24 months, depending on the size and complexity of the city and the proposed DHC system. Once these 20 to 40 assessments are near completion, HUD/DOE will evaluate the need for additional assessments and level of Federal financial assistance that may be required. It is anticipated that as DHC becomes more widely accepted in the United States, and the perceived risks are reduced, the need for detailed site-specific assessments will be minimized, and the need for Federal support of such assessments will be significantly reduced.

### 2.3.3 Implementation of systems

In order for significant benefits from DHC to accrue to the nation, planning must be followed by system implementation on a timely schedule. Therefore the program elements in this section are the most crucial in meeting the program objectives. As discussed in Section 1.5, very few projects are currently in phases leading toward possible construction of new DHC systems. Except for some relatively small projects, little Federal money has been allocated to support construction of these systems or to provide incentives for customers to hook up to such systems, should they be installed.

In view of the national benefits that can be attained through DHC, new incentives in terms of Federal financial support may be required to accelerate the construction of DHC systems in the United States. A number of options for Federal assistance are possible, including grants, loans, loan guarantees, tax incentives and the introduction of favorable regulation changes and new legislation. Federal grants could provide cost sharing of DHC system design, engineering, and construction. Low-interest loans or loan guarantees could be used to raise capital. The Interagency District Heating Coordinating Group seeks comments from interested parties as to how and to what extent the Federal Government should provide financial assistance for the construction of DHC systems.

The economics of DHC can vary considerably. The price of thermal energy from existing DHC systems, which varies from $2 to $10 per million Btu, depends on several factors:

(1) physical characteristics such as load density, load factor and proximity to heat source;
(2) type of fuel used (coal, oil, natural gas); and
(3) ownership and management arrangements.

The economic success of DHC projects will depend to a large extent on the cooperation among municipalities, utility companies, DHC customers and state and Federal Government in working out optimal management arrangements regarding financing, ownership, operating agreements, and contracts with customers.

The DHC system could be owned and operated by a public or investor-owned utility, by a municipality, or by some combination of these. Regulatory and institutional issues would differ according to the ownership of the system.

The availability of economic incentives such as tax credits or low-interest loans could stimulate building owners to connect to a DHC system. This would assure a substantial heat load at an early date and alleviate a potential cash-flow problem for the DHC owner/investor by earning revenues without long delays. Tax credits for retrofitting buildings to conserve energy are not without precedent. Such incentives are already provided for capital expenditures involving solar and geothermal equipment, insulation, etc., which aim to reduce consumption of oil and natural gas.

During their site-specific assessments, cities could develop master plans for DHC growth over a 20-year period; however, for practical purposes it is likely that systems could be implemented in stages of approximately four to five years each. Federal support will be most needed during the first five-year period of DHC system buildup, which is anticipated to be the most difficult phase. Once this stage is completed and the system has begun to recover some of its initial capital investment, the risk to the owner will be greatly reduced, and little or no Federal support should be required for the expansion of the system to its full potential.

The first stage of the project should be designed to accommodate future expansion potential, as determined by the master plan for the city. This may require additional capital expenditure at the beginning. For example, in order to meet the total projected heat demand, pipes may have to be installed which are larger than needed for the connected heat load during the first stage of the system.

2.3.3.1 Project selection

Many, but not all, of the projects in the implementation phase will result from current efforts (discussed in Section 1.5) and site-specific assessments (described in Section 2.3.2). If the Federal Government had the authority to provide some form of financial assistance for the construction of DHC systems but sufficient funding sources could not be developed to support all viable systems, it would be necessary to select some applications for initial projects. The recommended criteria by which to select such projects are:

(1) maximum potential for scarce fuel (oil and natural gas) savings;

(2) systems that are sufficiently typical to be introduced at a range of locations and therefore could stimulate significant energy savings on a national basis; – this won't favor geothermal

(3) systems most likely to achieve success, as demonstrated by participation of the DHC owner or operator and commitment of non-Federal funds;

(4) systems that would contribute significantly to the improvement of the community; and

(5) systems showing potential for significant environmental improvement in the community.

2.3.3.2 Implementation phases

The actual implementation of DHC systems may occur in step-wise progressions over three broad time frames. Although these could logically be considered as near-, mid-, and long-term phases, there would be considerable overlap, and no specific time period should be associated with each phase.

Immediate

Modern, flexible DHC systems will be implemented in cities where a minimum of time, money, and new effort would be required. These would include placing systems using existing technology in those areas which already have an element of a district heating and cooling system, such as a distribution system or a power plant or other heat source near the load center. Modernization or expansion of existing systems would be part of this phase. Sections of urban areas scheduled for redevelopment, as well as new developments, should include district heating and cooling in their initial plans in order to avoid the need for costly retrofitting at a later time. In these cases, advance planning will be necessary to ensure that the timing of the DHC system coincides with the development of the area. Smaller cities or communities that have short implementation schedules will also be early targets.

Near- and mid-term

New systems could be built using existing technology that will optimize thermal services to cities. The potential total benefits for this phase are greater than for retrofitting.

Long-range

New systems would be implemented using improved or advanced technologies in energy supply, distribution networks, or other design components. The introduction of new technologies would ensure the long-range viability of DHC for the maximum benefit of the consumers and the nation.

### 2.3.4 Technology development

The program elements described in Sections 2.3.1, 2.3.2, and 2.3.3 deal mainly with institutional, economic, and regulatory issues related to accelerated implementation of DHC systems using existing technology. DHC is already a highly successful energy strategy in other parts of the world. Existing information will be incorporated and not duplicated. In order to assure that the maximum benefit from DHC can be attained over the long term, a DHC technology program will address near- and long-term technical issues. It will emphasize projects that could:

(1) reduce the cost of DHC systems (capital costs, and operational and maintenance costs),

(2) improve reliability of the thermal transport system, and

(3) enhance scarce fuels saving and substitution.

Several DOE alternative energy technology programs that relate directly to DHC are well established, such as solid waste, geothermal energy, and seasonal thermal energy storage in underground aquifers. Other approaches that currently receive little emphasis, but deserve more attention, are discussed below. These examples are not intended to be complete in terms of all possible DHC technology, but do allude to major items. Once the program is under way, these additional items will be considered, as appropriate.

The major cost and reliability factors for DHC systems are associated with energy transmission and distribution; therefore, improvements in this area will be given high priority. Examples include the need to develop and test low-cost nonmetallic materials for piping systems and to improve trenching and installation techniques. A reduction in the total installed cost of piping would expand the market potential of DHC systems to serve lower-density heat-load areas. One approach that could be considered in carrying out this work is the establishment of a piping technology R&D center. Coordination and joint support of this center with private industry and European countries would be stressed. The center would conduct analysis, experimentation, testing, and demonstration of new technology. It should be noted that district heating technologies have been extensively demonstrated in Europe and elsewhere. To the extent of availability, therefore, district heating technology will be transferred into the U. S. to prevent duplication of technology development efforts.

One of the many advantages of DHC is the variety of fuels that can be utilized to supply thermal energy. Coal, municipal refuse, nuclear, solar, geothermal, oil and natural gas are used for district heating and cooling in European countries. Alternative energy forms could become significant sources of energy for DHC in the United States. Increased attention will also be given to assessing the application of nuclear energy for DHC so that data will be available regarding the technical and economic feasibility of nuclear-based DHC systems in the United States. This assessment would not examine the technical design of the reactor itself, but would stress increased effective utilization of thermal energy from nuclear plants, as well as changes in the nuclear system that would be required in order to supply the heat to the community and industry safely and economically.

Standards and codes are an important part of any system, and affect system design, cost, performance, reliability, and safety. Although DHC began in the United States about 100 years ago, existing U. S. standards, codes, and practices for steam DHC systems may not be applicable to modern hot-water systems. European standards for DHC piping differ significantly from U. S. standards. Therefore a review will be made of both pertinent U. S. and foreign codes and standards. New and/or modified U. S. standards will be proposed as deemed necessary. This activity will be carried out with the close cooperation of equipment manufacturers and users, the National Bureau of Standards, and technical and professional associations such as The American Society of Heating, Refrigeration and Air Conditioning Engineers, International District Heating Association, American Society of Mechanical Engineers, and American National Standards Institute. The review will begin as soon as possible in FY 1981 and would be completed in six months. Standards should be completed within 18 to 24 months after the review.

Other items of a technical nature can have a significant impact on DHC systems. For example, the availability of a reliable, low-cost thermal energy meter would improve the effectiveness of monitoring and billing the energy consumption of DHC customers. Such a product is likely to be developed by private industry once a market for DHC is established.

### 2.3.5 Information dissemination

Information dissemination and educational programs are important tools for accelerating DHC implementation nationwide. Enhanced public awareness of the benefits of DHC would help to create a favorable atmosphere for decisions relating to the implementation of new DHC systems. Information on the availability of public and private funds for DHC would be vital to communities interested in developing DHC systems. Therefore three major steps will be taken to disseminate information on various aspects of DHC: national conferences, regional conferences and workshops, and development of a national DHC information center.

#### 2.3.5.1 National annual DHC conference

A national conference on DHC systems is planned to be held with the cooperation of, or in conjunction with, the International District Heating Association (IDHA). The conference will be of a general nature, with papers presented on specific DHC projects and new developments in DHC. One feature of the conference will be a summary report by the DHC Committee on the status of new DHC projects and the progress made toward energy conservation through DHC.

#### 2.3.5.2 Workshops and regional conferences

Communication strategies will also include periodic workshops and regional conferences, having two target goals. Workshops with a limited number of attendees will promote free, informal discussions and cross-fertilization of ideas among the participants. These will be held periodically with groups such as state energy agencies, utilities, equipment manufacturers, financial institutions, regulators (such as the Economic Regulatory Administration, the Federal Energy Regulatory Commission and state public utility commissions), and administrators of site-specific projects.

Regional conferences will provide a forum for discussions among state and municipal governments, state public service commissions, and utility officials within a specific region of the country. The format would include aspects of both the national conferences and the workshops, i.e., some formal presentations but sufficient time allottment for informal discussions. Several conferences will be held each year either independently or in coordination with regional conferences of governors or mayors.

2.3.5.3 National DHC information center

A National DHC Information Center, established by DOE and coordinated with the DHC Committee, would provide a point of contact for providing general information to the public, as well as an abstracting service (through the National Technical Information Service, Springfield, Virginia, or the U.S. Department of Energy Technical Information Center, Oak Ridge, Tennessee) for individuals or organizations interested in receiving specific DHC publications. The information center would publish a brief monthly newsletter on current activities (perhaps in conjunction with, or as part of, IDHA's District Heating magazine), major announcements, and other issues of interest.

## 3.0 PROGRAM MILESTONES AND RESOURCE REQUIREMENTS

A milestone chart for the various phases and activities of the national DHC program discussed in Section 2 is shown in Figure 3.1. Various actions necessary to initiate the program are also included in this schedule. Portions of the program expand, or are based on, the ongoing activities discussed in Section 1.5. For example, implementation of systems could be scheduled to begin in FY 1981, instead of being delayed until new assessments are completed.

Resource requirements for the national program are shown in Table 3.1.

An environmental assessment of the Department's District Heating Program, including the proposed strategy, is being prepared. It will be completed and available for public comment prior to finalization of the strategy, and will provide the basis for identifying any additional requirements of the program for compliance with the National Environmental Policy Act.

Table 3.1 Resource requirements

(Federal Government portion only; figures do not include inputs from industry, states, or municipal governments)

| | Millions of dollars | | | | |
|---|---|---|---|---|---|
| ctivity or phase | FY 81 | FY 82 | FY 83 | FY 84 | FY 85 |
| State DHC plans | .2 | .5 | 1.0 | 1.0 | 1.0 |
| onference and workshops | 0.2 | 0.2 | 0.3 | 0.3 | 0.5 |
| echnology development ** | 2 | 4 | 6 | 6 | 6 |
| Site-specific assessments and implementation plans** | 4.3 | 10 | 10 | 10 | *** |
| mplementation of systems **** | | | | | |

* Partial funding for these activities may be available through existing Federal Government programs (HUD/UDAG, )OC/EDA) or proposed legislation (i.e., Community Energy Efficiency Act, Energy Management Partnership Act). \dditional Federal Government support in the form of grant, loan, loan guarantees or through DOE, HUD or another ıgency would have to be determined. This phase would continue beyond FY 1985.

** Some work presently ongoing (see Section 1.5).

*** To be determined (see decision milestone in Figure 3.1).

**** The extent of implementation assistance if any, is to be determined later after comments are received from ıffected industries, from state and local officials and from other interested parties as to how and to what extent the Federal Government should provide construction assistance to district heating and cooling projects.

1.5
4.3
6.3

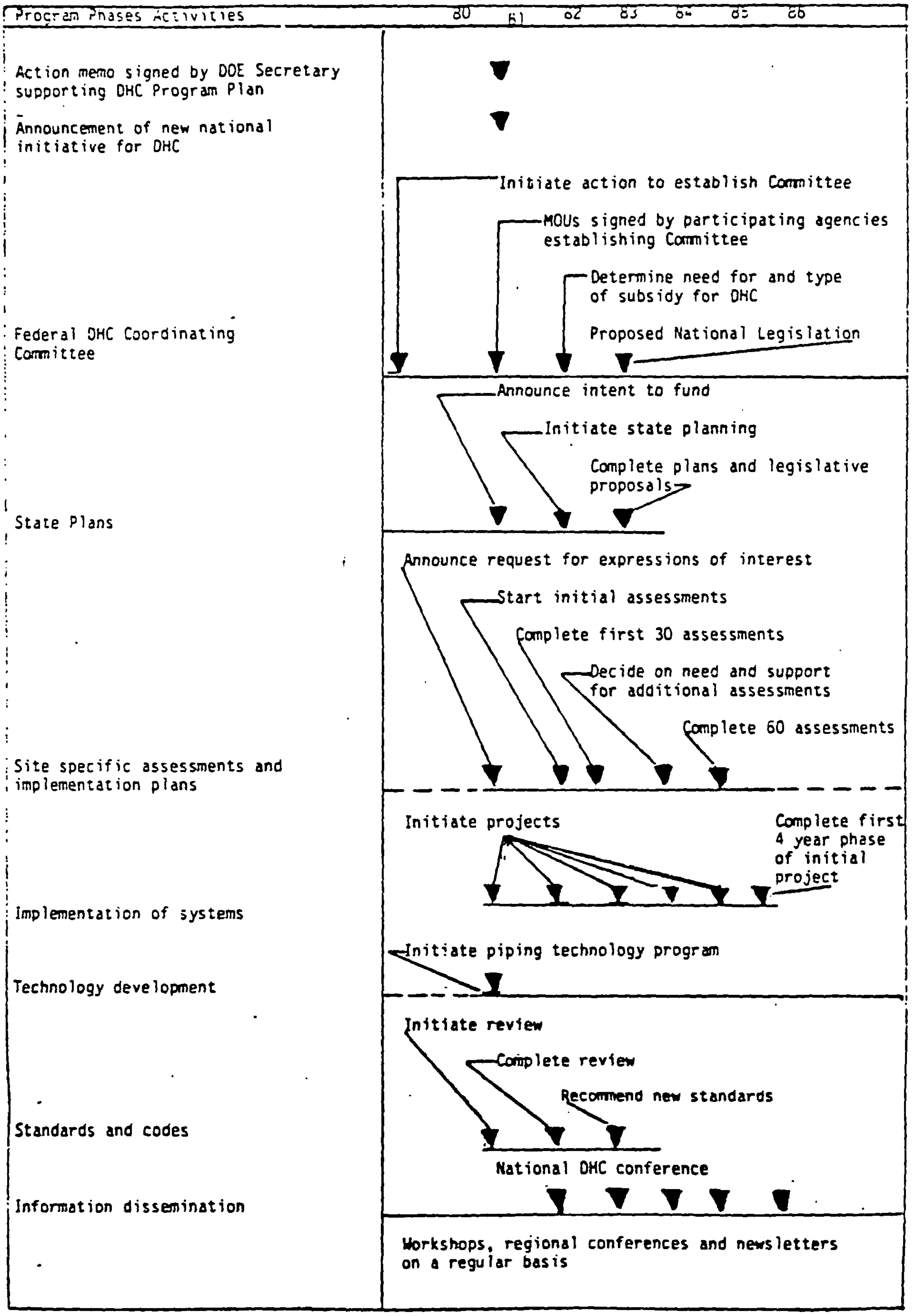


Figure 3.1 District heating and cooling program schedule and milestones

# APPENDIX A - SUMMARY OF EXPERIENCE WITH DISTRICT HEATING AND COOLING

## A.1. History and Current Status

### A.1.1. U.S. Experience

District heating and cooling (DHC) is not a new technology. In the United States the concept was first used over 100 years ago. In the first systems, boilers supplied steam used for space heating. Cogeneration district heating and cooling plants came into use early in the twentieth century. These systems used the exhaust steam from small dual-purpose power plants to heat buildings in the nearby business district. As a result, district heating and cooling, combined with cogeneration, became widely accepted.

The introduction of inexpensive oil and natural gas for space heating in the late 1940s reduced the rapid growth of district heating and cooling. Concurrently, utilities were building large condensing steam-electric power plants in non-urban areas. Because it was not economical to transport steam over such long distances, the older, small cogeneration units were retired; inexpensive energy sources for the steam district heating and cooling systems were eliminated; and the cost of supplying steam escalated, making district heating and cooling even less attractive.

Many of the early projects were not profitable because of inadequate rates or lack of proper metering devices. For example, as costs increased during the transition from the use of exhaust steam to prime steam, rates were kept low by regulation. As a result, utilities shut down many small district heating and cooling systems.

Today, existing district heating and cooling systems, including those serving cities, Government institutions, and college campuses, satisfy approximately one percent (0.16 quad) of the total demand for space and hot-water heating in the United States. Current International District Heating Association (IDHA) statistics (9) for 44 U. S. steam district heating and cooling utilities show that over the past three years there has been a general decline in the industry, with a decrease in steam sales of about six percent from 1976 to 1978.

### A.1.2 European Experience

The history of district heating and cooling in Europe differs from experience in the United States. The use of district heating and cooling developed rapidly in northern and eastern Europe after World War II, with hot water rather than steam used as the heat transport medium.

In terms of energy transport, a hot-water district heating and cooling system has many advantages over a steam system. Hot water has lower energy transport costs, resulting in more economical distribution over longer distances than is typical of steam systems. Steam transport of thermal energy is limited to a maximum distance of a few miles, whereas a hot-water system can transport energy economically and with low energy losses up to about 60 miles.

Another significant advantage is that hot water can be produced more cheaply than steam. A modified or new cogeneration plant does not sacrifice as much electricity when producing 250°F hot water as when producing steam for a district heating and cooling system. The lower electricity sacrifice and lower costs will result in greater willingness by utilities to modify their existing plants to supply thermal energy.

Extensive experience in Europe has shown the technical and economic feasility of hot-water cogeneration/DHC systems. A comparison of installed district heating and cooling capacity in several countries is given in Table A-1. European systems tend to have larger service areas than in the United States, are able to serve lower heat load density regions, and use remotely located cogeneration power plants.

Sweden, for example, with a population of 8.1 million, has been one of the leaders in the development of modern district heating and cooling systems. Approximately three million Swedes live or work in premises served by district heating and cooling, including apartments, single-family dwellings, and commercial buildings. All of the larger systems use combined heat/electric power stations that operate at efficiencies as high as 88 percent and contribute to the country's fuel conservation effort. Experience has shown that the total energy loss in a hot-water DHC network is between five and ten percent. Four major benefits of DHC have been attained in Sweden:

(1) energy conservation,

(2) improved air quality,

(3) flexibility of energy sources, and

- Table A-1 Installed district heating and cooling capacity (10,11)

| Country | Year | Installed capacity (MW) | Population (millions) | MW/millions inhabitants |
|---|---|---|---|---|
| USA | 1975 | 7,400 | 215 | 35 |
| West Germany | 1975 | 23,400 | 62 | 380 |
| Sweden | 1979 | 12,200 | 8 | 1,500 |
| Sweden | 2000* | 30,000 | 8 | 3,700 |
| Denmark | 1975 | 10,000 | 5 | 2,000 |
| France | 1973 | 5,200 | 52 | 100 |
| U. S. S. R. | 1975 | 494,000 | 246 | 2,000 |
| Finland | 1977 | 4,900 | 5 | 980 |

* Projected

If by the year 2000 we could have 2000 mw/million inhabitants (as Denmark and the USSR have today), then we could have somewhere in the area of 500,000 mw capacity installed by the year 2000. With 4,000 mw/million inhabitants we could have 1 million mw capacity.

(4) competitive space heating costs as compared with individual oil-fired units.

Sweden once considered DHC economically feasible only in cities having populations greater than 100,000 persons. However, DHC systems are now being planned for towns with as few as 10,000 persons. Currently, almost 25 percent of Sweden's space heating is provided by DHC, and their national goal is 60 percent by the year 2000.

## A.2 Economic Factors and Physical Classification

### A.2.1 General Background

There are four types of markets that can be served by DHC, each having different technical, economic, and institutional aspects:

(1) densely populated urban areas,

(2) high-density building clusters such as universities and shopping centers,

(3) low-density residential areas, and

(4) industrial complexes requiring process heat at low temperatures.

Systems currently in operation and a number of detailed site-specific studies show that DHC systems can be economically viable for densely populated urban areas, high-density building complexes, and industrial complexes. Experience in Europe also indicates that single-family residential areas could be served economically through DHC systems.

Aside from regulatory and legal issues, there are three main factors that affect the economic viability of district heating and cooling:

(1) heatload density,

(2) annual load factor, and

(3) consumer connection rate.

In general, DHC systems require a fairly high heat load density. A major portion (50 to 75 percent) of the capital investment required for a DHC system is for the energy transmission and distribution system; the remaining investment is for consumer equipment and energy production plants. At present, the high cost of the distribution system in single-family residential areas makes DHC uneconomical in some cases; however, if new low-cost, non-metallic piping technology and installation techniques can be developed, the economics could change.

The higher the annual load factor (i.e., cold climates with long heating seasons) the more economically viable a system becomes. Industrial demand could significantly increase the annual load factor, and thereby improve the economic viability . However, the integration of industrial steam requirements with space and hot-water heating would have to be addressed on a site-specific basis.

The rate of consumer connection determines the revenues which are critical for an economically viable system. Therefore, the maximum number of potential users in the service areas should be connected to the system as rapidly as possible, so that revenues can be generated without long delays. For new buildings, the cost of heat-transfer equipment for DHC would generally be less than or comparable to the cost of individual boilers or furnaces. The cost of conversion in existing buildings would depend on the type and condition of the existing heating equipment. If the existing system required replacement, the investment for conversion to DHC could be an attractive alternative.

### A.2.2. Densely Populated Urban Areas

DHC systems in densely populated urban areas are relatively general-purpose systems that serve a large portion of a downtown area. In larger cities, the system could have a capacity of several thousand MW, involve several miles of distribution pipes, and serve several hundred buildings. These systems would involve large amounts of financing and would require a phased construction over 20 to 30 years.

For example, a system that would serve a major portion of an area in downtown Philadelphia would require a 20 to 30-year period for its completion. The construction will be divided in four to five phases, and the cost of construction may reach $1 billion. A detailed site-specific assessment for Philadelphia shows that only a small portion of this cost is needed prior to project initiation, with the rest provided by the revenues that will be generated from the sales to customers.

The type of system that would serve the downtown area of a small city will have a capacity of only a few hundred MW, and the distribution pipes will extend only a few miles. The construction period may be from a few years to perhaps ten years, and the capital requirement could be a few tens of millions of dollars. (A typical example of a system in use in a small city is the DHC for Piqua, Ohio.)

While the capacity of urban-area DHC systems will vary widely from application to application, they have common characteristics. The impact of the system on the community is relatively important for all major areas that DHC addresses (energy, economic development, environmental and social).

(1) The service area will include a variety of building types, sites and uses. The systems could develop from an existing plant and/or an existing distribution network, and could include both steam and hot-water distribution systems in order to provide simultaneously to a wide variety of services (i.e., space heating, absorption cooling, domestic hot water, and process heat).

(2) Likely sources of thermal energy for these systems will be the surplus heat from existing electric plants and industrial plants, from new urban solid-waste plants, from geothermal wells, from underground water reservoirs (augmented by water-source heat pumps) and from solar collectors.

(3) The cost of the distribution network will be a major portion of the total system cost (from 50 percent to 75 percent) with the cost of the central plant(s) and the building retrofit being a smaller portion (from 25 percent to 50 percent) of the construction cost.

(4) The institutional arrangements necessary for a successful system implementation will be major and complex, requiring the intensive involvement of almost all local entities (public and private) from the early stages of the planning and development of the DHC system. While urban DHC systems have the largest potential for beneficial impact at the local and national level, the complexities of the institutional arrangements required may have a delaying effect on their widespread application.

### A.2.3 High-Density Clusters

DHC systems designed to serve specific high-density developments include a variety of users such as suburban shopping centers, a suburban high-density mixed development, a university campus, or a few blocks of a downtown high-rise section.

The plant and the distribution network are most likely to be new and sized to serve the specific service area of the DHC system. The distribution system may use either steam or hot water and will be relatively small, having a minor impact on the total cost of the system. System capacity will vary widely from application to application, with the smaller sites starting from a few MW and the larger sites reaching several hundred MW. The larger-capacity systems will be coal-fired, using fluidized-bed combustion, but this technology is not expected to dominate in the early years.

Oil and gas are expected to be the dominant fuels for smaller applications. The central source for the thermal energy will be either a new cogeneration plant, the surplus heat from an existing industrial plant or small peaking/retired electric plant. Geothermal energy and urban solid waste would serve as alternative fuels.

The institutional arrangements required for high-density-cluster applications are relatively simple and do not necessarily involve a great number of local decision makers. (The owner/operator of the source, the owner/operator of the distribution network, the few major customers, the local government and neighborhood groups would typically be involved.) The impact of the system on the overall community will be minor, and the construction period may be from a few years to ten years, in one or two phases. The required financing will be from a few million dollars to a few tens of millions.

Because the institutional arrangements associated with these applications are relatively simple, the amounts of financing involved relatively small, and the time of construction relatively short, cluster systems are expected to be pursued in larger numbers earlier than the DHC systems for densely populated urban areas described previously.

### A.2.4. Low-Density Residential Areas

DHC system use for low-density residential areas is dominated by single or duplex residential units. This type of system is fairly well dispersed, with the distribution network dominating the cost of construction, especially in the cases of an existing development.

The system will most likely use low-temperature hot water as the medium for distribution. Water-source heat pumps utilizing low-temperature water will augment the heating capacity of the system. Individual building solar systems may work synergistically with the hot-water distribution network, forming a storage network for solar systems.

The fuel source for low-density residential DHC may be gas and oil cogeneration stations, geothermal wells, underground water reservoirs and solar central plants. The central sources (plants) are most likely to be new, with capacities of less than one MWt to several MWt. The institutional arrangements required are less complex than those associated with the DHC for densely populated urban areas because the impact of their applications on the overall community will be very minor; however, they will be more complex than those for high-density clusters, which involve fewer customers. Because of the high capital cost and low utilization factor in this type of application, the operating economics may become the major impediments for the widespread implementation of these systems.

Will be typical of many potential geothermal sites i.e. - 11/14 - SRP

## A. 2.5. Industrial Complexes

Development of DHC for industrial complexes will be dominated by industrial loads, which may impose special demands for process steam. These special demands will dominate the configuration and economics of the system, especially if each user in the complex will have unique demands.

Fuels and central plant technology required for industrial use will be similar to the DHC used for a high-density clusters system. The institutional arrangements will be relatively simple, and similar to the ones for high-density clusters.

The distribution network will be compact in size but may be rather complex because of the varied thermal requirement of industrial users. This added complexity may make the cost of the distribution an important factor of the overall project cost. However, the economics of industrial DHC application are relatively good because of the high-utilization factor achieved with the base-load industrial customers.

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