

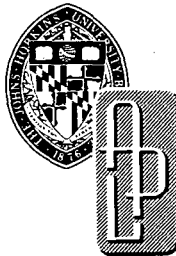
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FACT SHEETS RELATING TO USE OF GEOTHERMAL ENERGY IN THE UNITED STATES

DECEMBER 1980



Prepared for the
DEPARTMENT OF ENERGY
by
Applied Physics Laboratory
The Johns Hopkins University
Laurel, Maryland 20810

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CQO-3066

Department of Energy
Division of Geothermal Energy
12th and Pennsylvania Avenue, N.W.
Washington, D.C. 20461

Attention: Mr. Fred Abel

Subject: Forwarding of Revised Geothermal Energy Fact Sheets --
State of Alabama

Reference: JHU/APL QM-80-187, December 1980 -- "Fact Sheets Relating
to Use of Geothermal Energy in the United States"

Dear Sir:

Please find as enclosure the revised Fact Sheets for the State of Alabama to replace those in the referenced report. Other states are encouraged to keep the description of their geothermal effort and documentation of their state up-to-date. The Laboratory will provide a service of publishing and distributing these revised state fact sheets through September of this year. After that time, it is suggested that revisions be forwarded to your office.

By copy of this letter, the Alabama Fact Sheets are forwarded to interested parties. A distribution list is kept on file at this Laboratory and at the Department of Energy, Division of Geothermal Energy.

Sincerely,

F. C. Paddison
Assistant Director
Advanced Research Programs

A. M. Stone
Director of
Advanced Research Programs

FCP:sa

ALABAMA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Alabama)

TOTAL POPULATION: 3,444,165 TOTAL AREA: 50,708 SQ. MI.
POPULATION DENSITY: 68 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

	(1)	(2)
NAME	Southern Alabama	Black Warrior Basin
TYPE	Clastic sediments	Clastic sedimentary rocks
DEPTH	Excess of 20,000 ft.	10,000 ft.
WATER TEMP.	Over 340°F	180°F
EST. STORED WATER	2 x 10 ¹⁴ cu. ft.	8 x 10 ¹² cu. ft.
EST. ENERGY CONTENT	Over 1,000 x 10 ¹⁵ Btu	300 x 10 ¹⁵ Btu

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	248	26,403 thousand tons	707
Natural Gas (liq.)	92	12,340 thousand bbl	48
Natural Gas Wells	222	130,000 million cu. ft.	132
Crude Oil Wells	684	9,813 thousand bbl	56.9

ENERGY USE - 1975 (10¹² BTU)

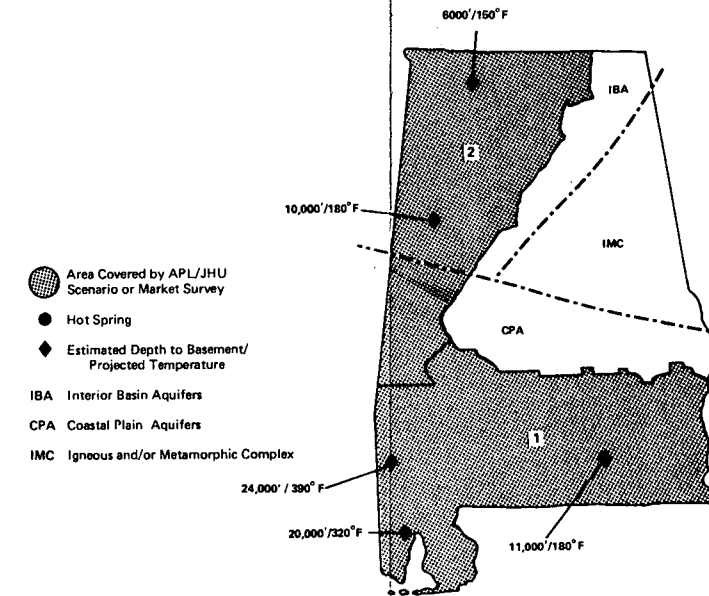
SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	420.4	20.9	286.4	683.9	142.0
RESIDENTIAL	6.6	16.6	54.0	0.2	47.6
COMMERCIAL	29.2	1.9	34.5	0.1	22.3
INDUSTRIAL	38.2	2.3	174.4	59.8	72.1
PERCENT	30	1	20	48	

GEOHERMAL ACTIVITIES

CURRENT USES	Hot Springs at Cottonwood and Dothan used for Balneologic Purposes
RECENT OR CURRENT STUDIES	1. VPI Study: Evaluation & Targeting of Geothermal Energy Resources in the Southeastern U.S. 2. State Coupled Reservoir Confirmation Program, State Geologic Survey. 3. ORAU-Extending DOE/DGE Resource Studies into Black Warrior Basin
PROPOSED STUDIES	
LEGAL ACTIVITIES	

GEOHERMAL OVERVIEW

Thick sedimentary cover in the southern and western portions of the state contain shallow hydrothermal aquifers (i.e., Tuscaloosa Formation) due to higher than normal gradients. Deeper aquifers are also known to occur. Sub-surface thermal data are being compiled by State Coupled State Geologic Survey. Data on geopressed regions in the southern portion of the state are available.



PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department of Conservation and Natural Resources, John McMillan, Commissioner (205) 832-6361
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Health Administration, Dept. of Public Health, William T. Willis, Director (205) 269-7632
OFFICE OF ENERGY POLICY:	Alabama Department of Energy, Jack E. Ravan, Director (205) 832-5010
PLANNING BUREAU:	Office of State Planning and Federal Programs, Office of Governor, Bobby Davis, Director (205) 832-3528
GEOLOGICAL SURVEY:	Richard N. Raymond, Acting State Geologist (205) 349-2852

LEGISLATIVE CONTACTS

SENATORS	Jeremiah Denton (R) Howell Heflin (D)	GOVERNOR	Forrest (Fob) James, Jr. (D)
CONGRESSMEN (DIST.)			
	1 - Jack Edwards (R)		
	2 - William L. Dickinson (R)		
	3 - William Nichols (D)		
	4 - Tom Beville (D)		
	5 - Ronnie G. Flipppo (D)		
	6 - Albert Lee Smith, Jr. (R)		
	7 - Richard Shelby (D)		

State Geothermal Fact Sheet

ALABAMA

I. DEMOGRAPHIC INFORMATION (1978) (C-4)

TOTAL STATE

Population: 3,742,000 Area: 50,710 sq. mi. Density: 74 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 2,460,000 Area: 35,000 sq. mi. Density: 71 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	76	219	278	28	42
Residential	1	174	52	0.01	14
Commerical	5	19	33	0.00	7
Industrial	6	24	169	2	21

Trillion Btu

GROSS	420.4	20.9	286.4	683.9	142.0
Residential	6.6	16.6	54.0	0.2	47.6
Commercial	29.2	1.9	34.5	0.1	22.3
Industrial	38.2	2.3	174.4	59.8	72.1
Percentages	30	1	20	48	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

AL-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	248	26,403 thousand tons	707
Natural gas (liq.)	92	12,340 thousand bbl	48
Natural gas wells	222	130,000 million cu. ft.	132
Crude oil wells	684	9,813 thousand bbl	56.9

IV. GEOLOGY

The southern half of Alabama, the Gulf Coastal Plain, consists of a southwest thickening wedge of unconsolidated Mesozoic and Cenozoic sediments that attain thicknesses in excess of 20,000 ft. near the coast.

In the west-central part of the State, these sediments overlies Paleozoic sedimentary rocks that are exposed to the north in the Black Warrior Basin (beneath the Allegheny Plateau and the Valley and Ridge Province). Throughout most of the south Alabama area, however, these sediments are underlain by Paleozoic and Pre-Cambrian crystalline rocks, which are represented in outcrop by the metamorphic and igneous complex of the Piedmont area in the east in the east-central part of the state.

Although several warm springs do occur in the crystalline Piedmont rocks, the most attractive resource areas lie within the sedimentary basins. Geopressed reservoirs may exist in the deeper parts of the coastal plain adjacent to the Mississippi Interior Salt Dome Basin. Hydrothermal resources probably occur in both the Black Warrior Basin and the coastal plains. The main restraint on development is the depth needed to obtain usefully hot water, and to locate reservoirs with easily extractable water. Geothermal gradients above 1.6°F/100 ft. occur locally in both basin areas.

V. RESOURCE DATA

Water availability is likely to be greater in the unconsolidated sediments of the Gulf Coastal Plain; however, several horizons in the Black Warrior Basin are highly permeable. Where 10,000 ft. of sediments exist, temperatures are likely to be at least 180°F. In the deeper areas, where sediments are 20,000 ft. thick, temperatures may be near 325°F. Exploration should aim to areas of higher heat flow.

The Tuscaloosa Sandstone Formation seems to be anomalously warm at depths of about 3,000 ft. near Cottonwood and Dothan, and produces waters of 122°F and 104°F, respectively.

1. BLACK WARRIOR BASIN

Type aquifer: Paleozoic clastic sediments Area: 17,000 sq. mi.
Depth: 6,000 to 10,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: 150° to 212°F
Recharge rate:
Estimate of water stored in aquifer: 8×10^{13} cu. ft.
Estimate of energy content in water: 300×10^{15} Btu[†]

2. SOUTHERN ALABAMA

Type aquifer: clastic sediments Area: 17,600 sq. mi.
Depth: in excess of 20,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: Over 350°F
Recharge rate:
Estimate of water stored in aquifer: 2×10^{14} cu. ft.
Estimate of energy content in water: Over $1,000 \times 10^{15}$ Btu[†]

[†]Above 120°F, reference to 90°F; 10% porosity assumed, about 4.5 times this amount in rock.

VI. GEOTHERMAL ACTIVITY

Current uses: Hot Springs (flowing deep well) at Cottonwood and Dothan used for balneological purposes.

Recent studies: Alabama Geologic Survey "Assessment of the Geothermal/Geopressure Potential of the Gulf Coastal Plain of Alabama."

DOE/DGE State Coupled Resource Assessment Program.

VII. LEGAL ACTIVITIES

Proposals of a Geothermal Resources Act have been considered by State Legislature. No act has been passed to date.

VIII. CONTACTS

1. Geological Survey of Alabama, P.O. Drawer 0, University, AL 35486, Richard N. Raymond, State Geologist, (205) 349-2852.

2. Alabama Department of Energy, 25 Washington Avenue, Montgomery, AL 36130, Jack Ravan, Director, (205) 832-5010.
3. State Planning Office, Alabama Development Office, State Capitol, Montgomery, AL 36130, William Mathews, (205) 832-6400.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) S. S. Papadopoulos, R. H. Wallace, Jr., J. B. Wesselman, and R. E. Taylor, "Assessment of Onshore Geopressured-Geothermal Resources in the Northern Gulf of Mexico Basin," Assessment of Geothermal Resources of the United States, USGS Circular 726, 1975.
- (2) R. S. Barnett, "Basement Structure of Florida and Its Tectonic Implications," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 122-139, 1975.
- (3) G. V. Wilson, "Early Differential Subsidence and Configuration of the Northern Gulf Coast Basin in Southwest Alabama and Northwestern Florida," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 196-206, 1975.
- (4) 1976 Alabama Directory of Mining and Manufacturing, Alabama Development Office, 1976.
- (5) "Assessment of the Geothermal/Geopressure Potential of the Gulf Coastal Plain of Alabama," A Progress Report: Technical Information Interchange Meeting Minutes, QM-79-261, Dec 1979.

COMMON REFERENCES

(C-1), (C-2), (C-3), (C-4), (C-5), (C-6), and (C-7).

FACT SHEETS RELATING TO USE OF
GEOTHERMAL ENERGY IN THE UNITED STATES

INTRODUCTION

This report is a compilation of data relating to geothermal energy in each of the 50 states. The data are summarized on one page for each state. All summary data sheets use a common format. Following the summary data sheet there are additional data on the geology of each state pertaining to possible hydrothermal/geothermal resources. Also there is a list of some of the reports available pertaining to the state and state energy contacts. The intent of these documents is to present in a concise form reference data for planning by the Department of Energy. It is planned that this report will be revised periodically as required to keep it current. For comments, additions, or corrections, please contact Mrs. B. Klaess the Applied Physics Laboratory (301) 953-7100, extension 3039.

GENERAL CONTACTS

The following lists of contacts are given to provide users of the fact sheets with an extended source of contact and information than might otherwise be included with the material for the individual states. The user must remember that there may have been personnel changes to the federal, state, or organizational level that would affect the accuracy of the lists of names of individuals, however, even though there may be shifts in personnel, the offices and addresses will probably remain as they are listed here.

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Inter Mountain Region (R-4)

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STATE COUPLED RESOURCE ASSESSMENT TEAMS

Principal Contacts

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East of Mississippi River: Joel Renner (Gruy Federal)

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West of Mississippi River: Mike Wright (UURI) (801) 581-5283

COMMON REFERENCES

- C-1 Geothermal Gradient Map of North America. AAPG and USGC, 1976.
- C-2 Population Distribution, Urban and Rural in U.S., 1970. US Maps GE-50, No. 45, Bureau of the Census, 1970.
- C-3 Heating and Cooling Degree Day Data, Environmental Information Summaries, C-14, NOAA 1976.
- C-4 County and City Data Book, 1972, GPO Stock No. 0324-00121, U.S. Bureau of the Census, 1973.
- C-5 1972 Census of Manufacturers, Vol. III, Area Statistics, U.S. Bureau of the Census, 1976.
- C-6 "Fuels and Energy Data, U.S. by States and Census Divisions, 1972," U.S. Department of Interior, Bureau of Mines Information Circular, IC-8722, 1976.
- C-7 Federal Energy Data System (FEDS), Statistical Summary, February 1978, DOE/EIA-0031/2, UC-13, U.S. Department of Energy.
- C-8 "Geothermal Energy and The Eastern U.S., Technical Information Interchange Meeting, Minutes," APL/JHU Report QM-79-261, Dec 1979. (See C-17 for fifth meeting in this series.)
- C-9 Resource Assessment/Commercialization Planning Meeting, Salt Lake City, Utah, Jan 1980, DOE:DGE/DGRM.
- C-10 "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Atlantic Coastal Plain," APL/JHU Report QM-77-129, Oct 1977.
- C-11 "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Coastal Plain in Southern Arkansas," APL/JHU Report QM-77-129-1, Oct 1977.
- C-12 "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Madison Limestone Aquifer in Western South Dakota," APL/JHU Report QM-77-129-2, Nov 1977.

- C-13 "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Eastern Gulf Coastal Plain," APL/JHU Report QM-77-129-3, Feb 1978.
- C-14 "Geothermal Energy and the Eastern U.S., A Draft Scenario for Geothermal Energy Development, Hot Dry Rock," APL/JHU Report QM-77-129-4, Mar 1978.
- C-15 J. K. Costain, L. Glover, III, and A. K. Sinha, "Evaluation and Targeting of Geothermal Energy Resources in the South-eastern United States-Progress Report," VPI and SU 5103-1 through -7 (represents a series of reports).
- C-16 J. L. Renner and Tracy L. Vaught, "Geothermal Resources of the Eastern United States," Report by Gruy Federal, Inc., (Contract No. DE-AC08-78ET28373), DOE/NVO/1558-7, Dec 1979.
- C-17 "Geothermal Energy and the Eastern U.S., Fifth Technical Information Interchange Meeting Minutes," JHU/APL Report QM-80-185, Dec 1980.

**ALABAMA
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Alabama)

TOTAL POPULATION: 3,444,165 TOTAL AREA: 50,708 SQ. MI.
POPULATION DENSITY: 68 PERSONS/SQ. MI.

GEOTHERMAL RESOURCE DATA

	(1)	(2)
NAME	Southern Alabama	Black Warrior Basin
TYPE	Clastic sediments	Clastic sedimentary rocks
DEPTH	Excess of 19,000 ft.	10,000 ft.
WATER TEMP.	Over 340°F	180°F
EST. STORED WATER	2 x 10 ¹⁴ cu. ft.	8 x 10 ¹² cu. ft.
EST. ENERGY CONTENT	Over 1,000 x 10 ¹⁵ Btu	300 x 10 ¹⁵ Btu

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	105	19,232 thousand tons	495
Natural Gas (liq.)	-	146 thousand bbl	0.6
Natural Gas Wells	15	11,271 million cu. ft.	12.3
Crude Oil Wells	586	11,677 thousand bbl	67.7

ENERGY USE - 1976 (10¹² BTU)

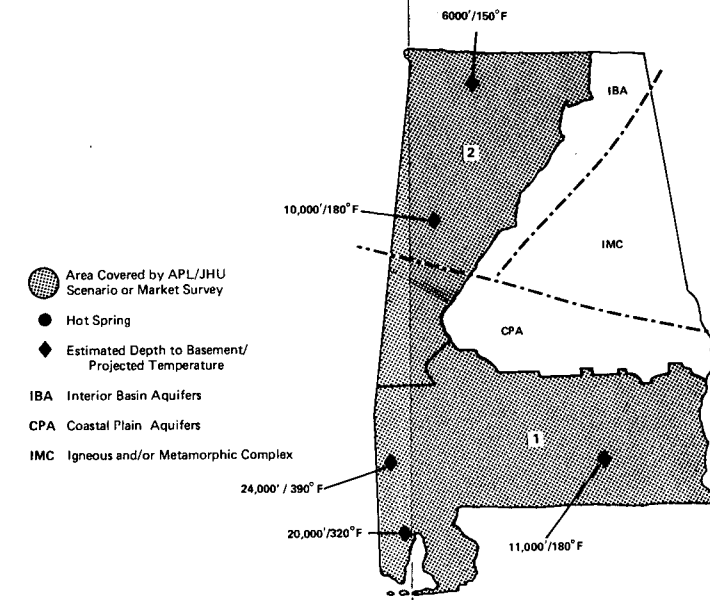
SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	420.4	20.9	286.4	683.9	142.0
RESIDENTIAL	6.6	16.6	54.0	0.2	47.6
COMMERCIAL	29.2	1.9	34.5	0.1	22.3
INDUSTRIAL	38.2	2.3	174.4	59.8	72.1
PERCENT	30	1	20	48	

GEOTHERMAL ACTIVITIES

CURRENT USES	Hot Springs at Cottonwood and Dothan used for Balneologic Purposes
RECENT OR CURRENT STUDIES	1. VPI Study: Evaluation & Targeting of Geothermal Energy Resources in the Southeastern U.S. 2. State Coupled Reservoir Confirmation Program, State Geologic Survey. 3. ORAU-Extending DOE/DGE Resource Studies into Black Warrior Basin
PROPOSED STUDIES	
LEGAL ACTIVITIES	

GEOTHERMAL OVERVIEW

Thick sedimentary cover in the southern and western portions of the state contain shallow hydrothermal aquifers (i.e., Tuscaloosa Formation) due to higher than normal gradients. Deeper aquifers are also known to occur. Sub-surface thermal data are being compiled by State Coupled State Geologic Survey. Data on geopressed regions in the southern portion of the state are available.



PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department of Conservation and Natural Resources, Claude D. Kelley, Commissioner (205) 269-7221
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Health Administration, Dept. of Public Health, William T. Willis, Director (205) 269-7632
OFFICE OF ENERGY POLICY:	Energy Advisory Council, John Harbert III, Chairman (205) 879-2211
PLANNING BUREAU:	Office of State Planning, Development Office, Office of Governor, John A. Rogers, Director (205) 269-7171
GEOLOGICAL SURVEY:	Thomas J. Joiner, State Geologist (205) 349-2852
	State Planning Office, Development Office, William Matthews (205) 832-6400
	Alabama Energy Management Board, Edwin G. Hudspeth, Staff Director (205) 832-5010

LEGISLATIVE CONTACTS

SENATORS	Donald Stewart (D) Howell Heflin (D)	GOVERNOR	Forrest (Fob) James, Jr. (D)
CONGRESSMEN (DIST.)			
1 - Jack Edwards (R)			
2 - William L. Dickinson (R)			
3 - William Nichols (D)			
4 - Tom Bevill (D)			
5 - Ronnie G. Flippo (D)			
6 - Albert Lee Smith, Jr. (R)			
7 - Richard Shelby (D)			

State Geothermal Fact Sheet

ALABAMA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 3,444,165 Area: 50,708 sq. mi. Density: 68 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 2,460,000 Area: 35,000 sq. mi. Density: 71 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	76	219	278	28	42
Residential	1	174	52	0.01	14
Commerical	5	19	33	0.00	7
Industrial	6	24	169	2	21

Trillion Btu

GROSS	420.4	20.9	286.4	683.9	142.0
Residential	6.6	16.6	54.0	0.2	47.6
Commercial	29.2	1.9	34.5	0.1	22.3
Industrial	38.2	2.3	174.4	59.8	72.1
Percentages	30	1	20	48	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	105	19,232 thousand tons	495
Natural gas (liq.)	-	146 thousand bbl	0.6
Natural gas wells	15	11,271 million cu. ft.	12.3
Crude oil wells	586	11,677 thousand bbl	67.7

IV. GEOLOGY

The southern half of Alabama, the Gulf Coastal Plain, consists of a southwest thickening wedge of unconsolidated Mesozoic and Cenozoic sediments that attain thicknesses in excess of 20,000 ft. near the coast.

These sediments overlies Paleozoic sedimentary rocks that are exposed in the northern part of the state in the Black Warrior Basin (beneath the Allegheny Plateau and the Valley and Ridge Province). Along the eastern border of the state, the Precambrian and Paleozoic crystalline basement rocks of the Piedmont and Blue Ridge are exposed, and Paleozoic and Pre-Cambrian metamorphic and igneous rocks are exposed in the east-central part of the State.

Although several warm springs do occur in the crystalline piedmont rocks, the most attractive resource areas lie within the sedimentary basins. Geopressured reservoirs may exist in the deeper parts of the coastal plain adjacent to the Mississippi Interior Salt Dome Basin. Hydrothermal resources probably occur in both the Black Warrior Basin and the coastal plains. The main restraint on development is the depth needed to obtain usefully hot water, and to locate reservoirs with easily extractable water. Geothermal gradients above 1.6°F/100 ft. occur locally in both basin areas.

V. RESOURCE DATA

Water availability is likely to be greater in the unconsolidated sediments of the Gulf Coastal Plain; however, several horizons in the Black Warrior Basin are highly permeable. Where 10,000 ft. of sediments exist, temperatures are likely to be at least 180°F. In the deeper areas, where sediments are 20,000 ft. thick, temperatures may be near 325°F. Exploration should aim to areas of higher heat flow.

The Tuscaloosa Sandstone Formation seems to be anomalously warm at depths of about 3,000 ft. near Cottonwood and Dothan, and produces waters of 122°F and 104°F, respectively.

1. BLACK WARRIOR BASIN

Type aquifer: Paleozoic clastic sediments Area: 17,000 sq. mi.
Depth: 6,000 to 10,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: 150° to 212°F
Recharge rate:
Estimate of water stored in aquifer: 8×10^{13} cu. ft.
Estimate of energy content in water: 300×10^{15} Btu[†]

2. SOUTHERN ALABAMA

Type aquifer: clastic sediments Area: 17,600 sq. mi.
Depth: in excess of 20,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: Over 350°F
Recharge rate:
Estimate of water stored in aquifer: 2×10^{14} cu. ft.
Estimate of energy content in water: Over $1,000 \times 10^{15}$ Btu[†]

[†]Above 120°F, references to 90°F; 10% porosity assumed, about 4.5 times this amount in rock.

VI. GEOHERMAL ACTIVITY

Current uses: Hot Springs at Cottonwood and Dothan used for balneological purposes.

Recent studies: Alabama Geologic Survey "Assessment of the Geothermal/Geopressure potential of the Gulf Coastal Plain of Alabama."

DOE/DGE State Coupled Resource Assessment Program.

VII. LEGAL ACTIVITIES

Proposals of a Geothermal Resources Act have been considered by State Legislature. No act has been passed to date.

VIII. CONTACTS

1. Geological Survey of Alabama, P.O. Drawer O, University, AL 35486, Thomas J. Joiner, State Geologist, (205) 349-2852.

2. Alabama Energy Management Board, c/o Alabama Development Office, State Capitol, Montgomery, AL 36130, Edwin G. Hudspeth, Staff Director, (205) 832-5010.
3. State Planning Office, Alabama Development Office, State Capitol, Montgomery, AL 36130, William Mathews, (205) 832-6400.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) S. S. Papadopoulos, R. H. Wallace, Jr., J. B. Wesselman, and R. E. Taylor, "Assessment of Onshore Geopressured-Geothermal Resources in the Northern Gulf of Mexico Basin," Assessment of Geothermal Resources of the United States, USGS Circular 726, 1975.
- (2) R. S. Barnett, "Basement Structure of Florida and Its Tectonic Implications," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 122-139, 1975.
- (3) G. V. Wilson, "Early Differential Subsidence and Configuration of the Northern Gulf Coast Basin in Southeast Alabama and Northwestern Florida," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 196-206, 1975.
- (4) 1976 Alabama Directory of Mining and Manufacturing, Alabama Development Office, 1976.
- (5) "Assessment of the Geothermal/Geopressure Potential of the Gulf Coastal Plain of Alabama," A Progress Report: Technical Information Interchange Meeting Minutes, QM-79-261, Dec 1979.

COMMON REFERENCES

(C-1), (C-2), (C-3), (C-4), (C-5), (C-6), and (C-7).

**ALASKA
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Alaska)

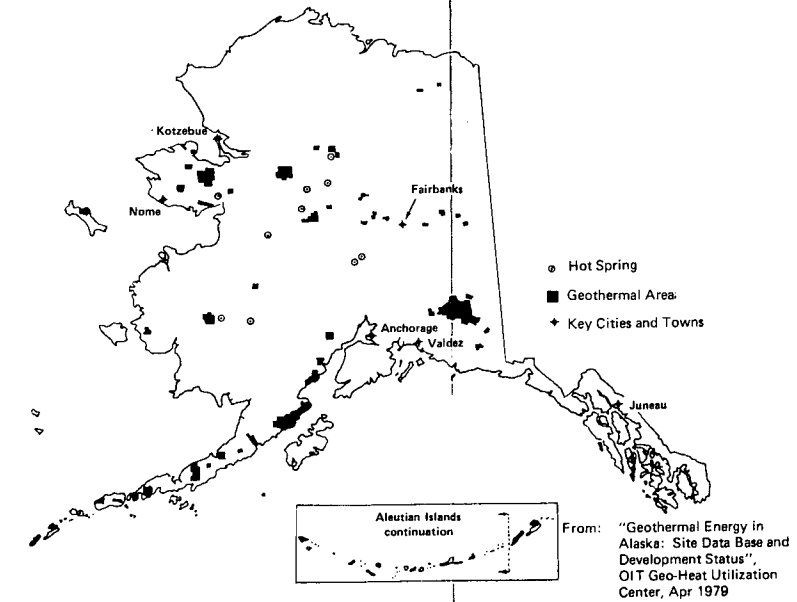
TOTAL POPULATION: 300,382 TOTAL AREA: 566,432 SQ. MI.
POPULATION DENSITY: 1.0 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	1	694 thousand tons	15.9
Natural Gas (liq.)	-	712 thousand bbl	2.9
Natural Gas Wells	52	131,007 million cu. ft.	143.2
Crude Oil Wells	192	72,323 thousand bbl	419.5

GEOTHERMAL OVERVIEW

Hot water hydrothermal convection systems with temperatures above 150°C are known to occur on Umnak Island and near Ketchikan on the Juneau Peninsula. Lower temperature systems (90°C to 150°C) are common in the east-west trending Brooks Range north of Fairbanks and near Sitka on the Juneau Peninsula. Areas of anomalously high geothermal gradient occur near Prudhoe Bay and Anchorage, although data are sparse.



ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	111.2	0.9	93.4	15.2	6.3
RESIDENTIAL	5.5	0.3	10.7	0.2	2.9
COMMERCIAL	14.4	0	14.4	0.1	2.8
INDUSTRIAL	11.9	0.5	47.4	10.5	0.7
PERCENT	50	0	42	7	

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:
DIVISION OF WATER RIGHTS:
DEPARTMENT OF ENVIRONMENTAL PROTECTION:
OFFICE OF ENERGY POLICY:
PLANNING BUREAU:
GEOLOGICAL SURVEY:

LEGISLATIVE CONTACTS

SENATORS	Ted Stevens (R) Mike Gravel (D)	GOVERNOR	Jay S. Hammond (R)
CONGRESSMAN (DIST.)	Don Young (R)		

State Geothermal Fact Sheet

ALASKA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 300,382 Area: 566,432 sq. mi. Density: 1 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	20	9	90	1	2
Residential	1	3	10	0	1
Commerical	3	0	15	0	1
Industrial	2	6	46	0.5	0

Trillion Btu

GROSS	111.2	0.9	93.4	15.2	6.3
Residential	5.5	0.3	10.7	0.2	2.9
Commercial	14.4	0	14.4	0.1	2.8
Industrial	11.9	0.5	47.4	10.5	0.7
Percentages	50	0	42	7	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1977) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	1	694 thousand tons	15.9
Natural gas (liq.)	-	712 thousand bbl	2.9
Natural gas wells	52	131,007 million cu. ft.	143.2
Crude oil wells	192	72,323 thousand bbl	419.5

IV. GEOLOGY

Hot water hydrothermal convection systems with temperatures above 150°C are known to occur on Umnak Island and near Ketchikan on the Juneau Peninsula. Lower temperature systems (90°C to 150°C) are common in the east-west trending Brooks Range north of Fairbanks and near Sitka on the Juneau Peninsula. Areas of anomalously high geothermal gradient occur near Prudhoe Bay and Anchorage, although data are sparse.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

None at present.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Donald Markle, "Geothermal Energy in Alaska: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Apr 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**ARIZONA
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Arizona)

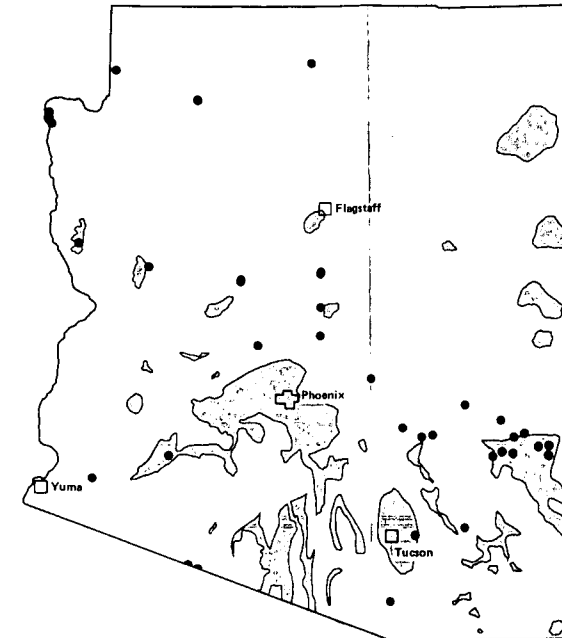
TOTAL POPULATION: 2,266,789 TOTAL AREA: 113,909 SQ. MI.
POPULATION DENSITY: 19.9 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	1	3,242 thousand tons	70.9
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	4	125 million cu. ft.	0.1
Crude Oil Wells	28	804 thousand bbl	4.7

GEOTHERMAL OVERVIEW

Thirty-seven moderate temperature reservoirs have been confirmed in eight southern and western counties in the Basin and Range geologic province. Deep circulation is expected in the many range-front and basin faults. Areas of recent volcanism in the Colorado Plateau province are considered to have potential.



Areas of Low and Moderate Temperature Potential
●●● Hot Springs > 30°

ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	286.2	4.5	159.3	86.0	69.3
RESIDENTIAL	2.1	2.3	39.1	0	24.7
COMMERCIAL	4.5	0.3	33.7	0	26.0
INDUSTRIAL	21.9	1.9	50.5	2.9	19.5
PERCENT	53	1	30	16	

GEOTHERMAL ACTIVITIES

CURRENT USES	Water use for balneologic purposes
RECENT OR CURRENT STUDIES	1. Resource assessment, engineering, and economic feasibility study of space heating and cooling. Williams Air Force Base in progress. Similar study for IBM plant in progress. 2. "Thermal Gradient Anomalies in Southern Arizona": Report of Investigation 6, Arizona Oil and Gas Conservation Commission, February 1978
PROPOSED STUDIES	Preparation of Site Specific and Area Development Plans
LEGAL ACTIVITIES	Geothermal statutes have been enacted and regulations promulgated.

PRIMARY CONTACTS

STATE GEOTHERMAL PROJECT TEAM	
COMMERCIALIZATION PLANNING:	Dr. Frank Mancini (Arizona Solar Energy Commission)
RESOURCE ASSESSMENT:	W. Richard Hahman, Sr., (Bureau of Geological and Mineral Technology, University of Arizona)
WATER COMMISSION:	Wesley Steiner, Executive Director
DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT:	Larry Landry, Executive Director
ENERGY PROGRAMS OFFICE:	Bob Hathaway, Director
DIRECTOR OF ENERGY PROGRAMS:	Gerry Cunningham

LEGISLATIVE CONTACTS

SENATORS	Barry Goldwater (R) Dennis DeConcini (D)	GOVERNOR	Bruce Babbitt (D)
CONGRESSMEN (DIST.)			
1 - John J. Rhodes (R)			
2 - Morris K. Udall (D)			
3 - Bob Stump (D)			
4 - Eldon Rudd (R)			

III. STATE FUEL PRODUCTION (1977) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	1	3,247 thousand tons	70.9
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	4	125 million cu. ft.	0.1
Crude oil wells	28	804 thousand bbl	4.7

IV. GEOLOGY

The southern, western, and extreme northwestern portion of Arizona are in the Basin and Range geologic province. This province consists of northward or northwestern-trending mountain blocks separated by flat, alluvial filled basins with valley floor elevations of 1000 to 2600 ft. (300 to 800 m). The mountains in general have been uplifted by range-front faulting relative to the basins. Valleys are underlain typically by thousands of feet (several thousand meters) of consolidated to relatively unconsolidated sediments resulting from erosion of the mountain blocks. Exposed mountain rocks include intrusive, extrusive metamorphic, and sedimentary types that are typically folded and faulted. They range in age from Precambrian to Recent.

Northern Arizona is in the Colorado Plateau province. The flat-lying sedimentary rocks from plateaus having typical elevations of 6500 ft. (1700 m) above mean sea level. The simple geologic structure indicates that the plateau has been relatively stable in the recent geologic past although the margins have been active.

No areas of geyser or fumarolic activity are known to exist; however, several areas of basaltic and rhyolitic volcanism are less than 3 million years old. Four of these areas occur in the Basin and Range province; three areas of young basaltic volcanism occur in the Colorado Plateau province.

V. RESOURCE DATA

There are no confirmed high temperature resources (>300°F (150°C)), but several areas are considered as likely prospects. Thirty-seven low and moderate temperature (<300°F (150°C)) resources have been confirmed in the Basin and Range province and many other areas are considered likely prospects. Over 2000 hydrothermal springs and wells (many with temperatures greater than 100°F (40°C)) have been identified.

VI. GEOHERMAL ACTIVITY

Current use: Five sites use water for balneologic purposes.

Recent studies: An extensive exploratory program is being conducted with federal funding by the Arizona Bureau of Geology and Mineral Technology. Geothermal energy space heating is being considered for the Williams Air Force Base near Phoenix and in the design of an IBM plant near Tucson.

VII. LEGAL ACTIVITIES

Geothermal statutes have been enacted and rules and regulations promulgated. A four year moratorium on leasing state and federal land for geothermal purposes was lifted (1979) following passage of the state law.

VIII. CONTACTS

1. State Geothermal Project Team:
 - a. Commercialization Planning:

Dr. Frank Mancini, (Arizona Solar Energy Commission);
W. Richard Hahman, Sr., (Bureau of Geology and Mineral Technology, University of Arizona).
 - b. Resource Assessment:

W. Richard Hahman, Sr., (Bureau of Geology and Mineral Technology, University of Arizona).
2. State Oil and Gas Conservation Commission, Wm. C. Allen, Acting Executive Secretary.
3. Water Commission, Wesley Steiner, Executive Director.
4. Department of Economic Planning and Development, Larry Lander, Executive Director; Energy Programs Office: Bob Hathaway, Director; and Gerry Cunningham, Director of Energy Programs.
5. Arizona Power Authority, Marshall Humphrey, Chairman.
6. EG&G Idaho, Inc., P.O. Box 1626 Idaho Falls, Idaho 83401, B. C. Lunis, Commercialization Planning.

REFERENCES AND LIST OF SIGNIFICANT REPORT

- (1) "Arizona Hydrothermal Commercialization Baseline,"
EG&G Idaho, Inc., Sep 1979. (This report contains a
bibliography of significant reports and documents.)

COMMON REFERENCES

(C-4), (C-6), and (C-7).

ARKANSAS
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Arkansas)

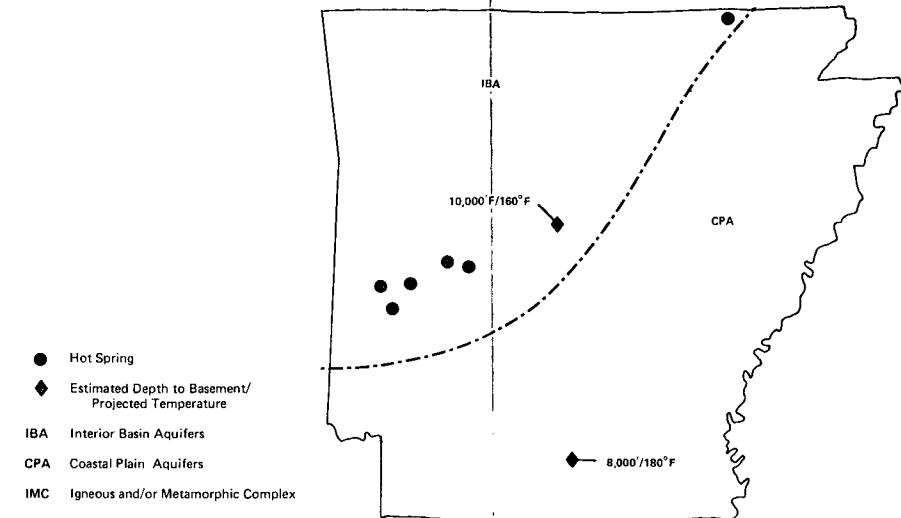
TOTAL POPULATION: 1,923,295 TOTAL AREA: 51,945 SQ. MI.
POPULATION DENSITY: 37 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	11	435 thousand tons	12.5
Natural Gas (liq.)	-	635 thousand bbl	2.6
Natural Gas Wells	876	157,529 million cu. ft.	172.2
Crude Oil Wells	7,232	18,016 thousand bbl	104.5

GEOHERMAL OVERVIEW

Thick sedimentary sequences throughout the state may harbor hydrothermal resources in areas where above average geothermal gradient coincides with aquifers. Unconsolidated sands in Coastal Plain areas have a greater water content. Fault controlled Hot Springs area appears to represent a hydrothermal area of reasonable size.



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	274.2	38.0	270.7	0	54.2
RESIDENTIAL	4.5	21.9	50.1	0	21.7
COMMERCIAL	15.6	2.4	34.4	0	14.7
INDUSTRIAL	34.0	12.5	140.8	0	17.7
PERCENT	47	7	46	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Dept. of Pollution Control and Ecology, S. Ladd Davies, Director (501) 371-1701
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Dept. of Pollution Control and Ecology, S. Ladd Davies, Director (501) 371-1701
OFFICE OF ENERGY POLICY:	State Energy Office, Nick C. Ruffin, Coordinator-Energy Policy & Planning (501) 371-1379
PLANNING BUREAU:	Same
GEOLOGICAL SURVEY:	Norman F. Williams, State Geologist (501) 371-1488
WATER RESOURCES:	Soil and Water Resources Division, Dept. of Commerce, John P. Saxton, Acting Director (501) 371-1611
ARKANSAS GEOLOGICAL COMMISSION:	Orville Wise, Charles Stone, William Kaplan
LITTLE ROCK AIR FORCE BASE:	W. E. Arnold, Chief Engineering and Construction
HOT SPRINGS NATIONAL PARK:	Richard H. Maeder, Superintendent

GEOHERMAL ACTIVITIES

CURRENT USES	1. Heating of Adm. Bldg., Hot Springs National Park. 2. Water use for balneological purposes. 3. Well head electrical generator.
RECENT OR CURRENT STUDIES	1. "Report of Heating Adm. Building", Supt. Hot Springs National Park, 1976. 2. DOE/DGE sponsoring geologic study by LASL and Univ. of Conn. 3. Studies of geothermal heating of bathhouse - Hot Springs National Park. 4. Power generation with geothermal brines.
LEGAL ACTIVITIES	None

LEGISLATIVE CONTACTS

SENATORS	David Pryor (D) Dale Bumpers (D)	GOVERNOR	Frank D. White (R)
CONGRESSMEN (DIST.)	1 - William Alexander, Jr. (D) 2 - Edwin R. Bethune, Jr. (R) 3 - John P. Hammerschmidt (R) 4 - Beryl Anthony (D)		

State Geothermal Fact Sheet
 ARKANSAS

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 1,923,295 Area: 51,945 sq. mi. Density: 37 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 858,603 Area: 18,624 sq. mi. Density: 46 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	49	398	262	0	16
Residential	1	230	49	0	6
Commerical	3	26	33	0	4
Industrial	6	131	136	0	5

Trillion Btu

GROSS	274.2	38.0	270.7	0	54.2
Residential	4.5	21.9	50.1	0	21.7
Commercial	15.6	2.4	34.4	0	14.7
Industrial	34.0	12.5	140.8	0	17.7
Percentages	47	7	46	0	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	11	435 thousand tons	12.5
Natural gas (liq.)	-	635 thousand bbl	2.6
Natural gas wells	876	157,529 million cu. ft.	172.2
Crude oil wells	7,232	18,016 thousand bbl	104.5

IV. GEOLOGY

Cretaceous to Recent unconsolidated sediments of the Gulf Coastal Plain underlie the southeastern half of the state. These sediments form a southeastward thickening wedge that attains a thickness of 15,000 ft. near the juncture of Louisiana and Mississippi. Good aquifers such as the Wilcox and Smackover Formations exist in the Coastal Plain at depths where they should contain hot water.

Beneath these sediments and exposed throughout the rest of Arkansas are lithified Paleozoic sedimentary rocks. These rocks thicken to the south, off the Ozark Uplift centered in Missouri, and into the Arkoma Basin, which attains depths in excess of 35,000 ft. Large gas deposits occur in this basin and good aquifers also exist at depth. The Ouachita Mountains have been thrust up over this basin. Hot Springs National Park, which produces 1,000,000 gallons per day of 143°F water, lies at the east end of this mountain belt. These springs are fault controlled and are spatially associated with Mesozoic intrusives (1).

V. RESOURCE DATA

Geothermal gradients greater than 2°F/100 ft. occur in the Arkoma Basin and beneath the Coastal Plain. These temperatures, where they coexist with deep aquifers, are attractive areas for development of hydrothermal resources.

VI. GEOHERMAL ACTIVITY

- Current use:
1. Heating of administration building in Hot Springs National Park.
 2. Water use for balneological purposes.
- Studies:
1. Report on heating administration building, Hot Springs National Park, 1976 (2).
 2. Report of study to convert bathhouse heating systems from gas to geothermal water (3).

3. APL technical assistance report for converting the Buckstaff and other bathhouses to heating system (4).
4. Arkansas Power and Light Company R&D project funded by DOE to use hot geothermal brine to vaporize pentane in a closed loop to drive a turbine for power generation. The final report for the first phase should be out by December 1980 (5) and (6).

VII. LEGAL ACTIVITIES

None

VIII. CONTACTS

1. Arkansas Geological Commission, Little Rock, Arkansas (Normal F. Williams [Director], Orville Wise, Charles G. Stone, William Kaplan).
2. U.S. Geological Survey, Little Rock, Arkansas (R. T. Sniegocki, John Hubble, Joseph E. Reed, Boyd Haley).
3. Hot Springs National Park, Hot Springs, Arkansas (Richard H. Maeder, Superintendent).
4. Little Rock Air Force Base, Little Rock, Arkansas (W. E. Arnold, Chief, Engineering and Construction).
5. Governor's Office, 504 Capitol Hill Bldg., Little Rock, AR 72201, William Onopah, Senior Planner.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) U.S.G.S., "The Waters of Hot Springs National Park, Arkansas - Their Origin, Nature, and Management," Open File Report, Little Rock, Arkansas, 1974.
- (2) F. C. Paddison and R. A. Eisenberg, enclosure to "Geothermal Energy and Arkansas," APL/JHU QM-76-104, Aug 1976.
- (3) J. A. Caple, "Feasibility Study for the Conversion of Bathroom Heating Systems from Gas to Geothermal Water," Cromwell, Neyland, Truemper, Levy, and Gathell, Inc., Aug 1978.

- (4) "Visit to the U.S. Park Service and Buckstaff Bathhouse," Technical Assistance, JHU/APL QM-79-272, Dec 1979 and CQO 2810, Feb 1980.
- (5) "Arkansas Utility to Harness Geothermal Brines," Energy Research Digest, 3 Jul 1978 (also personal communication between Arkansas Power and Light and JHU/APL on 15 Sep 1980).
- (6) A. W. Huebner, D. A. Wall, and T. L. Herlacher, "Research and Development of a 3 MW Power Plant from the Design, Development and Demonstration of a 100 kW Power System Utilizing the Direct Contact Heat Exchanger Concept for Geothermal Brine Recovery Project," Arkansas Power and Light Company report for the Department of Energy, ET 78-G-05-5917, Sep 1980.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**CALIFORNIA
GEOHERMAL DATA SUMMARY SHEET**

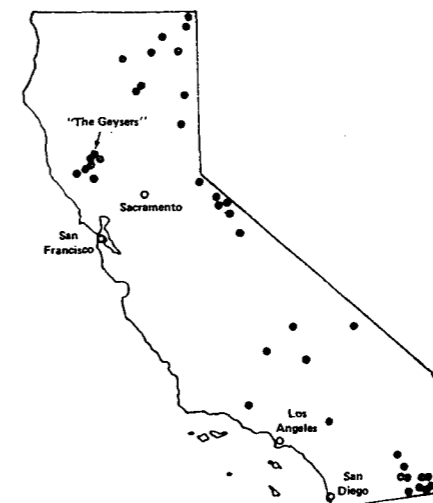
(cf. State Geothermal Fact Sheet, California)

TOTAL POPULATION: 19,957,715 TOTAL AREA: 156,361 SQ. MI.
POPULATION DENSITY: 128 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	12,194 thousand bbl	49.2
Natural Gas Wells	1,095	449,369 million cu. ft.	491.2
Crude Oil Wells	38,626	336,075 thousand bbl	1,949.2

GEOHERMAL OVERVIEW



○ Key Cities
● Identified hydrothermal convection systems, reservoir temperatures > 90°C
From: "Assessment of Geothermal Resources of the United States - 1978", Geological Survey Circular 780, USGS.

ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	2579.6	53.3	1928.8	54.3	490.1
RESIDENTIAL	16.2	11.5	651.6	0	148.0
COMMERCIAL	39.6	1.3	247.9	0	194.3
INDUSTRIAL	123.0	39.9	725.1	4.1	145.8
PERCENT	56	1	42	1	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:
DIVISION OF WATER RIGHTS:
DEPARTMENT OF ENVIRONMENTAL PROTECTION:
OFFICE OF ENERGY POLICY:
PLANNING BUREAU:
GEOLOGICAL SURVEY:

LEGISLATIVE CONTACTS

SENATORS	Alan Cranston (D) S. I. Hayakawa (R)	GOVERNOR	Edmund G. Brown, Jr. (D)
CONGRESSMAN (DIST.)			
1 - Harold T. Johnson (D)	16 - Leon E. Panetta (D)	30 - George E. Danielson (D)	
2 - Don H. Clausen (R)	17 - Charles Pashayan, Jr. (R)	31 - Charles H. Wilson (D)	
3 - Robert T. Matsui (D)	18 - William M. Thomas (R)	32 - Glenn M. Anderson (D)	
4 - Vic Fazio (D)	19 - Robert J. Lagomarsino (R)	33 - Wayne Grisham (R)	
5 - John L. Burton (D)	20 - Barry M. Goldwater, Jr. (R)	34 - Daniel E. Lungren (R)	
6 - Phillip Burton (D)	21 - James C. Corman (D)	35 - James Lloyd (D)	
7 - George Miller (D)	22 - Carlos J. Moorhead (R)	36 - George E. Brown, Jr. (D)	
8 - Ronald V. Dellums (D)	23 - Anthony C. Beilenson (D)	37 - Jerry Lewis (R)	
9 - Fortney H. Stark (D)	24 - Henry A. Waxman (D)	38 - Jerry M. Patterson (D)	
10 - Don Edwards (D)	25 - Edward R. Roybal (D)	39 - William E. Dannemeyer (R)	
11 - William Royer (D)	26 - John H. Roussetot (R)	40 - Robert E. Badham (R)	
12 - Paul N. McCloskey, Jr. (R)	27 - Robert K. Dornan (R)	41 - Bob Wilson (R)	
13 - Norman Y. Mineta (D)	28 - Julian C. Dixon (D)	42 - Lionel Van Deerlin (D)	
14 - Norman D. Shumway (R)	29 - Augustus F. Hawkins (D)	43 - Clair W. Burgener (R)	
15 - Tony Coelho (D)			

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

III. STATE FUEL PRODUCTION (1977) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	12,194 thousand bbl	49.2
Natural gas wells	1,095	449,369 million cu. ft.	491.2
Crude oil wells	38,626	336,075 thousand bbl	1,949.2

IV. GEOLOGY

California can be divided into the following geologic provinces: Basin and Range (Great Basin and Mohave Desert); Salton Trough; Sierra Nevada; Great valley; Coast Ranges-Traverse Ranges and Peninsular Ranges; Klamath Mountains; Cascade Mountains; and the Modoc Plateau.

Fault-dominated hot water geothermal systems occur in the Basin and Range region of the Great Basin and Mohave Desert. The magmatic upwelling along the East Pacific rise in the Gulf of California has resulted in the high heat flow province of the Salton Trough. Cenozoic volcanic centers throughout the state are associated with high temperature resources. The Geysers north of San Francisco is a steam field that produces much of the electricity for that city.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

No data.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

COLORADO
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Colorado)

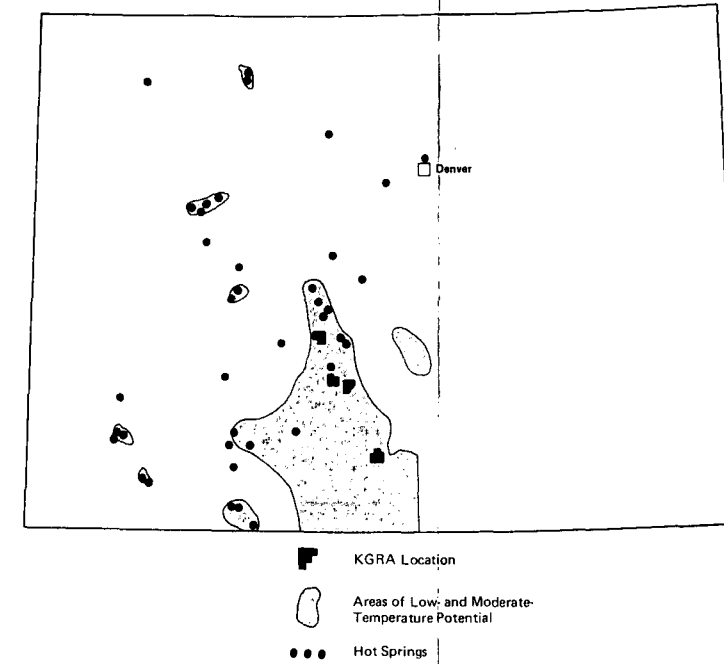
TOTAL POPULATION: 2,209,596 TOTAL AREA: 104,247 SQ. MI.
POPULATION DENSITY: 21.2 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	30	6,232 thousand tons	139.1
Natural Gas (liq.)	-	3,402 thousand bbl	13.7
Natural Gas Wells	1,050	137,725 million cu. ft.	150.5
Crude Oil Wells	2,004	36,590 thousand bbl	212.2

GEOHERMAL OVERVIEW

The western half of Colorado contains most of the 56 known thermal areas. Only one of these, in the southwest, is potentially a high temperature site. Direct use applications are limited because of the sparse population and the small amount of industry in the west. Evaluation of the eastern half of the state is yet to be made.



ENERGY USE - 1976 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	277.6	18.2	319.3	171.7	53.5
RESIDENTIAL	3.3	12.2	103.1	0.2	17.4
COMMERCIAL	17.6	1.4	78.7	0.1	24.7
INDUSTRIAL	24.7	4.4	77.3	16.1	11.4
PERCENT	35	2	41	22	

GEOHERMAL ACTIVITIES

CURRENT USES	About 114,000 acres on federal and state land have been leased.
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	A geothermal resources act was adopted in 1975.

PRIMARY CONTACTS

STATE GEOHERMAL TEAM	
OPERATIONS RESEARCH:	Colorado Geological Survey, Richard H. Pearl.
RESOURCE ASSESSMENT:	Colorado Geological Survey, Richard H. Pearl
COLORADO GEOLOGICAL SURVEY: John Rold, Director	
COLORADO DEPARTMENT OF NATURAL RESOURCES: Harris Sherman, Director	
COLORADO ENERGY RESEARCH INSTITUTE: Dr. Martin Robbins, Director	
COLORADO OFFICE OF ENERGY CONSERVATION: Buie Seawell, Director	
COLORADO OIL AND GAS COMMISSION: Douglas V. Rogers	

LEGISLATIVE CONTACTS

SENATORS	Gary Hart (D) William L. Armstrong (R)	GOVERNOR	Richard D. Lamm (D)
CONGRESSMEN (DIST.)			
1 - Patricia Schroeder (D)			
2 - Timothy E. Wirth (D)			
3 - Ray Kogovsek (D)			
4 - Hank Brown (R)			
5 - Ken Kramer (R)			

III. STATE FUEL PRODUCTION (1977) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	30	6,232 thousand tons	139.1
Natural gas (liq.)	-	3,402 thousand bbl	13.7
Natural gas wells	1,050	137,725 million cu. ft.	150.5
Crude oil wells	2,004	36,590 thousand bbl	212.2

IV. GEOLOGY

The Colorado Plateau Province in the western portion of the state is an area of flat-lying sedimentary rocks with areas of intrusive rocks and a number of young, silicic volcanic systems along the margins of the plateau. The Southern Rocky Mountains occupy the west-central part of Colorado and are composed of up-lifted, faulted and folded rocks. To the east is the Great Plains Province, which is a flat area of erosional material covering older rocks.

The margin of the Plateau is considered to have the greatest potential for locating high-temperature hydrothermal systems. The interior of the Plateau is thought to have relatively low heat flow. The Great Plains contain no igneous rocks or other encouraging geologic formations. However, recent study of oil well data show some discrete areas in the east that may have direct heat potential.

V. RESOURCE DATA

There are three areas designated as KGRAs in Colorado. No high temperature reservoirs have been confirmed, but one such prospect exists near Dunton in the southwestern part of the state. Pagosa Springs, in the same general area, has been confirmed as a moderate temperature reservoir. Over 50 other western area sites are considered as prospects for low, medium, and high temperature reservoir confirmation. Some known wells in the east offer potential in the low to moderate category.

VI. GEOHERMAL ACTIVITY

About 114,000 acres on state and federal land have been leased, 5000 in KGRAs.

About 40 systems using shallow wells and low flows are operational. Most of these are for spas and swimming pools; a few sites are for space heating homes or cabins, greenhouses, fish farming, or algae growing.

Area and Site Specific Development Plans have been prepared for 23 locations as part of the DOE/state planning process. One Time Phased Project Plan was developed for district heating at Pagosa Springs.

One PON and two PRDAs were awarded in Colorado since 1978, the first in Pagosa Springs for heating public buildings, schools, businesses, and homes; the other dealing with heating and cooling operations in the San Luis Valley.

VII. LEGAL ACTIVITIES

A geothermal resources act was adopted in 1973. Since then specific geothermal leases have been issued.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research, Colorado Geological Survey, Richard H. Pearl.
 - b. Resource Assessment, Colorado Geological Survey, Richard H. Pearl.
2. Colorado Geological Survey, John Rold, Director.
3. Colorado Department of Natural Resources, Harris Sherman, Director.
4. Colorado Energy Research Institute, Dr. Martin Robbins, Director.
5. Colorado Office of Energy Conservation, Buie Seawell, Director.
6. Colorado Oil and Gas Commission, Douglas V. Rogers.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Colorado Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Apr 1979.

COMMON REFERENCES

- (C-4), (C-6), and (C-7).

**CONNECTICUT
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Connecticut)

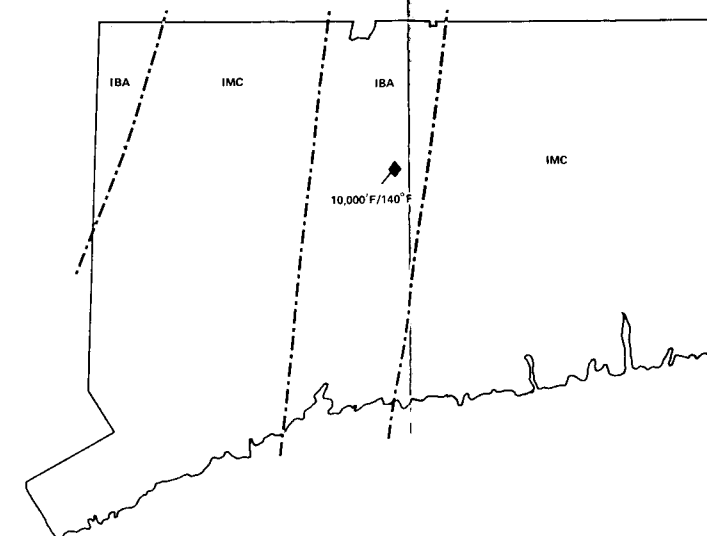
TOTAL POPULATION: 3,031,709 TOTAL AREA: 4862 SQ. MI.
POPULATION DENSITY: 624 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

Hot dry rock and/or hydrothermal potential may exist at depth in the Connecticut Valley Triassic Basin or in the sedimentary sequence in the northwest part of the state.



- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	508.5	8.4	67.2	0.9	63.6
RESIDENTIAL	91.7	3.3	33.2	0.0	25.5
COMMERCIAL	37.8	0.4	16.4	0.0	20.4
INDUSTRIAL	41.5	4.7	17.2	0.8	17.7
PERCENT	87	1	11	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department of Planning and Energy Policy, Stapley Pal, Commissioner (203) 566-2118
DIVISION OF WATER RIGHTS:	Benjamin Warner, Director (203) 566-7220
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Douglas M. Costle, Commissioner (203) 566-2110
OFFICE OF ENERGY POLICY:	Department of Planning and Energy Policy, Thomas Fitzpatrick, Undersecretary, (203) 566-2800
PLANNING BUREAU:	Horace H. Brown, Director (203) 566-4872
GEOLOGICAL SURVEY:	Dr. Hugo F. Thomas, State Geologist (203) 566-3540

LEGISLATIVE CONTACTS

SENATORS	Abraham A. Ribicoff (D) Lowell P. Weicker, Jr. (R)	GOVERNOR	Ella T. Grasso (D)
CONGRESSMEN (DIST.)			
*1 - William R. Cotter (D)			
2 - Samuel Gejdenson (D)			
*3 - Larry DeNardis (R)			
4 - Stewart B. McKinney (R)			
*5 - William Ratchford (D)			
*6 - Anthony Moffett (D)			
*Those in this State IBA Region			

GEOTHERMAL ACTIVITIES

CURRENT USES	None known
RECENT OR CURRENT STUDIES	None known
PROPOSED STUDIES	None known
LEGAL ACTIVITIES	None known

State Geothermal Fact Sheet

CONNECTICUT

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 3,031,709 Area: 4,862 sq. mi. Density: 624 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

CT-1

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	88	88	65	0.03	19
Residential	16	34	32	0.0	8
Commerical	6	4	16	0	6
Industrial	7	49	17	0.03	5

Trillion Btu

GROSS	508.5	8.4	67.2	0.9	63.6
Residential	91.7	3.3	33.2	0.0	25.5
Commercial	37.8	0.4	16.4	0.0	20.4
Industrial	41.5	4.7	17.2	0.8	17.7
Percentages	87	1	11	0	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

Connecticut is largely underlain by Precambrian and Paleozoic metamorphic and igneous rocks that were deformed or emplaced during the Paleozoic orogenies. In the central part of the state, the north-south trending Connecticut Valley-Triassic Basin has downdropped Mesozoic sedimentary rocks into the crystalline terrain. This basin has the appearance of a half-graben with as much as 15,000 ft. of sediments preserved along its eastern margin.

V. RESOURCE DATA

Little is known about water availability at the depths cited. However, the highly indurated and noncalcareous nature of most of the sequence suggests the importance of fractures and faults for the circulation of water. Subsurface temperature data are rare.

VI. GEOTHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Planning and Energy Policy, Stapley Pal, Commissioner, (203) 566-2118.
2. Division of Water Rights, Benjamin Warner, Director, (203) 566-7220.
3. Department of Environmental Protection, Douglas M. Costle, Commissioner, (203) 566-2110.
4. Department of Planning and Energy Policy, Thomas Fitzpatrick, Undersecretary, (203) 566-2800.

5. Planning Bureau, Horace H. Brown, Director, (203) 566-4872.
6. Dr. Hugo F. Thomas, State Geologist (203) 566-3540.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), and (C-10).

DELAWARE
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Delaware)

TOTAL POPULATION: 548,101 TOTAL AREA: 1,982 SQ. MI.
POPULATION DENSITY: 277 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOHERMAL OVERVIEW

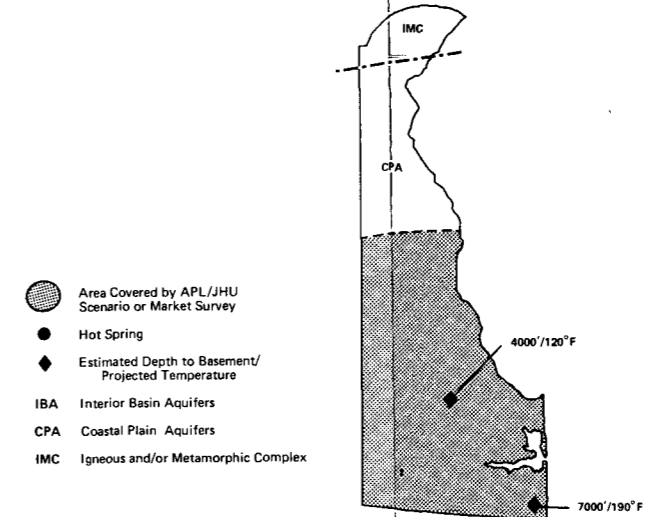
Lower Eastern Delaware is underlain by unconsolidated Coastal Plain sediments. The basement beneath the sediments has been interpreted by VPI&SU to contain plutons that may produce radiogenic heat. Data on aquifers above plutons needs to be developed. Depth to basement increases to the southeast to >7000 feet.

ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	135.8	3.4	19.7	24.6	17.7
RESIDENTIAL	9.6	1.7	7.2	0.1	5.1
COMMERCIAL	12.7	0.2	3.1	0.0	4.1
INDUSTRIAL	18.5	1.5	7.7	0.7	8.5
PERCENT	74	2	11	13	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	<ol style="list-style-type: none"> 1. R. N. Benson, 1976, Review of the Sub-surface Geology & Resource Potential of Southern Delaware: Delaware Geology Survey, Open File Report. 2. VPI "Evaluation & Targeting of Geothermal Energy in the Southeastern U.S." 3. DOE/DGE Gradient Drilling Program. 4. Eastern Geothermal Drilling Program - Solicitation Award - Lewes Del. 5. APL/JHU Geothermal Market Analysis. (See ref. 7). 6. DOE/DGE Funded Evaluation of States Geothermal Characteristics. 7. State Coupled Reservoir Assessment Program.
PROPOSED STUDIES	Organization of State team - develop State Prospectus - in process.
LEGAL ACTIVITIES	Geothermal Resources Act (Senate Bill No. 469) Passed both Houses - 1980 - Vetoed by Governor.



PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	John C. Byson, Secretary (302) 678-4403
DIVISION OF WATER RIGHTS:	William Ratledge, Director (302) 678-4411
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	N. C. Vasuki, Director (302) 678-4765
STATE ENERGY OFFICE:	Chris Warner (302) 678-5644
PLANNING BUREAU:	David S. Hugg III (302) 678-4271
GEOLOGICAL SURVEY:	Dr. Robert R. Jordan, State Geologist (302) 738-2833

LEGISLATIVE CONTACTS

	GOVERNOR Pierre S. duPont IV (R)
SENATORS	William V. Roth, Jr. (R) Joseph R. Biden, Jr. (D)
	Asst. Dennis Thomas Asst. Edward E. Kaufman
CONGRESSMEN (DIST.)	Thomas B. Evans, Jr. (R)
	Adm. Asst. Neil Messick

State Geothermal Fact Sheet

DELAWARE

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 548,101 Area: 1,982 sq. mi. Density: 277 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 162,245 Area: 1,544 sq. mi. Density: 105 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	23	35	19	1	5
Residential	2	18	7	0.00	1
Commerical	2	2	3	0	1
Industrial	3	15	7	0.02	3

Trillion Btu

GROSS	135.8	3.4	19.7	24.6	17.7
Residential	9.6	1.7	7.2	0.1	5.1
Commercial	12.7	0.2	3.1	0.0	4.1
Industrial	18.5	1.5	7.7	0.7	8.5
Percentages	74	2	11	13	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The coastal plain encompasses most of the state and is thought to consist of a southeasterly thickening wedge of Mesozoic and Cenozoic sedimentary rocks. An irregular but generally seaward sloping contact separates the basement complex from the overlying sedimentary package. Maximum depth to basement is about 7500 ft. and occurs near the southeast corner of the state (1). The concept of a gently sloping basement surface is being challenged as more geophysical data are made available (2).

V. RESOURCE DATA

Little is known of the resource other than that it is thought to extend into Delaware from the vicinity of Ocean City, Maryland. More specific data will result from the DOE/DGE sponsored drilling program along the Coastal Plain.

VI. GEOHERMAL ACTIVITY

Geothermal-gradient test holes have been completed as part of the DOE/DGE sponsored drilling program (6). Data are being assessed by VPI&SU (5). Drilling sites are shown on page DE-5. APL has completed the study of the potential geothermal market in the area (4). The State Energy Office submitted a winning proposal for Geothermal Energy at Lewes, Delaware, in response to Eastern Geothermal Drilling Program, June 1980 (9). DOE/DGE State Coupled Reservoir Assessment Program.

VII. LEGAL ACTIVITIES

NCSL has conducted survey of Legislative Work Shops relating to Geothermal energy (7). Geothermal Resource Act Senate Bill No. 469 was passed by both Houses, but was vetoed by the Governor.

VIII. CONTACTS

1. Delaware Energy Office, P. O. Box 1401, 114 W. Water Street, Dover, DE 19901, Chris Warner, or Dave Anstire (Governor's Energy Advisor), (302) 678-5644.

2. Division of Environmental Control, Department of Natural Resources, Tatnall Building, Dover, DE 19901, N. C. Vasuni, Director, (302) 678-4765.
3. Environmental Policy and Community Development Services, State Planning Office, Thomas Collins Building, Dover, DE 19901, David S. Hugg III, Principal Planner, (302) 678-4271.
4. National Legislative Representatives
 - a. Senate - Mr. William V. Roth, Jr. (Republican)
Adm. Asst., Mr. Dennis Thomas
Mr. Joseph R. Biden, Jr. (Democrat)
Adm. Asst., Mr. Edward E. Kaufman
 - b. Representatives - Mr. Thomas B. Evans, Jr. (Republican)
Adm. Asst., Mr. William T. Kendall

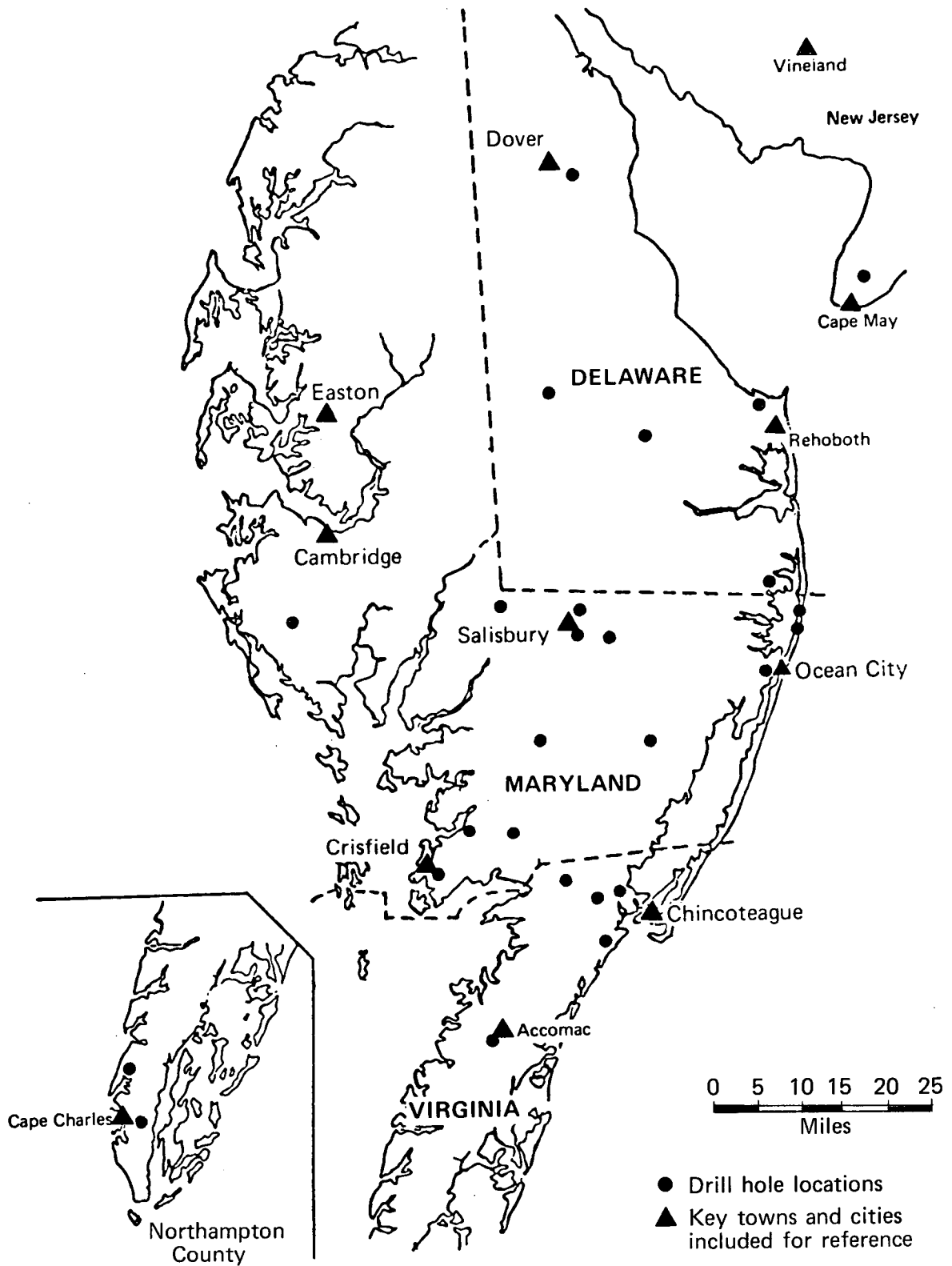
REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) P. M. Brown, J. A. Miller, and F. M. Swain, "Structural and Stratigraphic Framework, and Spatial Distribution of Permeability of the Atlantic Coastal Plain, North Carolina to New York," U.S.G.S. Professional Paper 796, 1972.
- (2) R. N. Benson, "Review of the Subsurface Geology and Resource Potential of Southern Delaware," Delaware Geology Survey, Open File Report, 1976.
- (3) "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Atlantic Coastal Plain," QM-77-129, Oct 1977.
- (4) "Definition of Markets for Geothermal Energy in the Northern Atlantic Coastal Plain," JHU/APL QM-80-075 (GEMS-002), May 1980.
- (5) "Evaluation and Targeting of Geothermal Energy Resource in the Southeastern United States," VPI&SU, Blacksburg, VA (a series of reports).
- (6) L. B. Cobb, L. Radford, and M. Glascock, "Atlantic Coastal Plain Geothermal Test Holes, Delaware," NVO-1558-2, Gruy Federal, Inc., Houston, TX, Mar 1979.
- (7) "Geothermal Policy Project - Quarterly Report," National Conference of State Legislatures, Denver, CO (a series of reports).

- (8) "Geothermal Energy and the Eastern U.S., Technical Information Exchange Meeting," APL/JHU QM-79-261: Chapter XXV - W. Woodruff, "Geothermal Studies, Delaware, and Comments Relating to Application at Town of Lewes."
- (9) Solicitation for Cooperative Agreement (SCA) Number DE-RP07-80ID12132, "Eastern Geothermal Drilling Project," U.S. Department of Energy, Idaho Operations Office, 19 Mar 1980.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-8).



Locations of gradient test holes — Delmarva.

FLORIDA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Florida)

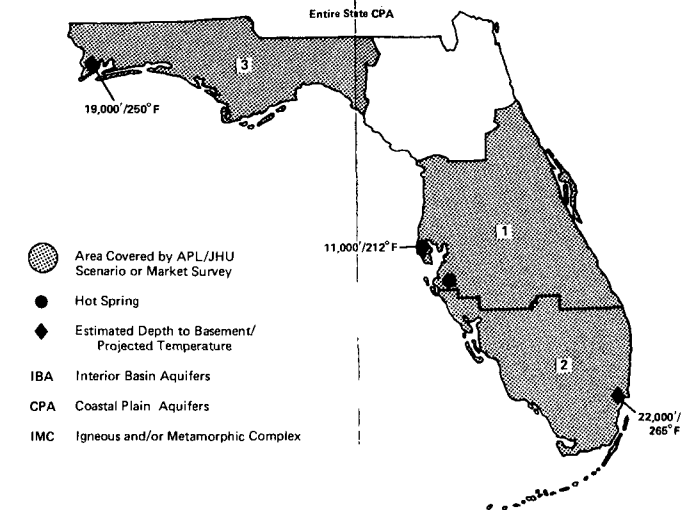
TOTAL POPULATION: 6,789,412 TOTAL AREA: 54,090 SQ. MI.
POPULATION DENSITY: 126 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	(1) Central Florida	(2) Southern Florida	(3) Florida Panhandle
TYPE	Limestone or dolomite	Limestone or dolomite	Clastic sediments
DEPTH	4,000 to 15,000 ft.	15,000 to 25,000 ft.	5,000 to 20,000 ft.
WATER TEMP.	120° to 212°F	212° to 300°F	120° to 300°F
EST. STORED WATER	2.1×10^{14} cu. ft.	4.14×10^{14} cu. ft.	1.5×10^{14} cu. ft.
EST. ENERGY CONTENT	Over 600 $\times 10^{15}$ Btu	Over 2,000 $\times 10^{15}$ Btu	Excess of 500 $\times 10^{15}$ Btu

GEOHERMAL OVERVIEW

Thick sedimentary sequences underlay most of Florida. The appearance that thermal gradients are modest in most of the state is possibly due to sparse data that are taken from shallow wells and that are also influenced by copious quantities of ground water. The caverns found in carbonate sequences in Florida make deep well drilling difficult.



ENERGY RESOURCES - 1973 ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10^{12} Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	2,133 thousand bbl	8.6
Natural Gas Wells	?	33,857 million cu. ft.	37
Crude Oil Wells	147	32,695 thousand bbl	189.6

ENERGY USE - 1976 (10^{12} BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1284.4	30.0	290.8	125.4	241.3
RESIDENTIAL	31.1	21.9	15.7	0.0	118.2
COMMERCIAL	11.6	2.4	32.8	0.0	76.7
INDUSTRIAL	62.3	5.4	94.3	0.5	46.5
PERCENT	74	2	17	7	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	Geothermal energy exploration in southeast Florida, 1975 - Florida State University for Florida Power and Light Company.
PROPOSED STUDIES	City of Gainesville, request for technical assistance, letter to APL, 24 Jan 1980.
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Harmon W. Shields, Executive Director (904) 488-1555
DIVISION OF WATER RIGHTS:	Bureau of Water Resources, Charles M. Sanders, Acting Chief (904) 488-7778
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Department of Pollution Control, Peter P. Baljet, Acting Executive Director (904) 488-1836
OFFICE OF ENERGY POLICY:	State Energy Office, William W. Goode, Jr., Energy Data & Policy Analysis Adm. (904) 488-0855
PLANNING BUREAU:	Division of State Planning, Dept. of Administration, Earl M. Starnes, Director (904) 488-2402
GEOLOGICAL SURVEY:	Bureau of Geology, Dept. of Natural Resources, Charles W. Hendry, Jr., Chief (904) 488-4191

LEGISLATIVE CONTACTS

SENATORS	Lawton M. Chiles, Jr. (D) Richard B. Stone (D)	GOVERNOR	Robert Graham (D)
CONGRESSMEN (DIST.)			
	1 - Earl D. Hutto (D)		9 - Bill Nelson (D)
	2 - Don Fuqua (D)		10 - Louis A. (Skip) Bafalis (R)
	3 - Charles E. Bennett (D)		11 - Dan Mica (D)
	4 - William V. Chappell, Jr. (D)		12 - Clay Shaw (R)
	5 - Bill McCollum (R)		13 - William Lehman (D)
	6 - C. W. Bill Young (R)		14 - Claude D. Pepper (D)
	7 - Sam M. Gibbons (D)		15 - Dante B. Fascell (D)
	8 - Andrew P. Ireland (D)		

State Geothermal Fact Sheet

FLORIDA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 6,789,412 Area: 54,090 sq. mi. Density: 126 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 5,862,000 Area: 42,400 sq. mi. Density: 138 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	226	314	282	6	71
Residential	5	229	15	0	35
Commerical	2	25	32	0	22
Industrial	10	56	91	0.02	14

Trillion Btu

GROSS	1284.4	30.0	290.8	125.4	241.3
Residential	31.1	21.9	15.7	0.0	118.2
Commercial	11.6	2.4	32.8	0.0	76.7
Industrial	62.3	5.4	94.3	0.5	46.5
Percentages	74	2	17	7	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	2,133 thousand bbl	8.6
Natural gas wells	?	33,857 million cu. ft.	37
Crude oil wells	147	32,695 thousand bbl	189.6

IV. GEOLOGY

Florida is entirely underlain by Cretaceous to Recent unconsolidated sands and lithified carbonates. There are two areas in Florida where the sedimentary sequence attains depths great enough to serve as hydrothermal reservoirs: (a) West Florida Panhandle, and (b) Southern Florida. Sediments in these areas thicken in a wedge off the Peninsula Arch. In the Florida Panhandle, clastic sediments increase in depth towards the west from about 5,000 ft. to over 10,000 ft. Good aquifers, such as the Tuscaloosa and Smackover Formations (sands with moderate permeabilities), are found at depth in this region. Locally the geothermal gradient exceeds 1.6°F/100 ft.

The remainder of Florida consists primarily of marine deposits such as limestone and dolomite. These deposits thicken southward from about 4,000 ft. to more than 20,000 ft. Gradients in central and southern Florida are below normal in the near surface and little is known about gradients and temperatures at depth. Estimated temperatures from shallow gradients indicate central Florida may have temperatures of 120°F to over 212°F and southern Florida may have temperatures in excess of 300°F at depth.

V. RESOURCE DATA

1. FLORIDA PANHANDLE

Type aquifer: clastic sediments Area: 13,000 sq. mi.
 Depth: 5,000 to 20,000 ft. Avg. thickness:
 Porosity: Transmissivity:
 Water temperature: 120°F to 300°F
 Recharge rate:
 Estimate of water stored in aquifer: 1.5×10^{14} cu. ft.
 Estimate of energy content in water: In excess of 500×10^{15} Btu[†]

2. CENTRAL FLORIDA

Type aquifer: limestone or dolomite Area: 17,600 sq. mi.
Depth: 4,000 to 15,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: 120°F to 212°F
Recharge rate:
Estimate of water stored in aquifer: 2.1×10^{14} cu. ft.
Estimate of energy content in water: $600^+ \times 10^{15}$ Btu[†]

3. SOUTHERN FLORIDA

Type aquifer: limestone or dolomite Area: 11,800 sq. mi.
Depth: 15,000 to 25,000 ft. Avg. thickness:
Porosity: Transmissivity:
Water temperature: 212°F to 300⁺°F
Recharge rate:
Estimate of water stored in aquifer: 4.14×10^{14} cu. ft.
Estimate of energy content in water: $2,000^+ \times 10^{15}$ Btu[†]

[†]Above 120°F, references to 90°F; 10% porosity assumed, about 4.5 times this amount in rock.

VI. GEOHERMAL ACTIVITY

Request for technical assistance, City of Gainesville; Ltr. to APL/JHU 24 January 1980.

VII. LEGAL ACTIVITIES

None at present.

VIII. CONTACTS

1. Department of Natural Resources, 903 West Tennessee St., Tallahassee, FL 32304, Charles W. Hendry, Jr., Chief, Bureau of Geology, (904) 488-4191.
2. State Energy Office, State of Florida, Department of Administration, Room 108, Collins Building, Tallahassee, FL 32304, William W. Goode, Jr., Energy Data and Policy Analysis Administrator, (904) 488-0855.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) R. S. Barnett, "Basement Structure of Florida and Its Tectonic Implications," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 122-139, 1975.

- (2) G. V. Wilson, "Early Differential Subsidence and Configuration of the Northern Gulf Coast Basin in Southeast Alabama and Northwestern Florida," Transactions of the Gulf Coast Association of Geological Societies, Vol. XXV, pp. 196-206, 1975.
- (3) "Directory of Florida Industries, 1978," Florida Chamber of Commerce, 1977.
- (4) W. J. Toth, "Pre-Scenario Visit to Florida," APL/JHU QM-77-161, 28 Dec 1977.
- (5) "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy and Development, The Eastern Gulf Coast Plain," APL/JHU QM-77-129-3, Feb 1978.
- (6) "Geothermal Resources of the Eastern United States," Gruy Federal, DDE/ET/28373-T2, U.S. Department of Energy, Division of Geothermal Energy.

COMMON REFERENCES

(C-1), (C-2), (C-3), (C-4), (C-5), (C-6), and (C-7).

GEORGIA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Georgia)

TOTAL POPULATION: 4,589,573 TOTAL AREA: 58,073 SQ. MI.
POPULATION DENSITY: 79 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	Tuscaloosa Formation
TYPE	Limestone/sandstone
DEPTH	3000 to 5250 ft.
AVG. THICKNESS	<500 ft.
WATER TEMP.	120°F to 155°F
EST. STORED WATER	(T > 120°F): 2.2 × 10 ¹⁴ cu. ft.
EST. ENERGY CONTENT	

ENERGY RESOURCES - 1973 ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

ENERGY USE - 1976 (10¹² BTU)

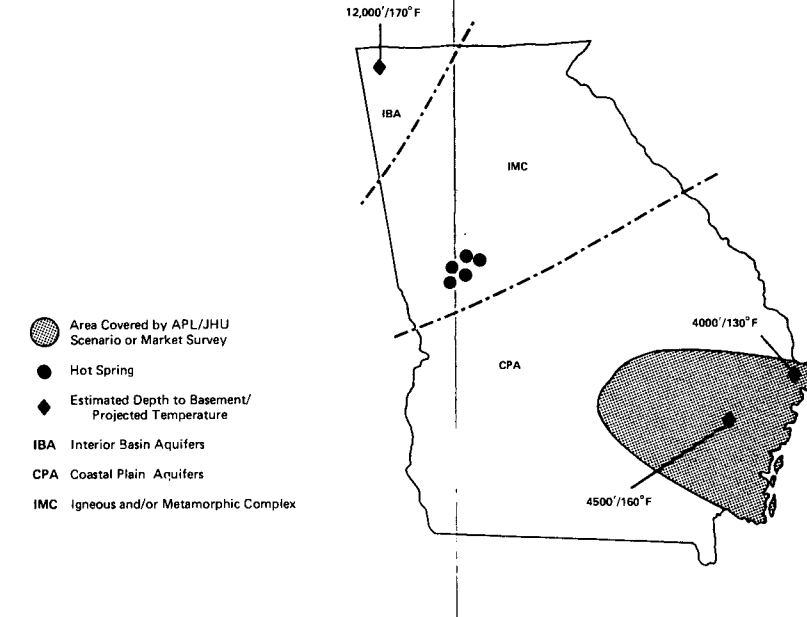
SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	567.7	26.5	338.4	352.1	141.3
RESIDENTIAL	7.0	16.6	90.0	0.6	56.0
COMMERCIAL	20.4	1.8	51.0	0.3	39.2
INDUSTRIAL	41.4	7.9	151.5	10.3	46.1
PERCENT	44	2	26	27	

GEOHERMAL ACTIVITIES

CURRENT USES	Catfish Farm - Warm brackish water from an old oil test well, Savannah
RECENT OR CURRENT STUDIES	1. Temp. log of 2 deep wells by VPI&SU. 2. USGG/WR Regional Aquifer Program.
PROPOSED STUDIES	1. Gradient Well at Kings Bay by VPI&SU. 2. VPI&SU Thermal Gradient Drilling Program in 1981. 3. APL/JHU Market Assessment Program late 1980.
LEGAL ACTIVITIES	NCSL plans DOE/DGE supported workshop with State Legislature to consider geothermal legislation.

GEOHERMAL OVERVIEW

The Atlantic Coastal Plain limestone and unconsolidated sandstones reach thicknesses in excess of 5000 feet to the southeast in Georgia. Hydrothermal resources exist in these areas and may also occur in the northwestern part of the state where deep parts of the Appalachian Basin occur.



PRIMARY CONTACTS

OFFICE OF ENERGY RESOURCES:	Mark Zwecker, Director (404) 656-5176
ENERGY FACILITY SITING:	Chart H. Bonham (404) 656-5176
COMPREHENSIVE LAND USE PLANNING:	Larry Gess (Coordinator) (404) 656-3832
ENVIRONMENTAL IMPACT ASSESSMENT:	Chuck Badger (404) 656-3858
PUBLIC UTILITY REGULATION:	Ben T. Wiggins (Chairman) (404) 656-4512 David O. Benson (Executive Director) (404) 656-5000
(STATE) INDUSTRY COMMITTEE:	Representative GERAL T. HARTON (Chairman) (404) 656-5000; Jack Littleton (Assn. Legislative Counsel)
(STATE) PLANNING AND COMMUNITY AFFAIRS COMMITTEE:	Representative G. D. ADAMS (Chairman) (404) 656-5000; Charles E. Tidwell (Chief Deputy Counsel)
(STATE) PUBLIC UTILITIES COMMITTEE:	Senator M. Parks Brown (Chairman) (404) 656-5000; Charles E. Tidwell
(STATE) CONSUMER AFFAIRS COMMITTEE:	Senator Jack L. Stephens (404) 656-5000 Virlyn Slaton (Department Legal Counsel)
LEGISLATIVE SERVICES:	Frank H. Edwards, Legislative Counsel (404) 656-5000

LEGISLATIVE CONTACTS

SENATORS	Herman E. Talmadge (D) Sam Nunn (D)	GOVERNOR	George Busbee (D)
CONGRESSMEN (Dist.)	1 - Roland Bo Ginn (D) 2 - Charles F. Hatcher (D) 8 - Billy Lee Evans (D)		

State Geothermal Fact Sheet

GEORGIA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 4,589,573 Area: 58,073 sq. mi. Density: 79 per sq. mi.

GEOTHERMAL RESOURCE AREA

Population: 626,892 Area: 15,131 sq. mi. Density: 41 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	104	277	328	15	41
Residential	1	173	87	0.02	16
Commerical	3	19	49	0.01	11
Industrial	7	83	147	0.37	14

Trillion Btu

GROSS	567.7	26.5	338.4	352.1	141.3
Residential	7.0	16.6	90.0	0.6	56.0
Commercial	20.4	1.8	51.0	0.3	39.2
Industrial	41.4	7.9	151.5	10.3	46.1
Percentages	44	2	26	27	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The southeastern half of Georgia is underlain by largely unconsolidated, water-rich sediments of the Atlantic and Gulf Coastal Plain. Crystalline rocks of the Piedmont and Blue Ridge underlie most of the northern half of the state. However a narrow belt of folded Paleozoic sedimentary rocks occurs in the northwest corner. The Cretaceous to Pleistocene sediments of the coastal plain consist of clastic and carbonate rocks that occur in a south-eastward thickening wedge. These sediments attain a depth of over 4000 ft. near the coast in the center of the Southeast Georgia Embayment. This embayment like the Salisbury Embayment in Maryland is a broad structural depression and it lies between two large uplifts. It is bounded by the Peninsula Arch in Florida and the Cape Fear Arch in South Carolina. A region of high geothermal gradients (>2.0°F/100 ft.) coincides with this embayment.

V. RESOURCE DATA

The coastal plains are the most attractive areas in Georgia for the existence of hydrothermal resources. The Cretaceous sands (Tuscaloosa Formation) are the deepest units that may contain extractable water between 120° and 160°F although the shallower limestone units may have higher permeabilities.

Number of resource areas: 1
 Type of resource: moderate temperature hydrothermal
 Type aquifer: limestone Area: 15,000 sq. mi.
 Porosity: 10% (est) Transmissivity: To be determined
 Avg. depth: 3000 to 5250 ft. Avg. thickness:
 Avg. water temperature: 120° to 155°F
 Total dissolved solids: To be determined
 Recharge rate: To be determined
 Estimated water volume in aquifer (T > 120°F): 2.2×10^{14} cu. ft.
 Estimated (extractable) energy content (T > 120°F): >> 20 quads

VI. GEOHERMAL ACTIVITY

Current use: Warm, brackish water from oil test well used to grow catfish - near Savannah.

Recent activity: 1. Temperature logs of two existing deep wells made by VPI&SU.
2. USGS/WR Regional Aquifer Program (continuing program beginning in 1980).

Planned activity: 1. Gradient test well at Kings Bay (U.S. Naval Base) in late 1980 by VPI&SU.
2. VPI&SU 1000 ft. thermal gradient drilling program to begin in 1981.
3. APL/JHU Market Assessment Program to begin in late 1980.

VII. LEGAL ACTIVITIES

1. NCSL plans DOE/DGE workshop to consider geothermal legislation.

VIII. CONTACTS

1. Office of Energy Resources, Rm. 615, 270 Washington Street, S.W., Atlanta, GA, 30334, Mark Zwecker, Director, (404) 656-5176.
2. Energy Facility Siting, State Energy Office, 7 Hunter St., Rm. 145, Atlanta, GA 30334, Chart H. Bonham, Deputy Director, (404) 656-5176.
3. Comprehensive Land Use Planning, Office of Planning and Budget, 270 Washington St., Atlanta, GA 30334, Larry Gess, Coordinator of Divisional Planning, (404) 656-3832.
4. Coastal Zone Management, Larry Gess (see Item 3 above).
5. Environmental Impact Assessments, Office of Planning and Budget, Chuck Badger, Administrator, State Clearinghouse (see Item 3), (404) 656-3858.
6. Public Utility Regulation, Public Services Commission, 244 Washington, S.W., Atlanta, GA 30334, Ben T. Wiggins, Chairman (404) 656-4512; David O. Benson, Executive Director, (404) 656-4539.
7. Legislative Energy Related Committees, State Capitol, Atlanta, GA 30334, (404) 656-5000.
 - a. Industry Committee, House of Representatives
Representative Gerald T. Horton, Chairman;
Jack Littleton, Asst. Legislative Counsel.

- b. State Planning & Community Affairs Committee,
House of Representatives
Representative G. D. Adams, Chairman;
Charles E. Tidwell, Chief Deputy Counsel.
 - c. Public Utilities Committee, State Senate
Senator M. Parks Brown, Chairman;
Charles E. Tidwell, Chief Deputy Legislative
Counsel.
 - d. Consumer Affairs Committee, State Senate,
Senator Jack L. Stephens
Virlyn Slaton, Deputy Legislative Counsel
8. Legislative Services, Office of Legislative Counsel,
316 State Capitol, Atlanta, GA 30334, Frank H. Edwards,
Legislative Counsel, (404) 656-5000.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) J. W. Antoine and V. J. Henery, "Seismic Refraction Study of Shallow Part of Continental Shelf Off the Georgia Coast," A.A.P.G. Bull., Vol. 49, pp. 601-609, 1965.
- (2) C. W. Cooke, "Geology of the Coastal Plain of Georgia," U.S.G.S. Bull. 941, p. 121, 1943.
- (3) "Energy and U.S. Agriculture: 1974 Data Base," Vol. 1, Federal Energy Administration, 1976.
- (4) S. M. Herrick and R. C. Vorhis, "Subsurface Geology of the Georgia Coastal Plain," Georgia Geol. Survey Information Circ. 25, 1963.
- (5) J. C. Maher and E. R. Applin, "Geologic Framework and Petroleum Potential of the Atlantic Coastal Plain and Continental Shelf," U.S.G.S. Professional Paper 659, 1971.
- (6) P. L. Rice, "Energy Conditions in the South," ORNL/TM-5568, Oak Ridge National Laboratory, 1976.
- (7) M. A. Warren, "Artesian Water in Southeastern Georgia," Georgia Geol. Survey, Bull. 49, 1944.
- (8) "Evaluation and Targeting of Geothermal Energy Resources in the Southeastern United States, Progress Report October 1, 1978 - March 30, 1979," VPI-SU-5648-5, VPI&SU, Blacksburg, VA.

- (9) "Evaluation and Targeting of Geothermal Energy Resources in the Southeastern United States, Progress Report July 1, 1979 to September 30, 1979," VPI&SU-78ET-27001-7, VPI&SU, Blacksburg, VA.
- (10) "Visit to Georgia State Survey and U.S.G.S. Resources Office, Atlanta and the Georgia State Energy Office," APL/JHU QM-77-010, 31 Jan 1977.
- (11) "Discussion of Geothermal Energy with the Georgia Power Company," APL/JHU QM-79-128, 8 Jun 1979.
- (12) "Visit to U.S.G.S. Water Resources, Atlanta," APL/JHU QM-79-130, 8 Jun 1979.
- (13) "Visit to Atlanta," APL/JHU QM-80-107, 30 Jun 1980.
- (14) "Geothermal Resources of the Eastern United States," Gruy Federal Inc., Report for the Department of Energy, DOE/ET/288373-T2.

COMMON REFERENCES

(C-1), (C-4), (C-6), and (C-7).

HAWAII
GEOHERMAL DATA SUMMARY SHEET

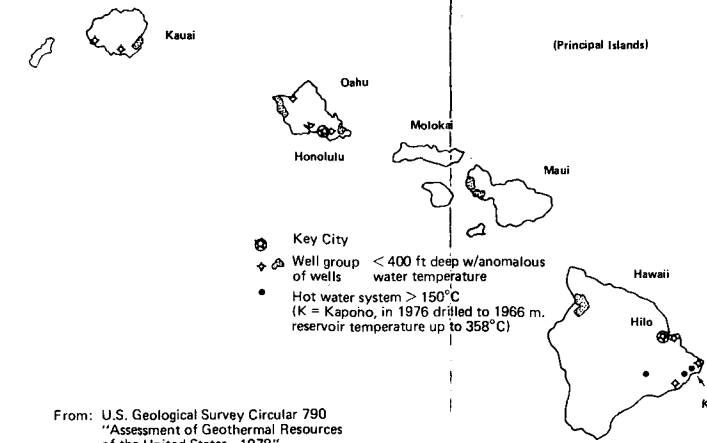
(cf. State Geothermal Fact Sheet, Hawaii)

TOTAL POPULATION: 768,561 TOTAL AREA: 6,425 SQ. MI.
POPULATION DENSITY: 120 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOHERMAL OVERVIEW



ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	197.3	3.5	0	0	18.2
RESIDENTIAL	1.0	1.4	0	0	5.7
COMMERCIAL	1.1	0.2	0	0	3.8
INDUSTRIAL	11.6	2.0	0	0	8.7
PERCENT	98	2	0	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:
DIVISION OF WATER RIGHTS:
DEPARTMENT OF ENVIRONMENTAL PROTECTION:
OFFICE OF ENERGY POLICY:
PLANNING BUREAU:
GEOLOGICAL SURVEY:

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

LEGISLATIVE CONTACTS

SENATORS Daniel Inouye (D) Spark M. Matsunaga (D)	GOVERNOR George R. Ariyoshi (D)
CONGRESSMEN (DIST.) 1 - Cecil Haftel (D) 2 - Daniel K. Akaka (D)	

State Geothermal Fact Sheet

HAWAII

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 768,561 Area: 6,425 sq. mi. Density: 120 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

I-1H

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	34	37	0	0	5
Residential	0	14	0	0	2
Commerical	0	16	0	0	1
Industrial	2	20	0	0	3

Trillion Btu

GROSS	197.3	3.5	0	0	18.2
Residential	1.0	1.4	0	0	5.7
Commercial	1.1	0.2	0	0	3.8
Industrial	11.6	2.0	0	0	8.7
Percentages	98	2	0	0	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The State of Hawaii occupies a series of Tertiary to Recent volcanic islands in the South Pacific. These volcanic centers are aligned and become younger from northwest to southeast. Hydro-thermal convective systems containing water above 150°C are known only on the main island of Hawaii.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

No data.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

IDAHO
GEOTHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, Idaho)

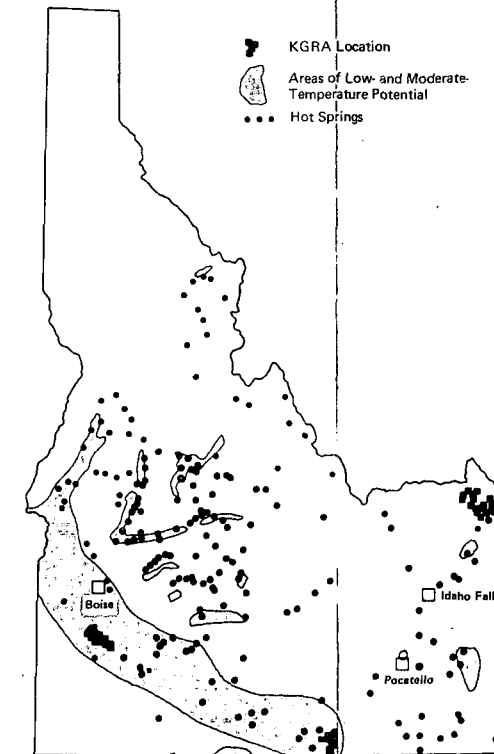
TOTAL POPULATION: 713,008 TOTAL AREA: 83,557 SQ. MI.
POPULATION DENSITY: 8.5 PEOPLE/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

Large volumes of young volcanic and intrusive rocks make Idaho an important region for geothermal exploration and development. Nine KGRAs have been designated and several moderate temperature reservoirs have been confirmed.



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	114.5	4.8	60.4	8.0	44.0
RESIDENTIAL	12.9	3.0	14.5	1.3	12.9
COMMERCIAL	10.6	0.3	12.6	0.7	12.2
INDUSTRIAL	16.3	1.4	28.9	6.0	18.9
PERCENT	61	3	32	4	

PRIMARY CONTACTS

STATE GEOTHERMAL TEAM
OPERATIONS RESEARCH: Idaho Office of Energy,
RESOURCE ASSESSMENT: Idaho Department of Water Resources
IDAHO OFFICE OF ENERGY: Kirk Hall, Director
DEPARTMENT OF WATER RESOURCES: C. Stephen Allred, Director
DEPARTMENT OF LANDS: Gordon Trombley, Director
BUREAU OF MINERALS: Arthur Zierold, Chief

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

LEGISLATIVE CONTACTS

SENATORS Frank Church (D) James A. McClure (R)	GOVERNOR John V. Evans (D)
CONGRESSMAN (DIST.) 1 - Larry Craig (D) 2 - George Hansen (R)	

State Geothermal Fact Sheet

IDAHO

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 713,008 Area: 83,557 sq. mi. Density: 8.5 per sq. mi.

GEOTHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1970) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	21	50	59	0.5	13
Residential	2	32	14	0	4
Commerical	2	4	12	0	4
Industrial	3	14	28	0	6

Trillion Btu

GROSS	114.5	4.8	60.4	8.0	44.0
Residential	12.9	3.0	14.5	1.3	12.9
Commercial	10.6	0.3	12.6	0.7	12.2
Industrial	16.3	1.4	28.9	6.0	18.9
Percentages	61	3	32	4	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

Five physiographic provinces occur in Idaho: the Snake River Plain, the Northern Rocky Mountains, the Basin and Range, the Middle Rocky Mountains, and the Columbia Plateau. A number of shallow, moderate and low temperature resources exists and are associated with faulting along the Snake River Plain and the Idaho Batholith of the Northern Rockies. The deeper, relatively un-drilled Snake River Plains downwarp may contain high temperature resources that are effectively hidden from surface exploration by the high flow rate cold water of the Snake Plains aquifer. Industry is focusing on the high temperature fluids from the Snake River Plain and from a portion of the Basin and range in south-eastern Idaho.

V. RESOURCE DATA

No high temperature resources have been confirmed but fourteen areas are considered to have good potential. Three low and moderate resources have been confirmed and many prospects exist.

VI. GEOHERMAL ACTIVITY

Geothermal leasing totals 373,000 acres, all but about 60,000 on federal lands.

Two PONs were awarded (1978) in Idaho: one for space heating commercial buildings and homes in Boise, one in Rexburg for municipal space heating and industrial food processing.

One PRDA supported study was conducted in 1979 to examine the use of hydrothermal energy in livestock meat and feed production and in facilities for potato processing and methane gas production.

A 5 MW binary geothermal electric plant is scheduled to be on line in 1980 as the culmination of the DOE sponsored Raft River power production project. In addition, experiments in agriculture, aquaculture, fluidized bed drying, air conditioning, and heat exchanger materials are being performed.

Various development plans have been prepared for 32 sites or areas as part of the DOE geothermal operations research project.

VII. LEGAL ACTIVITIES

In 1972 the Idaho Geothermal Resources Act was passed. This act gave regulating authority for all geothermal development to the Department of Water Resources.

In 1979 two bills were enacted that authorize cities and counties to operate geothermal systems. Cities are also authorized to issue revenue bonds to finance construction costs of such systems.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research, Idaho Office of Energy;
 - b. Resource Assessment, Idaho Department of Water Resources;
 - c. Idaho Office of Energy, Kirk Hall, Director.
2. Department of Water Resources, C. Stephen Allred, Director.
3. Department of Lands, Gordon Trombley, Director.
4. Bureau of Minerals, Arthur Zierold, Chief.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Idaho Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Apr 1979.
- (2) David V. McClain, "Geothermal Energy in Idaho: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Jul 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

ILLINOIS
GEOHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, Illinois)

TOTAL POPULATION: 11,109,935 TOTAL AREA: 55,748 SQ. MI.
POPULATION DENSITY: 199 PERSONS/SQ. MI.

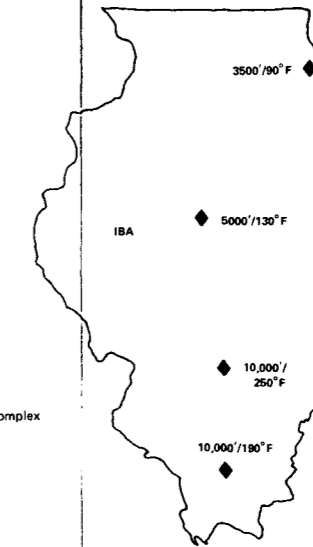
ENERGY RESOURCES -- 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	55	61,575 thousand tons	1,402.7
Natural Gas (liq.)	-	8,650 thousand bbl	34.7
Natural Gas Wells	36	1,638 million cu. ft.	1.8
Crude Oil Wells	24,309	30,669 thousand bbl	177.9

GEOHERMAL OVERVIEW

A deep sedimentary basin in the southern portion of the state has potential as a hydrothermal resource and for early hot dry rock development. Water is known to flow through the deep sandstone and carbonate aquifers and upward along fault zones.

- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex



ENERGY USE -- 1975 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1236.3	77.5	1113.6	880.5	291.1
RESIDENTIAL	94.1	38.8	493.9	8.3	89.4
COMMERCIAL	123.5	4.3	222.6	4.5	92.4
INDUSTRIAL	47.2	33.6	367.1	84.9	107.1
PERCENT	37	2	34	27	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department of Conservation, Anthony T. Dean, Director (217) 782-6302
DIVISION OF WATER RIGHTS:	Water Survey, Dept. of Registration & Education, William C. Ackermann, Chief (217) 333-2210
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Protection Agency, William L. Blaser, Director (217) 782-3397
OFFICE OF ENERGY POLICY:	Division of Energy, Dept. of Business & Economic Dev., Sidney M. Marder, Director (217) 782-5784
PLANNING BUREAU:	Energy Resources Commission, Hon. Adeline J. Geo-Karis, Chairman (217) 782-8097
GEOLOGICAL SURVEY:	Jack A. Simon, Chief (217) 344-1481

LEGISLATIVE CONTACTS

SENATORS	Charles H. Percy (R) Adlai E. Stevenson (D)	GOVERNOR	James R. Thompson (R)
CONGRESSMEN (DIST.)			
	1 - Harold Washington (D)		13 - Robert McClory (R)
	2 - Gus Savage (D)		14 - John N. Erlenborn (R)
	3 - Martin A. Russo (D)		15 - Tom J. Corcoran (R)
	4 - Edward J. Derwinski (R)		16 - Lynn M. Martin (R)
	5 - John G. Fary (D)		17 - George M. O'Brien (R)
	6 - Henry J. Hyde (R)		18 - Robert H. Michel (R)
	7 - Cardiss Collins (D)		19 - Tom RAILSBACK (R)
	8 - Dan Rostenkowski (D)		20 - Paul Findley (R)
	9 - Sidney R. Yates (D)		21 - Edward R. Madigan (R)
	10 - Abner J. Mikva (D)		22 - Daniel B. Crane (R)
	11 - Frank Annunzio (D)		23 - Charles M. Price (D)
	12 - Philip M. Crane (R)		24 - Paul Simon (D)

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. Illinois State Geologic Survey Study. 2. DOE/DGE Gruy Federal Study. 3. IASL performing initial planning studies for geothermal exploration.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	55	61,575 thousand tons	1,402.7
Natural gas (liq.)	-	8,650 thousand bbl	34.7
Natural gas wells	36	1,638 million cu. ft.	1.8
Crude oil wells	24,309	30,669 thousand bbl	177.9

IV. GEOLOGY

Illinois is underlain by Paleozoic sedimentary rocks that were deposited on the Precambrian basement. The dominant geologic feature is the Illinois Basin centered in the southeastern part of the state, where up to 14,000 ft. of sediments have been deposited. This basin is separated from the Appalachian Basin to the east by a basement high (the Cincinnati Arch) and to the north from the Michigan Basin by the Kankakee Arch. The Cenozoic Gulf Coastal Plain sediments overlie the Paleozoic sedimentary rocks to the south.

Surficial deposits of Pleistocene glacial till overlie the sedimentary rocks throughout most of the state and provide an ample fresh water supply. Water also occurs in the older sedimentary rocks of the Paleozoic Illinois Basin; however, it becomes more saline, hotter, and harder to extract with depth. In the deeper parts of the basin, the rocks become more indurated and secondary permeability becomes more important in the circulation of water. Along the southern border of the Illinois Basin lies the Rough Creek-Kentucky Fault zone. This major fault zone appears to have had a significant control on the deposition and deformation of the Paleozoic sediments. Water appears to circulate along this fault zone between permeable horizons.

V. RESOURCE DATA

Hydrologic data are available for much of the deep aquifer systems in the Illinois Basin. The Knox Formation, which is locally highly permeable due to solutioning (caverns), attains depths of about 10,000 ft. The Mt. Simon Formation and other basal sandstone do exhibit significant hydraulic heads in the deeper parts of the basin. This water is known to be hot since many oil and gas wells in this area have indicated gradients of greater than 1.8°F/100 ft. Temperatures in excess of 200°F can therefore be expected where these high gradients coincide with the deeper parts of the basin.

VI. GEOHERMAL ACTIVITY

- Recent studies:
1. Illinois State Geologic Survey Study.
 2. DOE/DGE Gruy Federal Study (C-16).
 3. LASL performing initial planning studies for geothermal exploration.

VII. LEGAL ACTIVITIES

None at present.

VIII. CONTACTS

1. Department of Conservation, Anthony T. Dean, Director, (217) 782-6302.
2. Water Survey, Dept. of Registration & Education, William C. Ackermann, Chief, (217) 333-2210.
3. Environmental Protection Agency, William L. Blaser, Director, (217) 782-3397.
4. Division of Energy, Dept. of Business & Economic Development, Sidney M. Marder Director, (217) 782-5784.
5. Energy Resources Commission, Hon. Adeline J. Geo-Karis, Chairman, (217) 782-8097.
6. Jack A. Simon, Chief, (217) 344-1481.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-16).

INDIANA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Indiana)

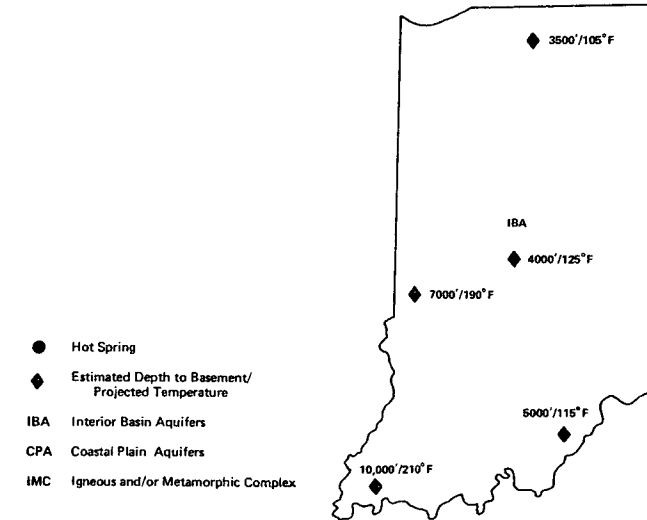
TOTAL POPULATION: 5,193,669 TOTAL AREA: 36,097 SQ. MI.
POPULATION DENSITY: 144 PERSONS/SQ. MI.

ENERGY RESOURCES -- 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	39	25,252 thousand tons	585.8
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	106	276 million cu. ft.	0.3
Crude Oil Wells	4,323	5,312 thousand bbl	30.8

GEOHERMAL OVERVIEW

A deep sedimentary basin in the southwestern portion of the state has potential as a hydrothermal resource and for early hot dry rock development.



ENERGY USE -- 1976 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	649.0	47.3	497.2	1103.8	162.2
RESIDENTIAL	78.8	28.3	168.1	10.2	54.6
COMMERCIAL	62.3	3.2	72.8	5.5	32.5
INDUSTRIAL	82.7	15.6	235.2	91.9	75.0
PERCENT	28	2	22	48	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	John R. Lloyd, Director (317) 633-6344
DIVISION OF WATER RIGHTS:	Robert F. Jackson, Director (317) 633-5267
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Coordination Commission, Andrew C. Offutt, Chairman (317) 633-5490
OFFICE OF ENERGY POLICY:	Indiana Energy Office, Thomas F. Kibler, Director (317) 633-6753
PLANNING BUREAU:	State Planning Services, Eugene Waterstraat, Asst. Director State Planning (317) 633-4346
GEOLOGICAL SURVEY:	Dr. John B. Patton, State Geologist (812) 337-2862

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. DOE/DGE - Gruy Federal Study. 2. LASL performing initial plans for exploration.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

LEGISLATIVE CONTACTS

SENATORS	Birch Bayh (D) Richard G. Lugar (R)	GOVERNOR	Robert Orr (R)
CONGRESSMEN (DIST.)			
1 - Adam Benjamin, Jr. (D)		7 - John T. Myers (R)	
2 - Floyd J. Fithian (D)		8 - H. Joel Deckard (R)	
3 - John P. Hiler (R)		9 - Lee H. Hamilton (D)	
4 - Daniel R. Coats (R)		10 - Philip R. Sharp (D)	
5 - Elwood H. Hillis (R)		11 - Andrew Jacobs, Jr. (D)	
6 - David W. Evans (D)			

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	39	25,252 thousand tons	585.8
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	106	276 million cu. ft.	0.3
Crude oil wells	4,323	5,312 thousand bbl	30.8

IV. GEOLOGY

Indiana is underlain by Paleozoic sedimentary rocks that were deposited on the Precambrian basement. The dominant geologic feature is the Illinois Basin, centered in the southwestern tip of the state where up to 12,000 ft. of sediments have been deposited. This basin is separated from the Appalachian Basin to the east by a basement high (the Cincinnati Arch) and to the north from the Michigan Basin by the Kankakee Arch. The Cenozoic Gulf Coastal Plain sediments overlie the Paleozoic sedimentary rocks to the south.

Surficial deposits of Pleistocene glacial till overlie the sedimentary rocks throughout most of the state and provide an ample fresh water supply. Water also occurs in the older sedimentary rocks of the Paleozoic Illinois Basin; however, it becomes more saline, hotter, and harder to extract with depth. In the deeper parts of the basin, the rocks become more indurated and secondary permeability becomes more important in the circulation of water. The Rough Creek-Kentucky fault zone lies along the southern border of the Illinois Basin. This major fault zone appears to have had a significant control on the deposition and deformation of the Paleozoic sediments. Water appears to circulate along this fault zone between permeable horizons.

V. RESOURCE DATA

Most well temperature data from Indiana come from oil and gas exploration in and around the Illinois Basin. The thicker sequences of sediments occur in the southwestern parts of the state. At Bloomington, the sedimentary pile is about 5000 ft. thick and temperatures at its base can be expected to be at least 130°F based on a gradient of 1.6°F/100 ft. Near Evansville, where the sequence is about 10,000 ft. thick and gradients are at least 1.6°F/100 ft., temperatures on the order of 210°F may occur.

VI. GEOHERMAL ACTIVITY

- Recent studies:
1. DOE/DGE - Gruy Federal Study (C-16).
 2. LASL performing initial plans for exploration.

VII. LEGAL ACTIVITIES

None at present.

VIII. CONTACTS

1. Department of Natural Resources, John R. Lloyd, Director, (317) 633-6344.
2. Division of Water Rights, Robert F. Jackson, Director, (317) 633-5267.
3. Environmental Coordination Commission, Andrew C. Offutt, Chairman, (317) 633-5490.
4. Indiana Energy Office, Thomas F. Kibler, Director, (317) 633-6753.
5. State Planning Services, Eugene Waterstraat, Asst. Director State Planning, (317) 633-4346.
6. State Geologist, Dr. John B. Patton, (812) 337-2862.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-16).

IOWA
GEOTHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, Iowa)

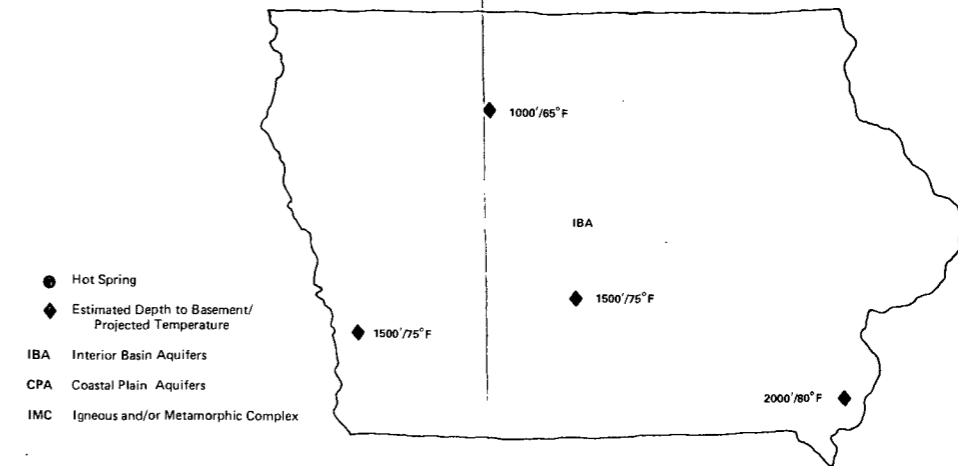
TOTAL POPULATION: 2,824,376 TOTAL AREA: 55,941 SQ. MI.
POPULATION DENSITY: 51 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	12	601 thousand tons	11.7
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

The entire state is underlain by a thin sedimentary cover on a crystalline basement. Thermal gradients are modest; therefore, there is little potential for geothermal energy development at present.



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	299.4	46.7	362.7	144.1	68.4
RESIDENTIAL	24.8	28.9	97.4	1.5	28.1
COMMERCIAL	12.1	3.2	69.1	0.8	17.6
INDUSTRIAL	32.7	14.5	131.2	27.1	22.7
PERCENT	35	5	43	17	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	
OFFICE OF ENERGY POLICY:	Energy Policy Council, Maurice Van Nostrand, Chairman (515) 281-3428
PLANNING BUREAU:	Office of Planning and Programming, Robert F. Tysop, Director (515) 281-5888
GEOLOGICAL SURVEY:	Dr. Stanley G. Grant, State Geologist (319) 338-1173
Energy Committee:	State Senate: Sen. James Gallagher, Chairman (515) 281-3048
	House of Rep: Rep. Mary O'Halloran, Chairman (515) 281-3048

LEGISLATIVE CONTACTS

SENATORS	John C. Culver (D) Roger W. Jepsen (R)	GOVERNOR	Robert D. Ray (R)
CONGRESSMEN (DIST.)			
	1 - James A. S. Leach (R)		
	2 - Tom Tauke (R)		
	3 - Cooper Evans (R)		
	4 - Neal Smith (D)		
	5 - Thomas R. Harkin (D)		
	6 - Berkley W. Bedell (D)		

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	DOE/DGE Report, "Geothermal Resources of the Eastern U.S."
PROPOSED STUDIES	None
LEGAL ACTIVITIES	To be determined.

State Geothermal Fact Sheet

IOWA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 2,824,376 Area: 55,941 sq. mi. Density: 51 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	55	488	351	7	20
Residential	4	302	94	0.1	8
Commerical	2	34	67	0.03	5
Industrial	6	152	127	1.1	7

Trillion Btu

GROSS	299.4	46.7	362.7	144.1	68.4
Residential	24.8	28.9	97.4	1.5	28.1
Commercial	12.1	3.2	69.1	0.8	17.6
Industrial	32.7	14.5	131.2	27.1	22.7

Percentages 35 5 43 17

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	12	601 thousand tons	11.7
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

DOE/DGE Analysis of Eastern U.S. See (C-16).

VI. GEOHERMAL ACTIVITY

Recent studies: DOE/DGE Report, "Geothermal Resources of the Eastern U.S."

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Energy Policy Council, Maurice Van Nostrand, Chairman, (515) 281-3428.
2. Office of Planning and Programming, Robert F. Tyson, Director, (515) 281-5888.
3. State Geologist, Dr. Stanely G. Grant, (319) 338-1173.
4. State Legislature Representatives:
 - a. State Senate: Sen. James Gallagher, Chairman, (515) 281-3048.
 - b. House of Rep: Rep. Mary O'Halloran, Chairman, (515) 281-3048.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-16).

**KANSAS
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Kansas)

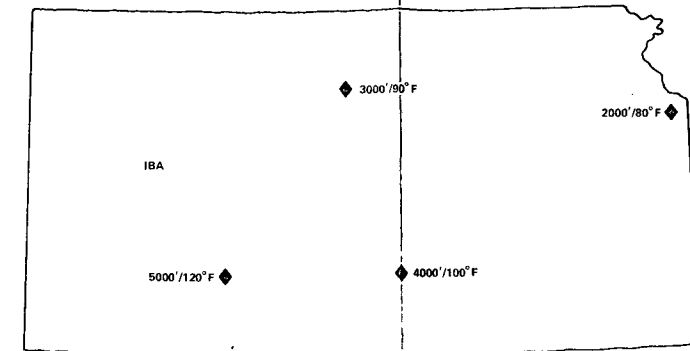
TOTAL POPULATION: 2,246,578 TOTAL AREA: 81,787 SQ. MI.
POPULATION DENSITY: 27.5 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	4	1,085 thousand tons	26.4
Natural Gas (liq.)	-	30,456 thousand bbl	122.8
Natural Gas Wells	8,765	893,118 million cu. ft.	976.2
Crude Oil Wells	41,520	66,227 thousand bbl	384.1

GEOTHERMAL OVERVIEW

A sedimentary basin in the western portion of the state is of modest depth and has normal temperature gradients.



- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	280.7	31.5	518.0	68.4	62.3
RESIDENTIAL	3.2	19.4	101.5	0	22.2
COMMERCIAL	9.4	2.1	53.4	0	21.0
INDUSTRIAL	38.2	9.4	159.8	2.8	19.1
PERCENT	31	4	58	8	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	Water Resources Board, Keith S. Krause, Executive Director (913) 296-3185
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Division of Environmental Health, Dept. of Health, Melville Gray, Director (913) 296-3821
OFFICE OF ENERGY POLICY:	Kansas Energy Office, Lamar "Budd" Weaver, (913) 296-2496
PLANNING BUREAU:	Planning Division, Dept. of Economic Development, Dennis C. McCartney, Director (913) 296-3485
GEOLOGICAL SURVEY:	Dr. William W. Hambleton, Director (913) 864-3965

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	State-coupled resource assessment program.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

LEGISLATIVE CONTACTS

SENATORS	Robert J. Dole (R) Nancy Landon Kassebaum (R)	GOVERNOR	John W. Carlin (D)
CONGRESSMEN (DIST.)			
1 - Pat Roberts (R)			
2 - Jim Jeffries (R)			
3 - Larry Winn, Jr. (R)			
4 - Daniel R. Glickman (D)			
5 - Robert Whittaker (R)			

State Geothermal Fact Sheet

KANSAS

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 2,246,578 Area: 81,787 sq. mi. Density: 27.5 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	51	330	502	3	19
Residential	1	203	98	0	7
Commerical	2	23	52	0	6
Industrial	7	98	155	0.1	6

Trillion Btu

GROSS	280.7	31.5	518.0	68.4	62.3
Residential	3.2	19.4	101.5	0	22.2
Commercial	9.4	2.1	53.4	0	21.0
Industrial	38.2	9.4	159.8	2.8	19.1

Percentages 31 4 58 8

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	4	1,085 thousand tons	26.4
Natural gas (liq.)	-	30,456 thousand bbl	122.8
Natural gas wells	8,765	893,118 million cu. ft.	976.2
Crude oil wells	41,520	66,227 thousand bbl	384.1

IV. GEOLOGY

Kansas has three geologic forms of interest. The Nemaha uplift (anticline) is the end of the midcontinent rift. This faulted Precambrian intrusive mass enters the state in the northeast corner and progresses southwest, disappearing just before it reaches the Oklahoma border about one-third of the way, going west. In the northwestern half of the state, the Cambridge Arch from Nebraska enters and becomes the Central Kansas uplift, followed by the Pratt anticline, which disappears before the border of Oklahoma is reached. The direction of this second system is opposite to the Nemaha, i.e., southeastern. In the western part of the state there is a plateau (the Hugoton Embayment) before the basement drops into the Anadarko Basin that extends into Colorado. In the southwestern region of the state, the basement rock plunges to the Anadarko Basin which continues to Oklahoma (in Kansas this is still termed the Hugoton Embayment). The depth of sedimentary rocks here reaches 15,000 ft. The Cambridge Arch and the Nemaha anticline are marked and are clearly evident.

V. RESOURCE DATA

Being determined.

VI. GEOHERMAL ACTIVITY

1. Geothermal workshop at Kansas Geologic Survey, 17 Dec 1976 (1).
2. DOE/DGE Supported Resource Assessment Program (C-6).

VII. LEGAL ACTIVITIES

None at present.

VIII. CONTACTS

1. Kansas Geological Survey, 1900 Ave. A, Campus West, Univ. of Kansas, Lawrence, KA 66044, Dr. Wm. W. Hambleton, Director; Mr. Owen Spitz, Oil and Gas Geologist; Mr. Donald Steeples, Geophysicist, (913) 864-3965.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Visit to Kansas Geological Survey, Lawrence, Kansas," APL/JHU CPE-77-016, 26 Jan 1977.
- (2) "Technical Information Interchange Meeting Minutes," APL/JHU QM-79-261, Dec 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**KENTUCKY
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Kentucky)

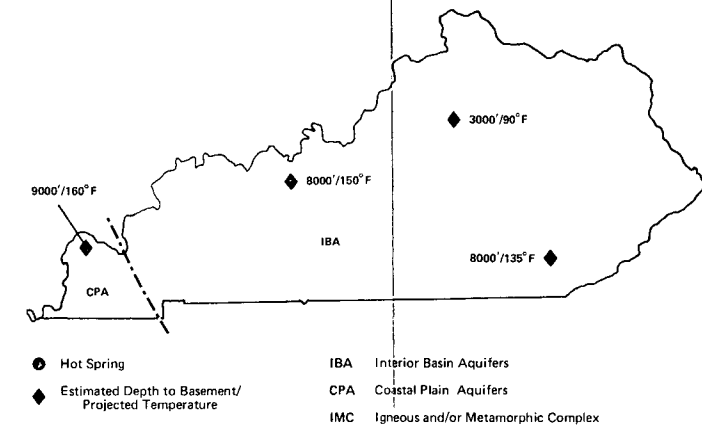
TOTAL POPULATION: 3,218,706 TOTAL AREA: 39,650 SQ. MI.
POPULATION DENSITY: 81 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	3,311	147,606 thousand tons	3,662.5
Natural Gas (liq.)	-	2,735 thousand bbl	11.0
Natural Gas Wells	7,649	60,902 million cu. ft.	66.6
Crude Oil Wells	14,046	6,581 thousand bbl	38.2

GEOHERMAL OVERVIEW

A thick sedimentary sequence underlies much of the state. Potential exists for normal geothermal gradients and hydrothermal resource.



ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	315.7	21.2	221.5	623.8	159.8
RESIDENTIAL	13.1	15.9	81.7	3.1	34.5
COMMERCIAL	13.1	1.8	39.7	1.7	34.8
INDUSTRIAL	33.6	3.4	75.6	34.3	90.5
PERCENT	27	2	19	53	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. DOE/DGE — Gruy Federal Study. 2. ORAU Program.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	To be determined.

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department for Natural Resources and Environmental Protection, Eugene F. Mooney, Secretary (502) 564-3350
DIVISION OF WATER RIGHTS:	Jewell Graham, Director (502) 564-3350
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Thomas O. Harris, Secretary (502) 564-3350
OFFICE OF ENERGY POLICY:	Department of Energy, David D. Drake, Secretary (502) 564-7070
PLANNING BUREAU:	Department for Natural Resources and Environmental Protection, Billy S. Lewis, Commissioner, Bureau of Land Resources (502) 564-3350
GEOLOGICAL SURVEY:	Dr. Donald C. Haney, Director and State Geologist (606) 258-5863

LEGISLATIVE CONTACTS

SENATORS	Walter D. Huddleston (D) Wendell E. Ford (D)	GOVERNOR	John Y. Brown, Jr.
CONGRESSMEN (DIST.)			
	1 - Carroll Hubbard, Jr. (D)		
	2 - William H. Natcher (D)		
	3 - Romano L. Mazzoli (D)		
	4 - Gene Snyder (R)		
	5 - Harold Rogers (R)		
	6 - Larry Hopkins (R)		
	7 - Carl D. Perkins (D)		

State Geothermal Fact Sheet

KENTUCKY

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 3,218,706 Area: 39,650 sq. mi. Density: 81 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	58	221	215	28	47
Residential	2	166	79	0.1	10
Commerical	2	18	39	1	10
Industrial	5	36	73		27

Trillion Btu

GROSS	315.7	21.2	221.5	623.8	159.8
Residential	13.1	15.9	81.7	3.1	34.5
Commercial	13.1	1.8	39.7	1.7	34.8
Industrial	33.6	3.4	75.6	34.3	90.5
Percentages	27	2	19	53	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1977) (Kentucky Dep't. of Energy)

Type	Number	Units	Trillion Btu
Coal mines	3,311	147,646 thousand tons	3,662.5
Natural gas (liq.)	-	2,735 thousand bbl	11.0
Natural gas wells	7,649	60,902 million cu. ft.	66.6
Crude oil wells	14,046	6,581 thousand bbl	38.2

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

ORAU Program

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department for Natural Resources and Environmental Protection, Eugene F. Mooney, Secretary, (502) 564-3350.
2. Department of Energy, David D. Drake, Secretary, (502) 564-7070.
3. Geological Survey, Dr. Donald C. Haney, Director and State Geologist, (606) 258-5863.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) ORAU Progress Reports.

COMMON REFERENCES

(C-4), (C-7), and (C-16).

LOUISIANA
GEOTHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, Louisiana)

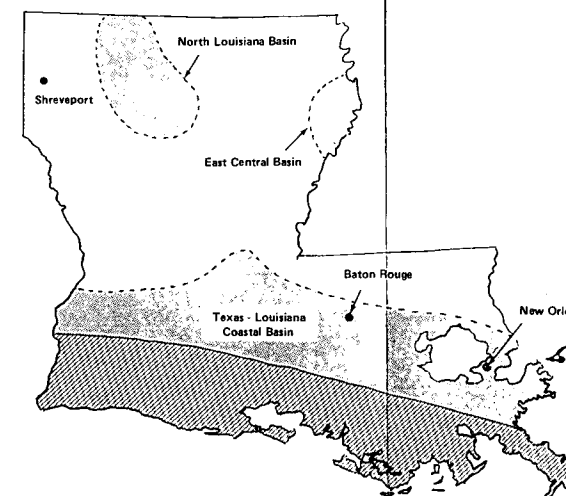
TOTAL POPULATION: 3,640,490 TOTAL AREA: 44,930 SQ. MI.
POPULATION DENSITY: 81 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	150,607 thousand bbl	607.3
Natural Gas Wells	10,551	8,242,423 million cu. ft.	9,009.0
Crude Oil Wells	27,869	831,524 thousand bbl	4,822.8

GEOTHERMAL OVERVIEW

Louisiana lies within the Mississippi Embayment of the Gulf Coastal Plain and is underlain by a southward thickening wedge of Paleozoic, Mesozoic, and Tertiary sediments overlying the Precambrian basement. Three salt dome basins separated by uplifts occur beneath the state. The Jurassic, Smackover, and Norphlet formations and younger Tertiary sediments overlie the salt in these basins and commonly contain geopressed reservoirs of oil, gas, and brine.



Salt Dome Basins
(from "Salt Domes - Gulf Region, United States and Mexico" by Michel T. Halbouty)
Warm aquifers overlying geopressed zones
(from "Geothermal Resources of the Eastern United States", Gruy Federal, Inc. Report, DOE/NVO/a558-7, Dec. 1979)

ENERGY USE - 1976 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	580.5	27.7	1863.4	0	136.3
RESIDENTIAL	13.2	8.9	99.3	0	42.8
COMMERCIAL	8.2	1.0	52.3	0	35.0
INDUSTRIAL	78.6	17.4	1281.2	0	58.5
PERCENT	24	1	75	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	William C. Huls, Secretary, P.O. Box 44156, Baton Rouge, Louisiana 70804, (504) 342-4500
GEOLOGICAL SURVEY:	Charles Groat, Director, University Station, P.O. Box G, Baton Rouge, LA 70804
STATE GEOLOGIST:	Leo W. Hough, (see Geological Survey, above)
ENVIRONMENTAL AFFAIRS, WATER RESOURCES:	Water Resources Section, Office of Public Works, Department of Transportation and Development, Darrel Primeaux, Chief, State Capitol, Baton Rouge, LA 70804, (504) 342-7567

LEGISLATIVE CONTACTS

SENATORS	Russell B. Long (D) J. Bennett Johnston, Jr. (D)	GOVERNOR	Edwin W. Edwards (D)
CONGRESSMEN (DIST.)			
	1 - Robert L. Livingston (R)		
	2 - Lindy (Mrs. Hale) Boggs (D)		
	3 - David C. Treen (R)		
	4 - Buddy Roemer		
	5 - Jerry Huckaby (D)		
	6 - W. Henson Moore (R)		
	7 - John B. Breaux (D)		
	8 - Gillis W. Long (D)		

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	150,607 thousand bbl	607.3
Natural gas wells	10,551	8,242,423 million cu. ft.	9,009.0
Crude oil wells	27,869	831,524 thousand bbl	4,822.8

IV. GEOLOGY

Louisiana lies within the Mississippi Embayment of the Gulf Coastal Plain and is underlain by a southward thickening wedge of Paleozoic, Mesozoic, and Tertiary sediments overlying the Precambrian basement. The state lies on the northern edge of the main Gulf geosyncline and contains many gravity faults. Thick sequences of Jurassic salt deposits (Louann) overlie the older rocks and serve as the source rocks for salt diapirs.

Three salt dome basins occur beneath the state, separated by uplifts. Overlying the salt in these basins, the Jurassic, Smackover, and Norphlet formations, and younger Tertiary sediments commonly contain geopressured reservoirs of oil, gas, and brine.

The shallower, less cemented formations contain near normal gradient hydrothermal resources throughout the state. These widespread lower temperature resources, together with the more local but higher temperature geopressured reservoirs, can provide a substantial energy source for the future.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, P.O. Box 44156, Baton Rouge, LA 70804, William C. Huls, Secretary, (504) 342-4500.

2. Geological Survey, University Station, P.O. Box G, Baton Rouge, LA 70804, Charles Groat, Director.
3. State Geologist, University Station, P.O. Box G, Baton Rouge, LA 70804, Leo W. Hough.
4. Environmental Affairs, Water Resources Section, Office of Public Works, Department of Transportation and Development, State Capitol, Baton Rouge, LA 70804, Darrel Primeaux, Chief, (504) 342-7567.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

MAINE
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Maine)

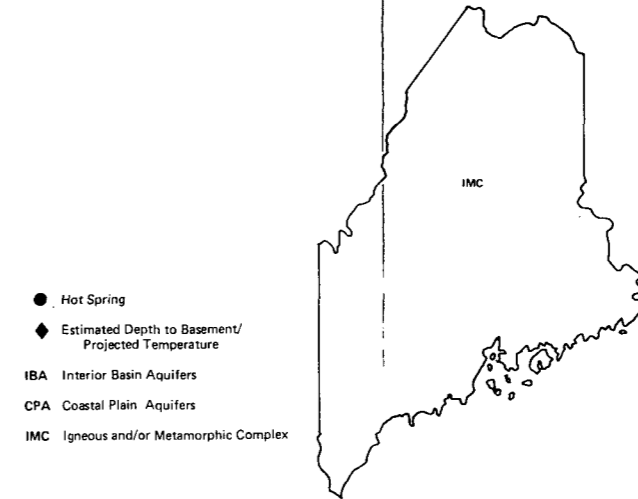
TOTAL POPULATION: 993,663 TOTAL AREA: 30,920 SQ. MI.
POPULATION DENSITY: 32 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOHERMAL OVERVIEW

Minor sedimentary cover exists on crystalline basement throughout the state. However, posttectonic alkaline plutons (with high radioactive element content) occur in the south, and a high heat flow region crosses the state.



ENERGY USE - 1975 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	211.8	3.8	2.0	1.1	21.6
RESIDENTIAL	41.8	2.6	0.7	0.1	8.6
COMMERCIAL	30.8	0.3	0.5	0.1	5.4
INDUSTRIAL	29.3	0.9	0.8	0.9	7.6
PERCENT	97	2.0	1.0	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Office of Energy Resources, Richard Barringer, Commissioner (207) 289-2212
DIVISION OF WATER RIGHTS:	C. R. Wagner, Subdistrict Chief (207) 289-3484
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	William R. Adams, Jr., Director (207) 289-2811
OFFICE OF ENERGY POLICY:	John M. Joseph, Director (207) 289-2196
PLANNING BUREAU:	State Planning Office, Executive Department Allen Pease, Director (207) 289-3261
GEOLOGICAL SURVEY:	Dr. Robert G. Doyle, State Geologist (207) 289-2801
	Walter A. Anderson, Acting Director, (207) 289-2801

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

LEGISLATIVE CONTACTS

SENATORS	George J. Mitchell (D) William S. Cohen (R)	GOVERNOR	Joseph E. Brennan (D)
CONGRESSMEN (DIST.)	1 - David F. Emery (R) 2 - Olympia Snowe (R)		

State Geothermal Fact Sheet

MAINE

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 993,663 Area: 30,920 sq. mi. Density: 32 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	37	39	2	0.03	6
Residential	7	27	0.7	0.00	2
Commerical	5	3	0.5	0.00	2
Industrial	5	9	0.8	0.03	2

Trillion Btu

GROSS	211.8	3.8	2.0	1.1	21.6
Residential	41.8	2.6	0.7	0.1	8.6
Commercial	30.8	0.3	0.5	0.1	5.4
Industrial	29.3	0.9	0.8	0.9	7.6
Percentages	97	2.0	1.0	0	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Office of Energy Resources, Richard Barringer, Commissioner, (207) 289-2212.
2. Division of Water Rights, C. R. Wagner, Subdistrict Chief, (207) 289-3484.
3. Department of Environmental Protection, William R. Adams, Jr., Director, (207) 289-2811.
4. Office of Energy Policy, John M. Joseph, Director, (207) 289-2196.
5. State Planning Office, Executive Department, Allen Pease, Director, (207) 289-3261.
6. Geological Survey, Dr. Robert G. Doyle, State Geologist, (207) 289-2801.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), and (C-10).

**MARYLAND/D.C.
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Maryland/District of Columbia)

TOTAL POPULATION: 4,688,000 TOTAL AREA: 9,952 SQ. MI.
POPULATION DENSITY: 471 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	Delmarva Peninsula
TYPE	Sands
DEPTH	5000 ft.
WATER TEMP.	120°F to 180°F
EST. STORED WATER	
EST. ENERGY CONTENT	

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	56	1,788 thousand tons	45.5
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	15	298 million cu. ft.	0.3
Crude Oil Wells	0	0 thousand bbl	0

ENERGY USE - 1976 (10¹² BTU)

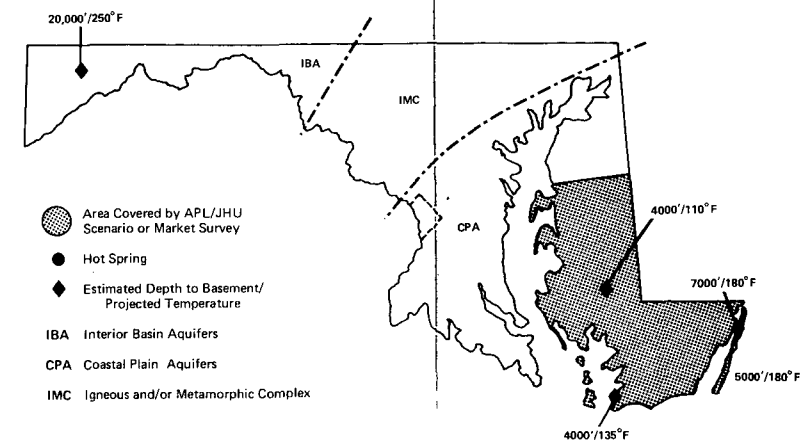
SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	610.8	9.2	175.2	213.2	113.7
RESIDENTIAL	59.1	5.3	85.0	0.6	35.8
COMMERCIAL	63.1	0.6	38.8	0.3	37.1
INDUSTRIAL	34.3	3.2	48.7	112.5	39.5
PERCENT	61	1	17	21	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	<ol style="list-style-type: none"> 1. APL/JHU Scenario for DGE/DOE - "The Atlantic Coastal Plain." 2. APL/JHU - Market Analysis. 3. VPI Evaluation and Targeting Study. 4. Atlantic Coastal Plain Gradient Drilling Program. 5. Preliminary draft of State Prospectus prepared by APL. 6. Deep hydrothermal confirmation well at Crisfield completed.
PROPOSED STUDIES	<ol style="list-style-type: none"> 1. Technical Assistance by APL. 2. Deep well at Cove Point.
LEGAL ACTIVITIES	A Geothermal Resource Act was passed by the 1978 Session of the Maryland Legislature and became State law, effective July 1, 1978; workshops in process to modify act.

GEOHERMAL OVERVIEW

The Atlantic Coastal Plain area under the Delmarva Peninsula has potential as a hydrothermal resource with higher than normal gradient. Potential for hot dry rock development also exists. A DOE deep well at Crisfield has provided preliminary information on both types of resources.



PRIMARY CONTACTS

ENERGY ADMINISTRATION:	Dr. Paul Massicott, General Director (301) 267-1264
ENERGY OFFICE:	Dr. Donald E. Milsten, Director (301) 383-6810
WATER RESOURCES ADMINISTRATION:	Thomas C. Andrews, Director (301) 264-3846
DEPARTMENT OF ECONOMIC AND COMMUNITY DEVELOPMENT:	James O. Robertson, Secretary (301) 269-3176
MARYLAND GEOLOGICAL SURVEY:	Kenneth N. Weaver, Director (301) 235-0771
DEPARTMENT OF STATE PLANNING:	Constance Lielier, Secretary (301) 383-2450
PUBLIC SERVICE COMMISSION:	Frank Wasowicz, Ex. Secretary (301) 383-2366
ENVIRONMENTAL HEALTH ADMINISTRATION:	Max Eisenberg (301) 383-2740

LEGISLATIVE CONTACTS

GOVERNOR	Harry R. Hughes (D) (301) 269-3591
SENATORS	Charles M. Mathias, Gordon Hawk, Exec. Asst. (301) 224-4654 Paul S. Sarbanes, Marion Moss, Asst. (301) 244-4524
CONGRESSMAN (DIST.)	1- Roy Dyson (D) Richard L. Ribbentrop, Adm. Asst. (301) 225-5311
COUNTIES OF GEOHERMAL INTEREST:	
	Carolina
	Dorchester
	Queen Anne
	Somerset
	Talbot
	Wicomico
	Worcester

State Geothermal Fact Sheet
 MARYLAND & DISTRICT OF COLUMBIA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 4,688,000 Area: 9,952 sq. mi. Density: 471 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 188,892 Area: 2,750 sq. mi. Density: 69 per sq. mi.
 480,000 (summer) 175 (summer)

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	107	96	170	8.	33
Residential	10	55	32	0.01	11
Commerical	11	6	38	0.00	10
Industrial	6	34	47	0.25	12

Trillion Btu

GROSS	610.8	9.2	175.2	213.2	113.7
Residential	59.1	5.3	85.0	0.6	35.8
Commercial	63.1	0.6	38.8	0.3	37.1
Industrial	34.3	3.2	48.7	112.5	39.5
Percentages	61	1	17	21	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	56	1,788 thousand tons	45.5
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	15	298 million cu. ft.	0.3
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The area of Maryland that is of current geothermal interest is the Atlantic Coastal Region, the so-called Eastern Shore of Maryland. The geology of this region is typical of the Delmarva Peninsula: the coastal plain consists of a thickening wedge of Mesozoic and Cenozoic sedimentary rocks. The basement is deeper than 7500 ft. at Ocean City and is from 4000 ft. or deeper in the contiguous counties of the southern Eastern Shore of the Chesapeake Bay. It is assumed (and verified by some recent data) that the top of the basement slopes down to the east into the Atlantic Ocean (3). Deep sandstone aquifers are known to underlie this region. The DOE/DGE deep well at Crisfield, which was spudded on 13 May 1979, and drilled into basement, gave the basement depth as 4460 ft. and provided stratigraphic data to 5550 ft (3). This well, which was also pump tested, provided information on deep aquifer water yield.

V. RESOURCE DATA

In the late 1940's three holes deeper than 5000 ft. were drilled on the Eastern Shore by oil companies. One of these, "Maryland Esso No. 1," in Ocean City was drilled to 7710 ft. and had a bottom hole temperature measured at 216°F. The DOE 1000 ft. well drilling program, conducted by VPI&SU, drilled 13 holes in Maryland. The gradient drilling program indicated a massive pluton under the Chesapeake Bay and a smaller one under Wallops Island; higher-than-normal gradients are found on a line from Smith's Point on the Western Shore of the Chesapeake Bay at the mouth of the Potomac River to Wallops Island on the Atlantic Coast. Other gradients appear to be normal.

The deep well drilled by DOE at Crisfield was pump tested for 3 deep aquifers. The most productive one was 86 ft. thick located about 3950 ft. down, had a temperature of about 133°F, a computed permeability of 110 millidarcies, and a storage coefficient of 4×10^{-3} . This well was extended into the basement as part of the Los Alamos (LASL) hot dry rock program.

VI. GEOHERMAL ACTIVITY

The VPI&SU 1000 ft. gradient well program has been completed and the deep well into basement at Crisfield has been tested and abandoned. Under DOE/PRDA, a feasibility study has been completed for a food processing plant in Salisbury. APL has completed the market study of potential geothermal application for the Eastern Shore. Four technical assistance studies completed by APL include two schools, a mariculture industry on the Eastern Shore, and the LNG facility at Cove Point on the Western Shore.

Beginning in mid or late 1980, APL will conduct four or five technical assistance studies for Ocean City, Salisbury, and Snow Hill. DOE plans to have VPI&SU drill a production test well at Cove Point. Drilling sites are shown on page MD-6.

VII. LEGAL ACTIVITIES

A Geothermal Resource Act was passed by the Maryland Legislature and became State Law 1 July 1978. NCSL is conducting workshops with the State Joint Legislative Subcommittee to modify the existing law.

VIII. CONTACTS

1. Energy Administration, Department of Natural Resources, James State Office Bldg., Annapolis, MD 21401, Dr. Paul Massicott, General Director, (301) 267-1264.
2. Energy Office (part of Energy Administration), 301 West Preston Street, Suite 1302, Baltimore, MD 21201, Dr. Donald E. Milsten, Director, (301) 383-6810.
3. Energy Conservation and Alternative Energy Sources (State Energy Office), 301 West Preston Street, Suite 1302, Baltimore, MD 21201, Felicity Evans, Chief, (301) 383-6810.
4. Water Resources Administration, Department of Natural Resources, Tawes State Office Building, Annapolis, MD 21401, Thomas C. Andrews, Director, (301) 269-3846.
5. Department of Economic and Community Development, 2525 Riva Road, Annapolis, MD 21401, James O. Robertson, Secretary, (301) 269-3176.
6. Public Service Commission, 301 West Preston Street, Baltimore, MD 21201, Thomas Hatem, Chairman; Frank Wasowicz, Executive Secretary, (301) 383-2366.

7. Special Joint Committee on Energy (Legislature)
 - a. Delegate - Catherine I. Riley, Chairman, 20 Office Street, Bel Air, MD 21014.
 - b. Senator - Peter A. Bozick, Co-Chairman, 5606 Lansing Drive, Camp Springs, MD 20031.
8. Maryland Geological Survey, Merryman Hall, The Johns Hopkins University, Baltimore, MD 21218, Dr. Kenneth N. Weaver, Director, (301) 235-0771.
9. Environmental Health Administration, 201 W. Preston Street, Baltimore, MD 21201, Max Eisenberg, (301) 383-2740.
10. Department of State Planning, 301 West Preston Street, Baltimore, MD 21229, Constance Lieder, Secretary, (301) 383-2450.
11. State Coupled Reservoir Assessment Program, Merryman Hall, The Johns Hopkins University, Baltimore, MD 21218, Dr. Ken Schwarz, Principal Contact, (301) 235-0771.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

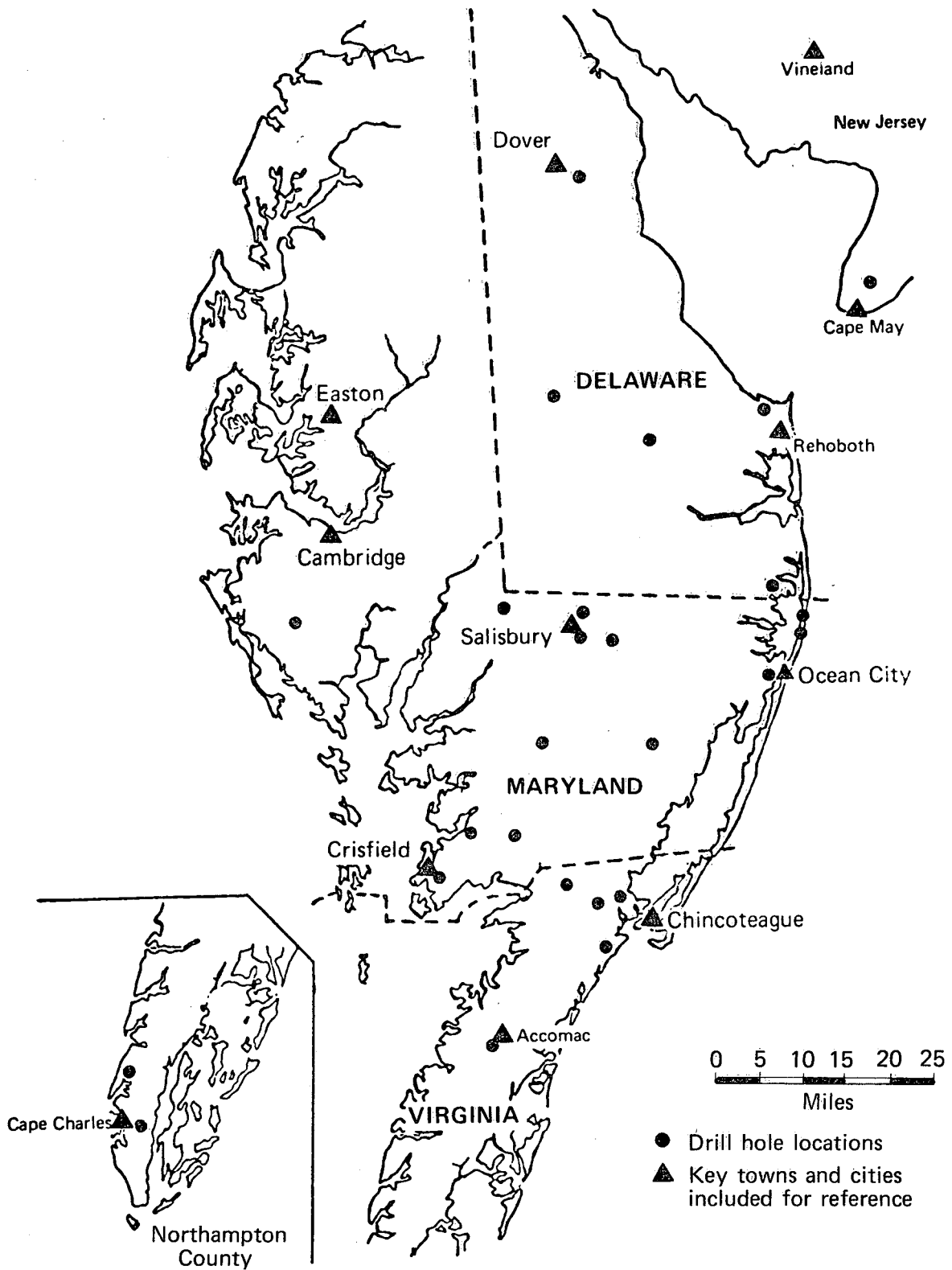
- (1) P. M. Brown, J. A. Miller and F. M. Swain, "Structural and Stratigraphic Framework and Spatial Distribution of Permeability of the Atlantic Coast Plain, North Carolina to New York," U.S.G.S. Professional Paper 796, 1972.
- (2) R. N. Benson, "Review of the Subsurface Geology and Resources Potential of Southern Delaware," Delaware Geological Survey, Open File Report, 1976.
- (3) "Geothermal Energy and the Eastern U.S.: A Framework for a Site Prospectus for Geothermal Energy Development, Delmarva Peninsula," APL/JHU QM-79-145, Jun 1979.
- (4) "Evaluation and Targeting of Geothermal Energy Resource in the Southeastern United States," VPI&SU, Blacksburg, VA, Report Nos. VPI&SU-5648-5 and VPI&SU-78ET-27001-7.
- (5) "Geothermal Energy and the Eastern U.S., Technical Information Exchange Meeting," APL/JHU QM-79-261:

Chapter VII - R. Gleason and L. Lambriase, "Mid Atlantic and Southeastern Moderate Temperature Program, Geologic Setting and Targeting Process;"

- Chapter VIII - J. C. Maxwell, "The Hot Dry Rock - Eastern Program;"
- Chapter XII - K. Schwarz, "The Crisfield Well, Somerset County, Maryland;"
- Chapter XIII - J. H. Hartsock, "Analysis of Test Data from DOE Crisfield Airport Well No. 1 Well;"
- Chapter XIV - K. Yu, "Crisfield Well Characteristics Determined Using All Test Data;" and
- Chapter XV - F. C. Paddison, "Geothermal Heating for the Crisfield Maryland High School."
- (6) "Completion Report Gruy Federal Inc - Department of Energy Crisfield Airport No. 1 Well, Somerset County, Maryland," Part I: Drilling and Completion, Aug 1979, Part II: Well Test Analysis, Oct 1979, Gruy Federal, Inc. 2500 Tanglewild Drive, Suite 150 Houston, TX 77063.
- (7) "Technical Assistance Report No. 4, Geothermal Space Heating - Pittsville Middle/Elementary School, Pittsville, Maryland," JHU/APL QM-80-101, Jun 1980.
- (8) "Utilization of Geothermal Energy at the Cove Point LNG Receiving Terminal," Columbia LNG Corporation, 20 Montchanin Road, Wilmington, Delaware, 19807.
- (9) "Geothermal Resources for the Eastern United States," Gruy Federal, Inc. Report for the Department of Energy, DOE/ET/288373-T2.
- (10) "Preliminary Results for the Technical Assistance to Columbia LNG Corporation," APL/JHU QM-80-047.
- (11) "The Crisfield, Maryland Well and Geothermal Energy," Letter to Mr. W. L. Rice, DOE/RA, JHU/APL CQO-2554, 12 Nov 1979.
- (12) "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Atlantic Coastal Plain," APL/JHU QM-77-129, Oct 1977.

COMMON REFERENCES

(C-1), (C-2), (C-3), (C-4), (C-6), and (C-7).



Locations of gradient test holes – Delmarva

**MASSACHUSETTS
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Massachusetts)

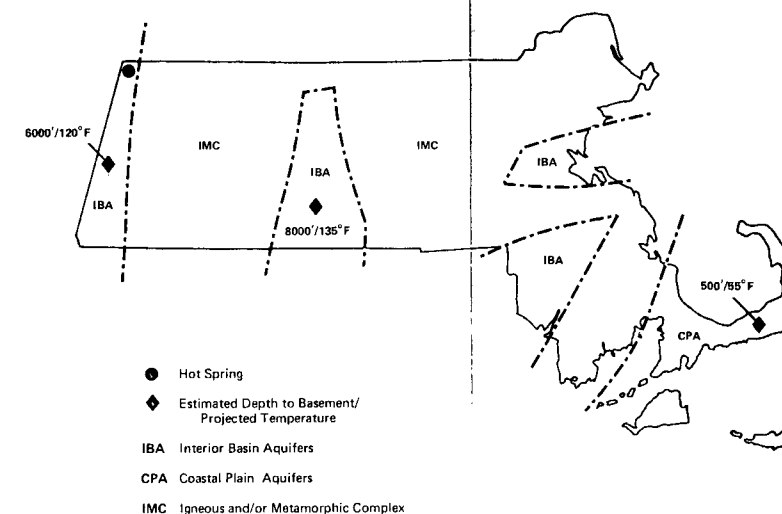
TOTAL POPULATION: 5,689,170 TOTAL AREA: 7,826 SQ. MI.
POPULATION DENSITY: 727 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOHERMAL OVERVIEW

In the western part of the state, a deep highly faulted sedimentary basin may be a hydrothermal resource as indicated by warm springs. The other interior basin area has a potential for hot dry rock or hydrothermal development.



ENERGY USE - 1975 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1081.2	9.2	162.8	10.0	101.0
RESIDENTIAL	174.9	4.3	93.1	0.3	37.6
COMMERCIAL	255.6	0.5	39.0	0.2	37.4
INDUSTRIAL	42.1	4.4	28.6	2.7	25.9
PERCENT	86	1	12	1	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Richard Kendall, Commissioner (617) 727-3163
DIVISION OF WATER RESOURCES:	Charles Kennedy, Director (617) 727-3267
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Executive Office of Environmental Affairs, Charles H. W. Foster, Secretary (617) 727-7700
OFFICE OF ENERGY POLICY:	Joseph Fitzpatrick, Director (617) 727-4732
PLANNING BUREAU:	Office of State Planning and Management, Lucy Flynn, Regional Coordinator (617) 727-4832
GEOLOGICAL SURVEY:	Mr. Joseph A. Sinnott, State Geologist (617) 727-4508

LEGISLATIVE CONTACTS

SENATORS	Edward M. Kennedy (D) Paul E. Tsongas (D)	GOVERNOR	Edward J. King (D)
CONGRESSMEN (DIST.)			
	1 - Silvio O. Conte (R)		7 - Edward J. Markey (D)
	2 - Edward P. Boland (D)		8 - Thomas P. O'Neill, Jr. (D)
	3 - Joseph D. Early (D)		9 - John J. Moakley (D)
	4 - Barney Frank (D)		10 - Margaret M. Heckler (R)
	5 - James Shannon (D)		11 - Brian Donnelly (D)
	6 - Nicholas Mavroules (D)		12 - Gerry E. Studds (D)

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	None
PROPOSED STUDIES	Joint proposal with NYSERDA - evaluation of geothermal potential Champlain Valley.
LEGAL ACTIVITIES	None

State Geothermal Fact Sheet
 MASSACHUSETTS

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 5,689,170 Area: 7,826 sq. mi. Density: 727 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	186	96	158	0.41	30
Residential	30	45	90	0.01	11
Commerical	42	5	38	0.01	11
Industrial	7	46	28	0.10	8

Trillion Btu

GROSS	1081.2	9.2	162.8	10.0	101.0
Residential	174.9	4.3	93.1	0.3	37.6
Commercial	255.6	0.5	39.0	0.2	37.4
Industrial	42.1	4.4	28.6	2.7	25.9
Percentages	86	1	12	1	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

Massachusetts is largely underlain by low grade to high grade metamorphic rocks and igneous intrusions. These rocks are of Precambrian and Paleozoic age and were deformed or emplaced during the Paleozoic orogenies. The western part of the state coincides with the Champlain Valley, which is underlain by a deep, complexly faulted sequence of sedimentary rocks. Warm springs occur in this area and are fault controlled. The Connecticut Valley Triassic Basin extends through the central part of the state and its thickness exceeds 10,000 ft. This basin is bounded by deep-seated fault zones. Both of these areas are attractive for harboring geothermal energy because they consist of thick sedimentary sequences that act as insulating blankets and are associated with significant faulting. Little is known about water availability at depth; however, many of the sedimentary units are highly indurated making fracturing and faulting important for the circulation of water.

V. RESOURCE DATA

Few subsurface temperature data are available for Massachusetts.

VI. GEOHERMAL ACTIVITY

Joint proposal with NYERDA - evaluation of geothermal potential of Champlain Valley.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, Richard Kendall, Commissioner, (617) 727-3163.

2. Division of Water Resources, Charles Kennedy, Director, (617) 727-3267.
3. Department of Environmental Protection, Executive Office of Environmental Affairs, Charles H. W. Foster, Secretary, (617) 727-7700.
4. Office of Energy Policy, Joseph Fitzpatrick, Director, (617) 727-4832.
5. Office of State Planning and Management, Lucy Flynn, Regional Coordinator, (617) 727-4732.
6. Geological Survey, Mr. Joseph A. Sinnott, State Geologist, (617) 727-4508.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), and (C-10).

**MICHIGAN
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Michigan)

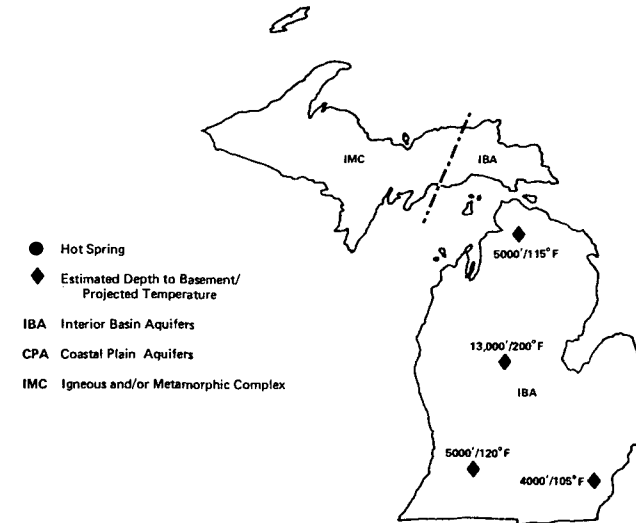
TOTAL POPULATION: 8,875,083 TOTAL AREA: 56,817 SQ. MI.
POPULATION DENSITY: 156 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	1,063 thousand bbl	4.3
Natural Gas Wells	1,145	44,579 million cu. ft.	48.7
Crude Oil Wells	3,733	14,614 thousand bbl	84.8

GEOTHERMAL OVERVIEW

A deep sedimentary basin may have potential as a hydrothermal resource.



ENERGY USE — 1975 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	975.1	28.6	915.9	776.4	213.7
RESIDENTIAL	108.3	22.2	345.6	5.3	71.0
COMMERCIAL	74.7	2.5	187.8	2.9	50.4
INDUSTRIAL	48.0	3.9	323.3	110.7	92.3
PERCENT	36	1	34	29	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Ralph A. MacMullan, Director (517) 373-1220
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Protection Branch, Dept. of Natural Resources, Ralph W. Purdy, Deputy Director (517) 373-2682
OFFICE OF ENERGY POLICY:	Department of Commerce, Richard Helmbrecht, Director (517) 373-8290
PLANNING BUREAU:	Planning and Policy Analysis Div., Bureau of Budget, Thomas Clay, Director (517) 373-7560
GEOLOGICAL SURVEY:	Arthur E. Slaughter, State Geologist (517) 373-1256

LEGISLATIVE CONTACTS

SENATORS	Donald W. Riegle, Jr. (D) Carl Levin (D)	GOVERNOR	William G. Milliken (R)
CONGRESSMEN (DIST.)			
1 - John Conyers, Jr. (D)		11 - Robert W. Davis (R)	
2 - Carl D. Pursell (R)		12 - David E. Bonior (D)	
3 - Howard Wolpe (D)		13 - George Crockett, Jr. (D)	
4 - David A. Stockman (R)		14 - Dennis M. Hertel (D)	
5 - Harold S. Sawyer (R)		15 - William D. Ford (D)	
6 - Jim Dunn (R)		16 - John D. Dingell (D)	
7 - Dale E. Kildee (D)		17 - William M. Brodhead (D)	
8 - Bob Traxler (D)		18 - James J. Blanchard (D)	
9 - Guy A. VanderJagt (R)		19 - William S. Broomfield (R)	
10 - Donald Joseph Albosta (D)			

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	DOE/DGE - Gruy Federal Study - Resource Assessment.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	1,063 thousand bbl	4.3
Natural gas wells	1,145	44,579 million cu. ft.	48.7
Crude oil wells	3,733	14,614 thousand bbl	84.8

IV. GEOLOGY

The geology of Michigan is dominated by a large central basin, which in large part underlies the Lower Peninsula. The depth of this sedimentary basin exceeds 12,000 ft. and contains Cambrian to Triassic rocks overlying the Precambrian basement. Lower to Upper Precambrian rocks are exposed on part of the Upper Peninsula as part of the Wisconsin Arch. Sedimentary sequences dip off the basement high to the southeast into the Michigan Basin and to the northwest into the Lake Superior Syncline.

A thick sequence of glacial drift (Pleistocene in age), over several hundred feet deep, overlies the older rocks throughout most of the State. Most of Michigan's ground water supply is obtained from these sediments. Water from deeper horizons becomes increasingly more saline because of the presence of evaporite beds.

A thick basal sandstone sequence that contains the Mt. Simon Formation represents a fair aquifer along the borders to the Michigan Basin, but is believed to become tighter and less permeable at greater depths.

V. RESOURCE DATA

Thermal gradient data indicate values in excess of 1.5°F/100 ft. The deeper parts of the Basin do not correspond with large demographic centers; however, Grand Rapids and Lansing coincide with basement contours of 7000 to 8000 ft. The 2.0°F/100 ft. gradient near Grand Rapids may produce water near 200°F.

VI. GEOHERMAL ACTIVITY

See Gruy Report (C-16).

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, Ralph A. MacMullan, Director, (517) 373-1220.
2. Department of Natural Resources, Environmental Protection Branch, Ralph W. Purdy, Deputy Director, (517) 373-2682.
3. Department of Commerce, Office of Energy Policy, Richard Helmbrecht, Director, (517) 373-8290.
4. Bureau of Budget, Planning and Policy Analysis Div., Thomas Clay, Director, (517) 373-7560.
5. Geological Survey, Arthur E. Slaughter, State Geologist, (517) 373-1256.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-16).

**MINNESOTA
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Minnesota)

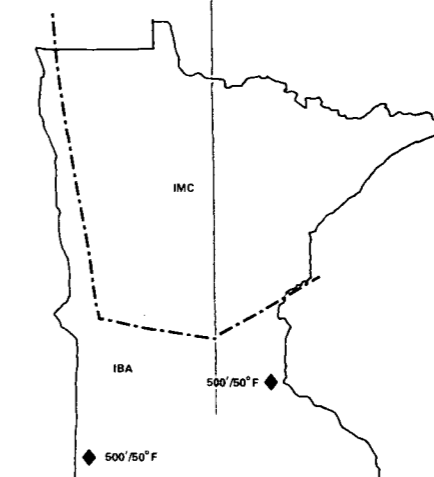
TOTAL POPULATION: 3,804,971 TOTAL AREA: 79,289 SQ. MI.
POPULATION DENSITY: 48 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

There is a very thin cover of sedimentary rock over the crystalline basement complex. Only low geothermal gradients are known to exist.



- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	465.7	35.5	318.0	209.0	89.3
RESIDENTIAL	65.3	25.7	110.6	2.3	34.2
COMMERCIAL	31.0	2.9	71.3	1.2	17.5
INDUSTRIAL	46.7	8.2	136.1	24.8	37.6
PERCENT	43	3	33	20	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	None
PROPOSED STUDIES	None
LEGAL ACTIVITIES	To be determined.

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	State Planning Agency, Joseph Sizer, Director Envir. Planning (612) 296-3985
OFFICE OF ENERGY POLICY:	
PLANNING BUREAU:	State Planning Agency, Roger Williams, Manager (612) 296-2633
GEOLOGICAL SURVEY:	Dr. Matt S. Watson, Director (612) 373-3372

LEGISLATIVE CONTACTS

SENATORS	David Durenberger (R) Rudy Boschwitz (R)	GOVERNOR	Albert H. Quie (R)
CONGRESSMEN (DIST.)			
1 - Arlen Erdahl (R)			
2 - Thomas M. Hagedorn (R)			
3 - Bill Frenzel (R)			
4 - Bruce F. Vento (D)			
5 - Martin Sabo (D)			
6 - Vin Weber (R)			
7 - Arlan Stangeland (R)			
8 - James L. Oberstar (D)			

State Geothermal Fact Sheet

MINNESOTA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 3,804,971 Area: 79,289 sq. mi. Density: 48 per sq. mi.

GEOTHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

MN-1

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	83	386	338	11	26
Residential	11	269	114	0.1	10
Commerical	5	29	90	0.06	5
Industrial	8	86	107		11

Trillion Btu

GROSS	465.7	35.5	318.0	209.0	89.3
Residential	65.3	25.7	110.6	2.3	34.2
Commercial	31.0	2.9	71.3	1.2	17.5
Industrial	46.7	8.2	136.1	24.8	37.6
Percentages	43	3	33	20	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

APL trip report (1).

VII. LEGAL ACTIVITIES

None

VIII. CONTACTS

1. Department of Environmental Protection, State Planning Agency, Joseph Sizer, Director Environmental Planning, (612) 296-3985.
2. State Planning Agency, Roger Williams, Manager, (612) 296-2633.
3. Geological Survey, Dr. Matt S. Waton, Director, (612) 373-3372.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Visit to the State of Minnesota, 5 October 1976," APL/JHU QM-76-133, 15 Oct 1976 (see list of reports in this report).

COMMON REFERENCES

(C-4), (C-6), and (C-7).

MISSISSIPPI
GEOTHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Mississippi)

TOTAL POPULATION: 2,216,912 TOTAL AREA: 47,296 SQ. MI.
POPULATION DENSITY: 47 PERSONS/SQ. MI.

GEOTHERMAL RESOURCE DATA

	(1)	(2)
NAME	Mississippi Salt Dome Basin	Black Warrior Basin
TYPE	Unknown	Unknown & variable
DEPTH	10,000 to 25,000 ⁺ ft.	5,000 to 15,000 ft.
WATER TEMP.	180° to over 350°F	180° to 212°F (may be 250° locally)
EST. STORED WATER	1.06 × 10 ¹⁵ cu. ft.	1.60 × 10 ¹⁴ cu. ft.
EST. ENERGY CONTENT	7,900 × 10 ¹⁵ Btu	600 × 10 ¹⁵ Btu

GEOTHERMAL OVERVIEW

The Coastal Plain area of the state contains a thick sequence of carbonates and unconsolidated sands and may represent a hydrothermal resource. There is some evidence of geopressured fairways in the southern portion of the state. Shallow formations such as the Tuscaloosa Formation represent moderate temperature, shallow, hydrothermal resources. State Geologic Survey has mapped depth of isotherm contours in southern portion of state.

ENERGY RESOURCES — 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	571 thousand bbl	2.3
Natural Gas Wells	250	99,706 million cu. ft.	109
Crude Oil Wells	2,901	56,102 thousand bbl	325.4

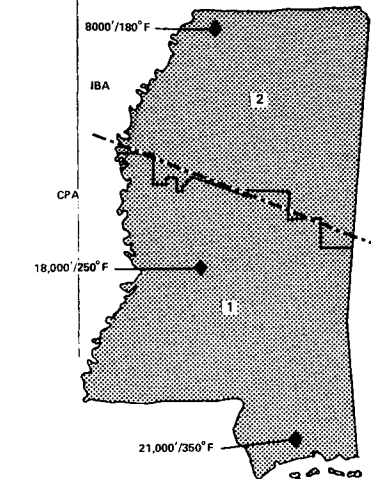
ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	297.1	30.0	243.6	37.3	65.5
RESIDENTIAL	8.8	18.0	30.5	0.0	26.9
COMMERCIAL	16.4	2.0	24.7	0.0	16.3
INDUSTRIAL	23.5	9.3	116.4	0.6	22.3
PERCENT	49	5	40	6	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	Mississippi Geological Survey: "Final Report — An Investigation of Potential Geothermal Energy Sources in Mississippi," with attached maps.
PROPOSES STUDIES	None
LEGAL ACTIVITIES	None

- Area Covered by APL/JHU Scenario or Market Survey
- Hot Spring
- ◆ Estimated Depth to Basement/Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex



County Lines
Separation of Geologic Formations

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	Board of Water Commissioners, Jack W. Pepper, Water Engineer (601) 354-7236
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Air and Water Pollution Control Commission, Glen Wood, Jr., Acting Executive Secretary (601) 354-6783
OFFICE OF ENERGY POLICY:	Fuel and Energy Management Commission, George A. Cochran, State Fuel Coordinator (601) 354-7406
PLANNING BUREAU:	Federal-State Programs, Office of the Governor, William M. Headrick, Coordinator (601) 354-7570
GEOLOGICAL SURVEY:	Mississippi Geological Economic and Topographical Survey, William H. Moore, Director and State Geologist (601) 354-6228
	Mississippi Research and Development Center, J. R. Peterson, Associate Director (601) 982-6454

LEGISLATIVE CONTACTS

SENATORS	John C. Stennis (D) Thad Cochran	GOVERNOR	William F. Winter (D)
CONGRESSMEN (DIST.)			
	1 - Jamie L. Whitten (D)		
	2 - David R. Bowen (D)		
	3 - Gillespie V. Montgomery (D)		
	4 - Jon Hinson (R)		
	5 - Trent Lott (R)		

State Geothermal Fact Sheet

MISSISSIPPI

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 2,216,912 Area: 47,296 sq. mi. Density: 47 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 2,216,912 Area: 47,296 sq. mi. Density: 47 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	53	314	236	2	19
Residential	2	188	30	0	8
Commerical	3	21	24	0	5
Industrial	4	97	113	0.02	7

Trillion Btu

GROSS	297.1	30.0	243.6	37.3	65.5
Residential	8.8	18.0	30.5	0.0	26.9
Commercial	16.4	2.0	24.7	0.0	16.3
Industrial	23.5	9.3	116.4	0.6	22.3

Percentages 49 5 40 6

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

MS-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	571 thousand bbl	2.3
Natural gas wells	250	99,706 million cu. ft.	109
Crude oil wells	2,901	56,102 thousand bbl	325.4

IV. GEOLOGY (1)

Mississippi may be divided into two resource areas. The northern portion of the state is part of the Black Warrior Basin that also extends into Alabama. Sediment thicknesses vary from 6,000 to 15,000 ft., averaging 10,000 ft. over much of this area. Geothermal gradients range from near-normal to well-above-normal (1.7°F/100 ft. or greater) in northern Mississippi. Temperatures at the bottom of the sedimentary pile should be from 150 to 210°F with local hot spots of up to 250°F. Provided that deep formations have sufficient porosities and permeabilities, significant geothermal resources may exist in the old sediments of the Black Warrior Basin.

In the second resource area, it appears that a sizeable abnormally pressured geothermal resource may be found in the Mississippi Salt Dome Basin, which lies in the south central part of the state. In addition to potential geopressured-geothermal resources, the Salt Dome Basin contains numerous salt domes. Some think that the interiors of the salt pillars should show high temperatures because of the high thermal conductivity of salt and the contact of some pillars with the deep hot salt beds. Another potential energy source in the Salt Dome Basin is the heat from igneous intrusions, one of the largest being the Jackson Dome under Jackson, Mississippi. These buried plutons may still be at elevated temperatures and the heat may be trapped by the overlying sedimentary deposits. The thick sediments in Mississippi extend to depths in excess of 25,000 ft. The porosity is expected to be high enough to yield sufficient water at great depths to be suitable resources. Geothermal gradients fluctuate locally but appear to be about normal with somewhat higher values in localized areas of central Mississippi. Temperatures in excess of 210°F should be experienced at depths of 10,000 ft. or more in any location exhibiting near-normal or higher geothermal gradients.

V. RESOURCE DATA

1. BLACK WARRIOR BASIN

Type aquifer: unknown & variable Area: 19,400 sq. mi.
Depth: 5,000 to 15,000 ft. Avg. thickness:
Porosity: unknown Transmissivity:
Water temperature: 180 to 212°F (up to 250°F locally)
Recharge rate:
Estimate of water stored in aquifer: 1.60×10^{14} cu ft.
Estimate of energy content of water: about 600×10^{15} Btu[†]

2. MISSISSIPPI SALT DOME BASIN

Type aquifer: unknown Area: 27,917 sq. mi.
Depth: 10,000 to 25,000[†] ft. Avg. thickness:
Porosity: unknown Transmissivity:
Water temperature: 180°F to in excess of 350°F
Recharge rate:
Estimate of water stored in aquifer: 1.06×10^{15} cu. ft.
Estimate of energy content of water: $7,900 \times 10^{15}$ Btu[†]

[†]Above 120°F, referenced to 90°F; 10% porosity assumed, about 4.5 times this amount in rock.

VI. GEOHERMAL ACTIVITY

Recent studies: Mississippi Geological Survey: "Final Report - An Investigation of Potential Geothermal Energy Sources in Mississippi," with attached maps.

VII. LEGAL ACTIVITIES

None

VIII. CONTACTS

1. Mississippi Geological, Economic, and Topographical Survey, 2525 N. West St., P. O. Drawer 4915, Jackson, MS 39216, William H. Moore, Director & State Geologist, (601) 354-6228.

2. Fuel and Energy Management Commission, 1307 Woolfolk State Office Bldg., Jackson, MS 39205, George A. Cochran, State Fuel Coordinator, (601) 354-7406.
3. Mississippi Research & Development Center, Jackson, MS 39205, J. R. Peterson, Associate Director, (601) 982-6454.
4. Board of Water Commissioners, Jack W. Pepper, Water Engineer, (601) 354-7236.
5. Air and Water Pollution Control Commission, Glen Wood, Jr., Acting Executive Secretary, (601) 354-6783.
6. Federal-State Programs, Office of the Governor, William M. Headrick, Coordinator, (601) 354-7570.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) W. J. Toth and F. C. Paddison, "Pre-Scenario Visit to Mississippi," APL/JHU QM-77-159, 12 Dec 1977.
- (2) S. S. Papadopoulos, R. H. Wallace, Jr., J. B. Wesselman, and R. E. Taylor, "Assessment of Onshore Geopressured-Geothermal Resources in the Northern Gulf of Mexico Basin," Assessment of Geothermal Resources of the United States, USGS Circular 726, 1975.
- (3) Executive Reference Map No. 305, "Geomap Company 1977.
- (4) W. J. Toth and F. C. Paddison, "Meeting with Dr. Ray Wallace, USGS/WR," APL/JHU QM-78-010, 25 Jan 1978.
- (5) J. R. Peterson, Computer Printout of Industries in Mississippi, 1 Dec 1977.

COMMON REFERENCES

(C-1), (C-2), (C-3), (C-4), (C-5), (C-6), and (C-7).

MISSOURI
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Missouri)

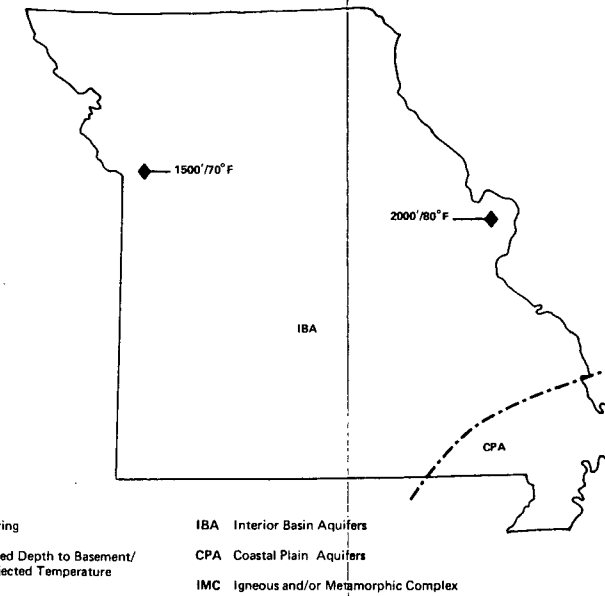
TOTAL POPULATION: 4,676,501 TOTAL AREA: 68,995 SQ. MI.
POPULATION DENSITY: 68 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	10	4,657 thousand tons	101.5
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	2	33 million cu. ft.	0.0
Crude Oil Wells	135	60 thousand bbl	0.3

GEOHERMAL OVERVIEW

Relatively shallow sedimentary cover and low gradients reduce the likelihood of exploitable resources in Missouri.



ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	489.1	51.6	389.0	434.5	111.5
RESIDENTIAL	23.1	40.5	160.1	1.7	44.7
COMMERCIAL	23.2	4.5	93.6	0.9	29.0
INDUSTRIAL	32.8	6.6	100.4	39.1	37.8
PERCENT	36	4	29	32	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	DOE/DGE Report: "Geothermal Resources of the Eastern U.S."
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None known

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES: James L. Wilson, Director (314) 751-4000
DIVISION OF WATER RIGHTS:
DEPARTMENT OF ENVIRONMENTAL PROTECTION: Division of State Planning and Analysis (314) 751-4834
OFFICE OF ENERGY POLICY: Missouri Energy Agency, Weston Fisher, Program Director (314) 751-4000
PLANNING BUREAU: Division of State Planning and Analysis
GEOLOGICAL SURVEY: Dr. Wallace B. Howe, Director and State Geologist (314) 364-1752

LEGISLATIVE CONTACTS

SENATORS Thomas F. Eagleton (D) John C. Danforth (R)	GOVERNOR Christopher S. Bond (R)
CONGRESSMEN (DIST.)	
1 - William L. Clay (D)	
2 - Robert A. Young (D)	
3 - Richard A. Gephardt (D)	
4 - Ike Skelton (D)	
5 - Richard Bolling (D)	
6 - E. Thomas Coleman (R)	
7 - Gene Taylor (R)	
8 - Wendell Bailey (R)	
9 - Harold L. Volkmer (D)	
10 - Bill Emerson (R)	

State Geothermal Fact Sheet

MISSOURI

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 4,676,501 Area: 68,995 sq. mi. Density: 68 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	90	541	377	20	33
Residential	4	424	155	0.1	13
Commerical	4	47	91	0.04	9
Industrial	6	69	97	1.5	11

Trillion Btu

GROSS	489.1	51.6	389.0	434.5	111.5
Residential	23.1	40.5	160.1	1.7	44.7
Commercial	23.2	4.5	93.6	0.9	29.0
Industrial	32.8	6.6	100.4	39.1	37.8

Percentages 36 4 29 32

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	10	4,657 thousand tons	101.5
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	2	33 million cu. ft.	0.0
Crude oil wells	135	60 thousand bbl	0.3

IV. GEOLOGY

See reference list (1).

V. RESOURCE DATA

Recent seismic activity and the relative highs in the silica geotemperatures in ground water near New Madrid, MO, suggests the possibility for a deep fluid circulation system with geothermal potential (C-6).

VI. GEOHERMAL ACTIVITY

None known, but see (1).

VII. LEGAL ACTIVITIES

None known.

VIII. CONTACTS

1. Department of Natural Resources, James L. Wilson, Director, (314) 751-4000.
2. Division of State Planning and Analysis, (314) 751-4834.
3. Missouri Energy Agency, Weston Fisher, Program Director, (314) 751-4000.
4. Division of State Planning and Analysis.
5. Geological Survey, Dr. Wallace B. Howe, Director and State Geologist, (314) 364-1752.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Renner, J. L. and Vaught, Tracy L., Geothermal Resources of the Eastern United States, DOT/ET/28373-T2, Gruy Federal, Inc., Arlington, VA.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

MONTANA
GEOHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, Montana)

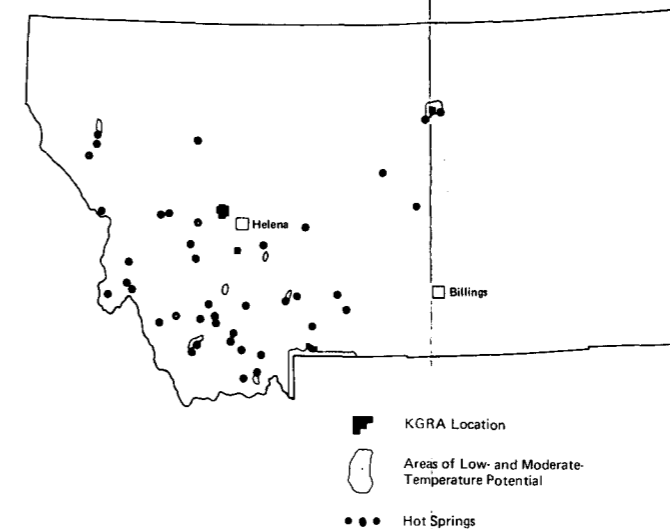
TOTAL POPULATION: 742,500 TOTAL AREA: 147,138 SQ. MI.
POPULATION DENSITY: 5.0 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	9	10,725 thousand tons	228.8
Natural Gas (liq.)	-	679 thousand bbl	2.7
Natural Gas Wells	1,118	56,175 million cu. ft.	61.4
Crude Oil Wells	3,471	34,620 thousand bbl	200.8

GEOHERMAL OVERVIEW

The Northern Rocky Mountain and the Middle Rocky Mountain physiographic provinces occur in western and southeastern Montana. These are composed of faulted and folded sedimentary rocks and intrusive rocks that form mountain blocks and intermontane basins. These provinces also contain several confirmed reservoirs of low to moderate temperatures and most of the hot springs in the state. North central and eastern Montana is in the Great Plains Province. Part of the Madison aquifer, with its yet undetermined potential for direct heat applications, is in this area.



ENERGY USE - 1975 (10¹⁴ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	118.4	5.5	83.7	16.3	30.3
RESIDENTIAL	5.9	4.1	24.9	0.1	7.0
COMMERCIAL	17.5	1.4	78.7	0.1	24.7
INDUSTRIAL	27.1	0.8	36.7	0.7	17.4
PERCENT	53	3	37	7	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION:	Ted Doney, Director
ENERGY PLANNING DIVISION:	Randy May, Administrator
ALTERNATIVE RENEWABLE ENERGY SOURCE PROGRAM:	Garry Knudsen, Administrator
DEPARTMENT OF HEALTH AND ENVIRONMENTAL SERVICES:	Arthur C. Knight, M.D., Director
MONTANA BUREAU OF MINES:	Sid Groff, Director
STATE GEOTHERMAL TEAM	
OPERATIONS RESEARCH:	Randy Moy (Montana Dept. of Natural Resources)
RESOURCE ASSESSMENT:	John Sonderegger (Montana Bureau of Mines and Geology)

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	Montana Major Facilities Siting Acts amended in 1979.

LEGISLATIVE CONTACTS

SENATORS	John Melcher (D) Max Baucus (D)	GOVERNOR	Ted Schwinden (D)
CONGRESSMEN (DIST.)	1 - Pat Williams (D) 2 - Ron Marlenee (R)		

State Geothermal Fact Sheet

MONTANA

I. DEMOGRAPHIC INFORMATION (1975) (C-4)

TOTAL STATE

Population: 742,500 Area: 147,138 sq. mi. Density: 5.0 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	21	58	81	1	9
Residential	1	43	24	0	2
Commerical	3	14	76	0	7
Industrial	5	9	36	0	5

Trillion Btu

GROSS	118.4	5.5	83.7	16.3	30.3
Residential	5.9	4.1	24.9	0.1	7.0
Commercial	17.5	1.4	78.7	0.1	24.7
Industrial	27.1	0.8	36.7	0.7	17.4

Percentages 53 3 37 7

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	9	10,725 thousand tons	228.8
Natural gas (liq.)	-	679 thousand bbl	2.7
Natural gas wells	1,118	56,175 million cu. ft.	61.4
Crude oil wells	3,471	34,620 thousand bbl	200.8

IV. GEOLOGY

The Northern Rocky Mountains and Middle Rocky Mountains physiographic provinces underlie roughly half of Montana from the northern border toward the west to the southern border toward the east. Faulted and folded sedimentary rocks as well as intrusive rocks form mountain blocks and intermontane basins. The Boulder Batholith is in southwestern Montana and is a large intrusion dated at 68 to 74 million years in age. Much of this area shows higher than normal heat flow and numerous hot springs. Geochemical well- and spring-temperature observations suggest low or moderate temperature resources that could be suited to direct heat applications. The Great Plains Province occurs in the rest of the state. The east is underlain by part of the Madison aquifer.

V. RESOURCE DATA

Three KGRAs are defined in Montana. West Yellowstone is expected to be a high temperature (>300°F) resource, but that is not confirmed as yet. Corwin, just outside the Yellowstone park, and Marysville, near Helena, are confirmed to be low to moderate (<300°F) resources. Eight other sites are also confirmed reservoirs in this temperature range. A number of other sites, including the broad area of the Madison aquifer, are considered to be likely prospects for low to moderate temperature waters.

VI. GEOHERMAL ACTIVITY

DOE selected the Warm Springs state Hospital PON proposal (1978) for design, construction, and operation of a space heating system. Resource evaluation was conducted (1979) by the Montana Energy Research and Development office and the MHD R&D Institute, Inc.

The total average of six noncompetitive leases on federal land was 10,687 (March 1979). No competitive leases in KGRAs have been awarded and no state land has been leased.

A number of test wells, ranging from 200 ft. to 6,600 ft. have been drilled in four western counties.

Exploratory activities in eight western counties include gravity, geology, resistivity, seismic, magnetic, heat flow surveys, and gradient hole drilling. USGS performed ideal flow and formation mapping in the the area of the Madison aquifer (eastern Montana) from 1977 to 1979.

Twelve counties, all but one in the Rocky Mountains Province, have operating hydrothermal systems. In addition to spas and swimming pools these projects include space heating of houses, resort cabins, and one complex of a large warehouse and shops. A subdivision of 100 to 300 units in Lewis and Clark county is to use hydrothermal space heating if disposal problems can be recorded.

VII. LEGAL ACTIVITIES

The Montana Major Facilities Siting Act includes geothermal production provisions. This act was amended in 1979 lowering the energy production limits to 50 MW for electricity and 25×10^6 Btu/hr for geothermal; the term "direct use" is not stated explicitly.

VIII. CONTACTS

1. Department of Natural Resources and Conservation, Ted Doney, Director.
2. Energy Planning Division, Randy May, Administrator.
3. Alternative Renewable Energy Source Program, Garry Knudsen, Administrator.
4. Department of Health and Environmental Services, Arthur C. Knight, M.D., Director.
5. Montana Bureau of Mines, Sid Goff, Director.
6. State Geothermal Team:
 - a. Operations Research, Randy Moy (Montana Dept. of Natural Resources).
 - b. Resource Assessment, John Sonderegger (Montana Bureau of Mines and Geology).

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Montana Hydrothermal Commercialization Baseline," EG&G Idaho Inc., Jun 1979.
- (2) Keith E. Brown, "Geothermal Energy in Montana: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Nov 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**NEBRASKA
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Nebraska)

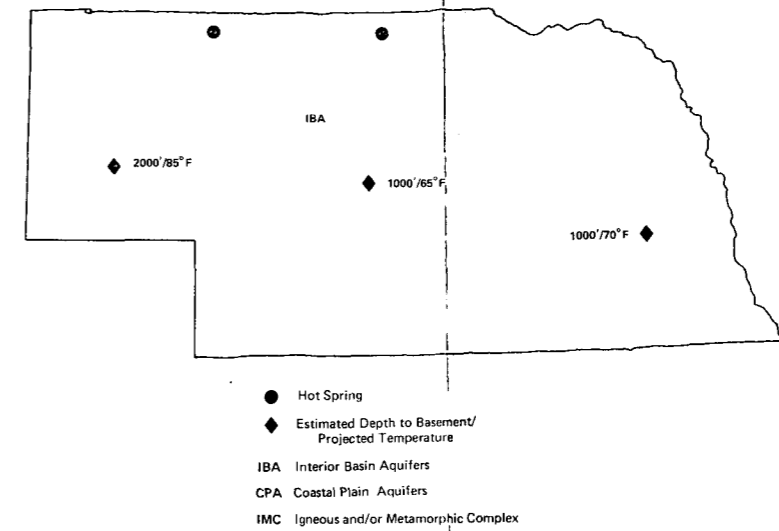
TOTAL POPULATION: 1,482,412 TOTAL AREA: 76,483 SQ. MI.
POPULATION DENSITY: 19 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	357 thousand bbl	1.4
Natural Gas Wells	29	3,836 million cu. ft.	4.2
Crude Oil Wells	1,107	7,240 thousand bbl	42.0

GEOTHERMAL OVERVIEW

A significant area shows higher than normal thermal gradient. Basement depth reaches several thousand feet only in western part of state.



ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	177.3	23.0	229.0	37.6	38.9
RESIDENTIAL	9.2	13.4	55.5	0.1	15.8
COMMERCIAL	8.3	1.5	44.5	0.1	14.9
INDUSTRIAL	17.6	7.8	79.3	6.6	8.2
PERCENT	38	5	49	8	

GEOTHERMAL ACTIVITIES

CURRENT USES	Ranchers use Hot Springs
RECENT OR CURRENT STUDIES	1. State-coupled resource assessment program. 2. Shallow Well Drilling Program, LASL HDR.
PROPOSED STUDIES	Continuation of above.
LEGAL ACTIVITIES	None known

PRIMARY CONTACTS

NATURAL RESOURCES COMMISSION:	Dayle E. Williamson, Exec. Secretary (402) 471-2081
STATE ENERGY OFFICE:	William Palmer, Director, (402) 471-2867
DEPARTMENT OF WATER RESOURCES:	John W. Newberger, Director (402) 471-2363
DEPARTMENT OF ENVIRONMENTAL CONTROL:	Dan T. Drain, Director (402) 471-2186
GEOLOGIC SUMMARY:	Vincent C. Dreeszen, State Geologist (402) 472-3471
STATE OFFICE OF PLANNING:	Don Stenberg, Director (402) 471-2414
STATE COUPLE RESOURCE PROGRAM:	William Gosnold (402) 554-2457

LEGISLATIVE CONTACTS

SENATORS	Edward Zorinsky (D)	GOVERNOR	Charles Thone (R)
	J. J. Exon (D)		
CONGRESSMEN (DIST.)			
1 - Douglas K. Bereuter (R)			
2 - Hal Daub (R)			
3 - Virginia (Mrs. Haven) Smith (R)			

State Geothermal Fact Sheet

NEBRASKA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 1,482,412 Area: 76,483 sq. mi. Density: 19 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	33	241	222	2	11
Residential	2	140	54	0.00	5
Commerical	1	16	43	0.00	4
Industrial	3	82	77	0.3	2

Trillion Btu

GROSS	177.3	23.0	229.0	37.6	38.9
Residential	9.2	13.4	55.5	0.1	15.8
Commercial	8.3	1.5	44.5	0.1	14.9
Industrial	17.6	7.8	79.3	6.6	8.2
Percentages	38	5	49	8	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	357 thousand bbl	1.4
Natural gas wells	29	3,836 million cu. ft.	4.2
Crude oil wells	1,107	7,240 thousand bbl	42.0

IV. GEOLOGY

Nebraska lies the so-called "Central Stable" geologic region of the U.S. The depth to basement varies from about 1000 ft. in the eastern to over 6000 ft. in the southwestern part of the state. A faulted zone, the Nemaha Uplift, crosses the southeastern part of Nebraska; the Denver Basin underlies the southwestern part of the Nebraska panhandle. The Nemaha Uplift is the locus of epicenters for mild seismic activity.

V. RESOURCE DATA

About 13,000 oil and gas well holes have been drilled in the state, concentrated in the western part where the deeper sedimentary strata lie (1). It is inferred that most of these holes are nonproducing, the logging records providing the permanent data. Only recently (1) has an attempt been made to fill in more completely the geothermal gradient information contained on the AAPG Geothermal Gradient Map of North America (C-1). The results of 10 heat-flow measurements in the State as well as a refined thermal gradient map are given in (1). Areas in the western, northern, and southwestern parts of the state show gradients higher than 2°F/100 ft. and a large part of the state shows a gradient in excess of 1.8°F/100 ft. Little is known of the hydrology of the deep aquifers. Oil wells into the Chadron and Cambridge Arches (which run northwest just west of central Nebraska) pump some water. The Madison Aquifer extends into Nebraska under these arches, but no information on water quantity or quality is available.

VI. GEOHERMAL ACTIVITY

There is a State Coupled Resource Assessment Program under the direction of the University of Nebraska. This program has completed information on the oil and gas wells in the state and the calculated heat flow for a few sites. Using measurements from old and a limited number of newly drilled wells, this effort has produced some refinement of the AAPG geothermal map and future plans consider the use of Bouguer gravity mapping and chemical

geothermometry. As part of the LASL Hot Dry Rock Program, a limited amount of gradient drilling has been done and is planned.

VII. LEGAL ACTIVITIES

None known.

VIII. CONTACTS

1. State Energy Office, Box 95085, Lincoln, NE 68509, William Palmer, Director, (402) 471-2867.
2. Department of Water Resources, 301 Centennial Mall, Lincoln, NE 68509, John W. Newberger, Director, (402) 471-2363.
3. Department of Environmental Control, 301 Centennial Mall, S., Lincoln, NE 68509, Dan J. Drain, Director; Gene Robinson, Air and Water Pollution Control, (402) 471-2186.
4. Geologic Survey, University of Nebraska, 113 Nebraska Hall, Lincoln, NE 68588, Vincent C. Dreeszen, State Geologist; Marvin Carlson, State Coupled Reservoir Assessment Program, (402) 472-3471.
5. State Office of Planning and Programming, Box 94601, State Capitol, Lincoln, NE 68509, Don Stenberg, Director, (402) 471-2414.
6. Natural Resources Commission, 301 Centennial Mall, Lincoln, NE 68509.
7. State Coupled Resource Program, Dept. of Geography and Geology, University of Nebraska - Omaha, Omaha, NE 68182, William Gosnold (also see item 4 above), (402) 554-2457.
8. Public Service Commission, 301 Centennial Mall, S., Lincoln, NE 68504, Everett W. Green, Secretary, (402) 471-3101.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) W. D. Gosnold, Jr., "Geothermal Studies, Nebraska," (Chapter XXIV of common reference C-8).
- (2) J. C. Maxwell, "The Hot Dry Rock Eastern Program," (Chapter VIII of common reference C-8).

- (3) "Visit to State of Nebraska," APL/JHU QM-76-134, 15 Oct 1976.
- (4) "Geothermal Resources of the Eastern United States," Gruy Federal, Inc., Arlington, VA, Report for DOE, DOE/ET/28373-T2.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), and (C-8).

NEVADA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Nevada)

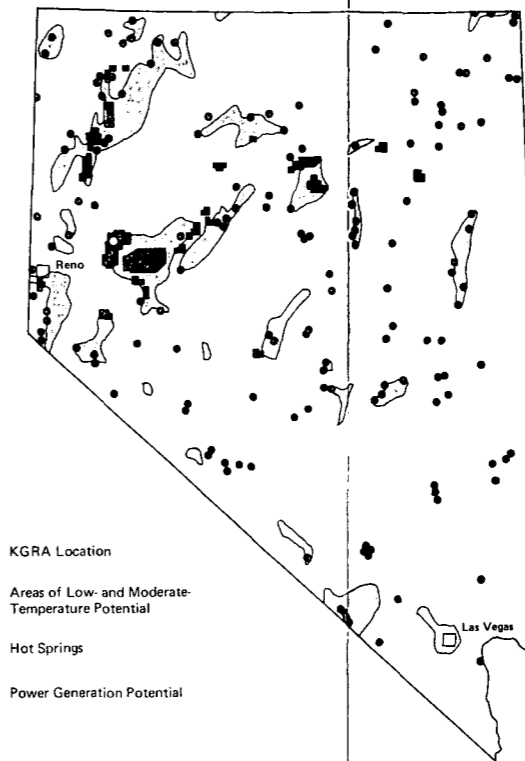
TOTAL POPULATION: 488,738 TOTAL AREA: 110,540 SQ. MI.
POPULATION DENSITY: 4.4 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	6	96 thousand bbl	0.6

GEOHERMAL OVERVIEW

Northern Nevada displays considerable potential for geothermal development. Thirty KGRAs are identified and more than 300 other sites are thought to exist. The possible generation of electricity from geothermal resources is being investigated at seven locations.



ENERGY USE - 1975 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	103.2	2.0	63.4	100.5	26.0
RESIDENTIAL	2.4	1.3	11.5	0.1	9.7
COMMERCIAL	1.6	0.2	15.4	0.1	10.3
INDUSTRIAL	3.9	0.5	10.6	1.7	6.0
PERCENT	38	1	27	37	

PRIMARY CONTACTS

STATE GEOHERMAL TEAM	
COMMERCIALIZATION PLANNING:	Noel Clark (Nevada Department of Energy)
RESOURCE ASSESSMENT:	Dennis Trexler (Nevada Bureau of Mines and Geology)
NEVADA DEPARTMENT OF ENERGY:	Noel Clark, Director
NEVADA BUREAU OF MINES AND GEOLOGY:	John Schilling, Director
NEVADA PUBLIC SERVICE COMMISSION:	Heber P. Hardy, Chairman
NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES:	Norman Hall, Director

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	The Nevada Dept. of Energy was established in 1977.

LEGISLATIVE CONTACTS

SENATORS	Howard W. Cannon (D) Paul Laxalt (R)	GOVERNOR	Robert F. List (R)
CONGRESSMEN (DIST.)	At Large - Jim Santini (D)		

State Geothermal Fact Sheet

NEVADA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 488,738 Area: 110,540 sq. mi. Density: 4.4 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	19	21	61	5	8
Residential	0	14	11	0	3
Commerical	0	2	15	0	3
Industrial	1	5	10	0	2

Trillion Btu

GROSS	103.2	2.0	63.4	100.5	26.0
Residential	2.4	1.3	11.5	0.1	9.7
Commercial	1.6	0.2	15.4	0.1	10.3
Industrial	3.9	0.5	10.6	1.7	6.0
Percentages	38	1	27	37	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	6	96 thousand bbl	0.6

IV. GEOLOGY

Nevada lies almost entirely within the Basin and Range physiographic province. This province is characterized by northward-trending mountain blocks separated by alluvial-filled basins. Mountain and valley blocks are separated by faults with vertical displacements of up to 9 or 10 thousand feet. Deep circulating water along these faults is thought to be the source of many warm springs and wells, especially in the northern half of the state. Several areas are known to contain young volcanic rocks and it is expected that other such areas will be found. At least two of the known hydrothermal systems, Steamboat Springs and Silver Peak, are thought to be related to igneous activity. Heat flow throughout the tectonically active Basin and Range province is high; it is especially high near Battle Mountain in the northern part of Nevada. In addition, northern Nevada contains numerous springs and wells whose geochemical thermometry indicates high reservoir temperatures. Thirty sites have been designated as KGRAs, over 300 more sites are believed to have exploitable geothermal potential.

V. RESOURCE DATA

Desert Peak in the Brady-Hazen KGRA has been confirmed as a high temperature reservoir. Seven more sites are believed to qualify. Four sites have been confirmed as low or moderate reservoirs. There are many more prospects.

VI. GEOHERMAL ACTIVITY

About 753,000 acres of federal land have been leased for geothermal purposes.

Two PONs were awarded (1978) in Nevada: one in Elko to demonstrate space heating of commercial buildings and one in Reno to retrofit an apartment complex with geothermal heating.

Geothermal Food Processors, Inc. started operating a food dehydration facility in 1979. This project was backed by a DOE guaranteed loan.

DOE/State and Industry Couples Programs are active at thirteen sites. These programs are providing data from existing holes as well as new gradient holes and deeper exploratory ones.

Thirty-six sites are included in the DOE/State geothermal planning process.

VII. LEGAL ACTIVITIES

The Nevada Department of Energy was established by 1977 legislation. Pending legislation (1979) deals with taxation of geothermal resources, products, and by-products.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Commercialization Planning, Noel Clark (Nevada Department of Energy);
 - b. Resource Assessment, Dennis Trexler (Nevada Bureau of Mines and Geology).
2. Nevada Department of Energy, Noel Clark, Director.
3. Nevada Bureau of Mines and Geology, John Schilling, Director.
4. Nevada Public Service Commission, Heber P. Hardy, Chairman.
5. Nevada Department of Conservation and Natural Resources, Norman Hall, Director.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Nevada Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Aug 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**NEW HAMPSHIRE
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, New Hampshire)

TOTAL POPULATION: 877,488 TOTAL AREA: 9,027 SQ. MI.
POPULATION DENSITY: 97.2 PERSONS/SQ. MI.

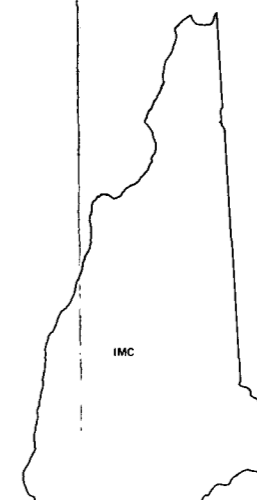
**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (Liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOHERMAL OVERVIEW

Little sedimentary cover exists in this state; however, post-tectonic plutons (which have above average concentrations of radioactive elements) do occur across the state and may have some future value.

- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex



ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	128.8	5.8	8.1	28.0	16.6
RESIDENTIAL	41.8	2.6	0.7	0.1	8.6
COMMERCIAL	19.6	0.3	2.7	0.01	3.2
INDUSTRIAL	10.0	2.5	1.4	0.2	6.2
PERCENT	75	3	5	17	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	LASL Program — Drilling and Testing Conway Granite — DOE/DGE Funded.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Division of Resources Development, Dept. of Resources and Economic Development, George Gilman, Commissioner (603) 271-2411
DIVISION OF WATER RIGHTS:	Water Resources Board, George McGee, Chairman (603) 271-3406
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	
OFFICE OF ENERGY POLICY:	Governor's Council on Energy, William R. Humm, Director (603) 271-2711
PLANNING BUREAU:	Ron Poltak, Executive Director (603) 271-2155
GEOLOGICAL SURVEY:	Robert Davis, State Geologist (603) 862-1718

LEGISLATIVE CONTACTS

SENATORS	John A. Durkin (D) Gordon Humphrey (R)	GOVERNOR	Hugh Gallen (D)
CONGRESSMEN (DIST.)			
1 - Norman E. D'Amours (D)			
2 - Judd Gregg (R)			

State Geothermal Fact Sheet

NEW HAMPSHIRE

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 877,488 Area: 9,027 sq. mi. Density: 97.2 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	23	60	8	1	5
Residential	7	27	0.7	0.00	2
Commerical	3	3	3	0.00	1
Industrial	2	26	1.3	0.00	2

Trillion Btu

GROSS	128.8	5.8	8.1	28.0	16.6
Residential	41.8	2.6	0.7	0.1	8.6
Commercial	19.6	0.3	2.7	0.01	3.2
Industrial	10.0	2.5	1.4	0.2	6.2

Percentages 75 3 5 17

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

New Hampshire is underlain by Paleozoic and Mesozoic metamorphic and igneous rocks. The highest heat flow belt (>1.8 HFU) in the East extends through this state. A group of Mesozoic igneous rocks, the White Mountain Magma Series, have higher than average concentrations of radioactive material. However, no deep sedimentary basins exist to serve as insulation for areas of high heat flow. Because of weathering, this lack of insulation, and rare subsurface data, above average subsurface temperatures are not known to exist.

V. RESOURCE DATA

Not applicable at this time.

VI. GEOHERMAL ACTIVITY

See references (1) and (2).

VII. LEGAL ACTIVITIES

Not applicable at this time.

VIII. CONTACTS

1. Division of Resources development, Dept. of Resources and Economic Development, George Gilman, Commissioner, (603) 271-2411.
2. Water Resources Board, George McGee, Chairman, (603) 271-3406.
3. Governor's Council on Energy, William R. Humm, Director, (603) 271-2711.
4. Planning Bureau, Ron Poltak, Executive Director, (603) 271-2155.

5. Geological Survey, Robert Davis, State Geologist,
(603) 862-1718.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Hot Dry Rock Geothermal Energy Development Project,
Annual Report Fiscal Year 1977," Los Alamos Scientific
Laboratory, LA-7109-PR.
- (2) "Geothermal Energy & New Hampshire," APL/JHU QM-76-108.

COMMON REFERENCES

(C-1), (C-4), (C-6), and (C-7).

**NEW JERSEY
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, New Jersey)

TOTAL POPULATION: 7,168,164 TOTAL AREA: 7,521 SQ. MI.
POPULATION DENSITY: 953 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

The unconsolidated, water rich sediments of the Atlantic Coastal Plain underlie the southern half of the state and increase in thickness in the southeast to 6500 feet. An above average geothermal gradient in the east central part of New Jersey is attractive for exploitation for hot dry rock.

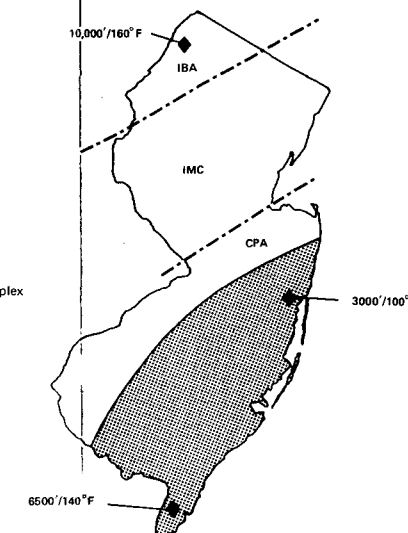
ENERGY USE — 1976 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1099.8	11.1	253.8	61.7	148.4
RESIDENTIAL	147.4	4.1	133.6	0.8	49.7
COMMERCIAL	176.1	0.5	55.1	0.6	47.7
INDUSTRIAL	94.0	6.4	56.0	2.1	51.0
PERCENT	77	1	18	4	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. Study by State Geologic Survey. 2. VPI&SU Targeting of Geothermal Energy - DOE/DGE. 3. APL/JHU Market Analysis. 4. DOE/DGE Drilling Program.
PROPOSED STUDIES	None known
LEGAL ACTIVITIES	None known

- Area Covered by APL/JHU Scenario or Market Survey
- Hot Spring
- ◆ Estimated Depth to Basement/Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex



PRIMARY CONTACTS

DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Jerry F. Englick, Commissioner (609) 292-2885
BUREAU OF GEOLOGY:	Kemble Widmer, Chief (609) 292-2576
DIVISION OF WATER RESOURCES:	Jeffery Feliksni, Director (609) 292-1637
DEPARTMENT OF ENERGY:	Joel R. Jacobson, Commissioner (201) 648-3240
DIVISION OF STATE AND REGIONAL PLANNING:	Richard A. Ginsman, Director (609) 292-2953
BOARD OF PUBLIC UTILITIES:	George H. Barbour, President (201) 648-2744

LEGISLATIVE CONTACTS

SENATORS	Harrison A. Williams, Jr. (D) Bill Bradley (D)	GOVERNOR	Brendan Byrne (D)
CONGRESSMEN (DIST.)	3 - James J. Howard (D) Timothy F. Sullivan, Adm. Asst.		
	4 - Christopher H. Smith (R)		
	7 - Marge Roukensa (R)		
	15 - Bernard J. Dwyer (D)		

State Geothermal Fact Sheet

NEW JERSEY

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 7,168,164 Area: 7,521 sq. mi. Density: 953 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 1,166,024 Area: 2,506 sq. mi. Density: 465 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	193	116	246	2.5	43
Residential	25	43	129	0.03	15
Commerical	30	5	53	0.02	14
Industrial	15	67	54	0.08	15

Trillion Btu

GROSS	1099.8	11.1	253.8	61.7	148.4
Residential	147.4	4.1	133.6	0.8	49.7
Commercial	176.1	0.5	55.1	0.6	47.7
Industrial	94.0	6.4	56.0	2.1	51.0
Percentages	77	1	18	4	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The coastal plain of New Jersey is underlain by sedimentary rocks of Mesozoic and Cenozoic age. These sedimentary accumulations form a wedge that thickens to the southeast and lies on a southeasterly sloping basement surface. The maximum depth to basement, approximately 6500 ft., occurs in Cape May County at the southern tip of the state (1). The lowermost sedimentary units in the southern half of the state are sandstones of very low permeability (2). The basement surface rises to the north (1500 ft. near Sandy Hook) in conjunction with an increase in both permeability and water quality in the overlying sediments.

A maximum geothermal gradient (2.0°F/100 ft.) occurs along the central coastal region of the state in the vicinity of Point Pleasant (3). The association and overlap of the elevated basement surface and high geothermal gradient may be related to an underlying pluton.

V. RESOURCE DATA

Before the DOE temperature gradient wells were drilled in 1978, it was known that several wells showed gradients in excess of 35°C/km (1.9°F/100 ft.). In 1978, five 1000 ft. holes were drilled as part of the DOE coastal plain drilling program (4) and the gradients were measured by VPI&SU who estimated the temperatures at basement. This program confirmed the existence of somewhat higher than normal gradients in the central and north-central coastal plain; however, the higher gradients lie in regions where the basement is only about 2000 ft. deep. From (3), the maximum estimated basement temperature which occurs at Cape May at an estimated depth of 6500 ft. is 62°C or 143°F, resulting from a near normal gradient in this limited area of relatively deep sedimentary strata. The regions of shallow sediments and above normal gradients may have possibilities as a hot dry rock source.

VI. GEOHERMAL ACTIVITY

The geothermal gradient test holes and the assessment of the data have been completed as part of the DOE/DGE East Coast drilling program. The APL study of potential energy markets in the resource area has been completed (5).

VII. LEGAL ACTIVITIES

None known.

VIII. CONTACTS

1. Department of Energy, 1100 Raymond Blvd., Newark, NJ 07102, Joel R. Jacobson, Commissioner, (201) 648-3290.
2. Bureau of Geology, Dept. of Environmental Protection, P.O. Box 1390, Trenton, NJ 08625, Kemble Widmer, Chief, (609) 292-2576.
3. Division of Water Resources, Department of Environmental Protection, P.O. Box 2809, Trenton, NJ 08625, Jeffery Feliksoni, Director, (609) 292-1637.
4. Department of Environmental Protection, P.O. Box 1390, Trenton, NJ 08625, Jerry F. English, Commissioner, (609) 292-2885.
5. Division of State and Regional Planning, P.O. Box 2768, 329 W. State Street, Trenton, NJ 08625, Richard A. Ginsman, Director, (609) 292-2953.
6. Board of Public Utilities, 101 Commerce Street, Newark, NJ 07102, George H. Barbour, President, (201) 648-2744.
7. State Coupled Geothermal Assessment Program, VPI&SU, Blackburg, VA 24061, Prof. John Costain, (703) 961-5096.

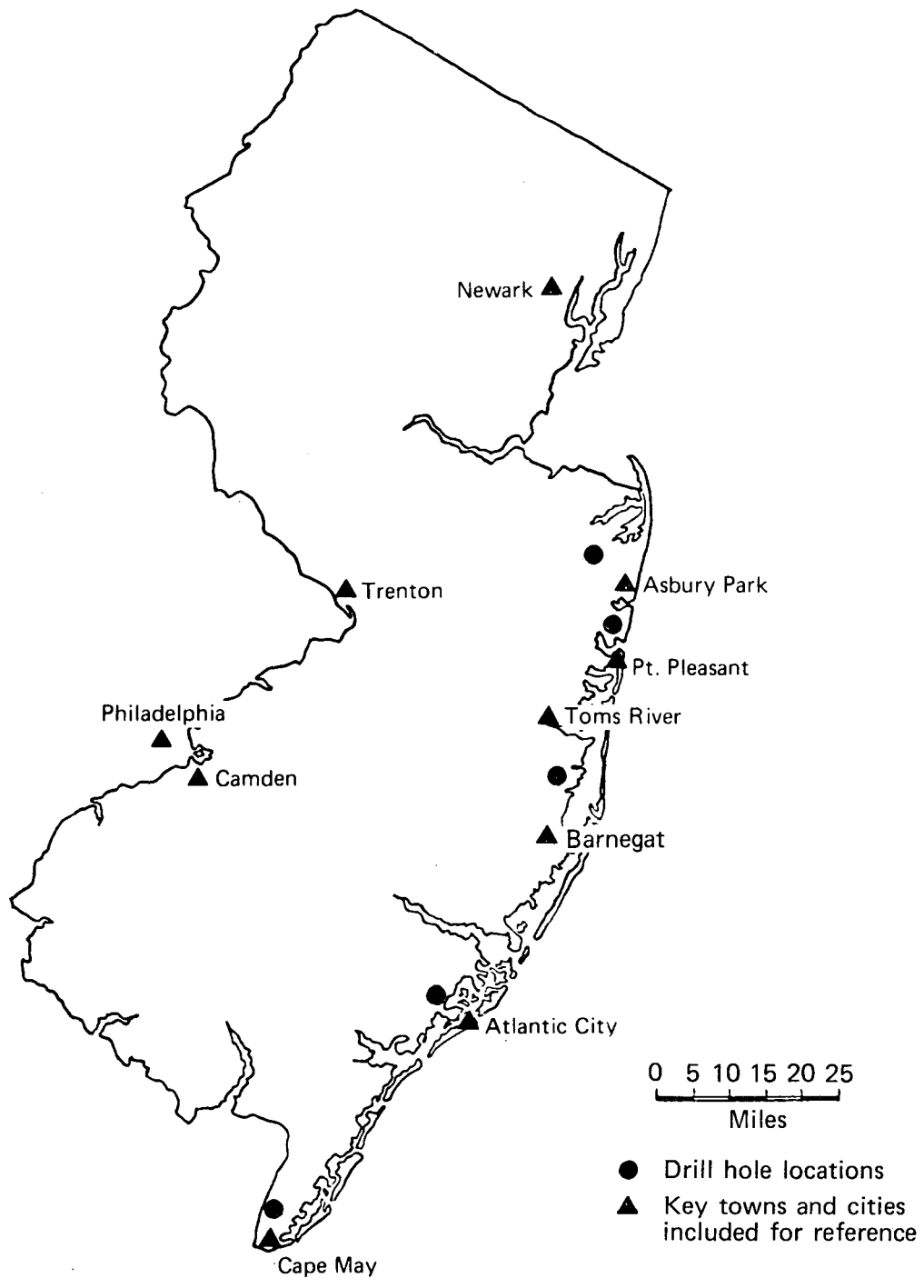
REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) P. M. Brown, J. A. Miller, and F. W. Swain, "Structural and Stratigraphic Framework, and Spatial Distribution of Permeability of the Atlantic Coastal Plain, North Carolina to New York," U.S.G.S. Professional Paper 796, 1972.
- (2) "New Jersey and Geothermal Energy," APL/JHU QM-78-031, 20 Mar 1978.

- (3) "Evaluation and Targeting of Geothermal Energy Resources in the Southeastern United States," VPI&SU, Blacksburg, VA, DOE Report No. VPI&SU-5648-5, 30 Mar 1979.
- (4) "Atlantic Coastal Plain Geothermal Test Holes, New Jersey," Gruy Federal, Inc., Houston, Texas, DOE Report No. NVD-1558-1.
- (5) "Geothermal Energy Market Study in the Atlantic Coastal Plain, Definitions of Markets for Geothermal Energy in the Northern Atlantic Coastal Plain," JHU/APL GEM-002 (QM-80-075), May 1980.
- (6) "Geothermal Resources of the Eastern United States," Gruy Federal, Inc., Arlington, VA, U.S. DOE Report No. DOE/ET/28373-T2.

COMMON REFERENCES

(C-1), (C-4), (C-6), and (C-7).



Locations of gradient test holes — New Jersey.

**NEW MEXICO
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, New Mexico)

TOTAL POPULATION: 1,143,827 TOTAL AREA: 121,666 SQ. MI.
POPULATION DENSITY: 9.4 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	6	9,070 thousand tons	209.3
Natural Gas (liq.)	-	39,500 thousand bbl	159.3
Natural Gas Wells	9,711	1,218,749 million cu. ft.	1,332.1
Crude Oil Wells	17,099	100,986 thousand bbl	585.7

GEOTHERMAL OVERVIEW

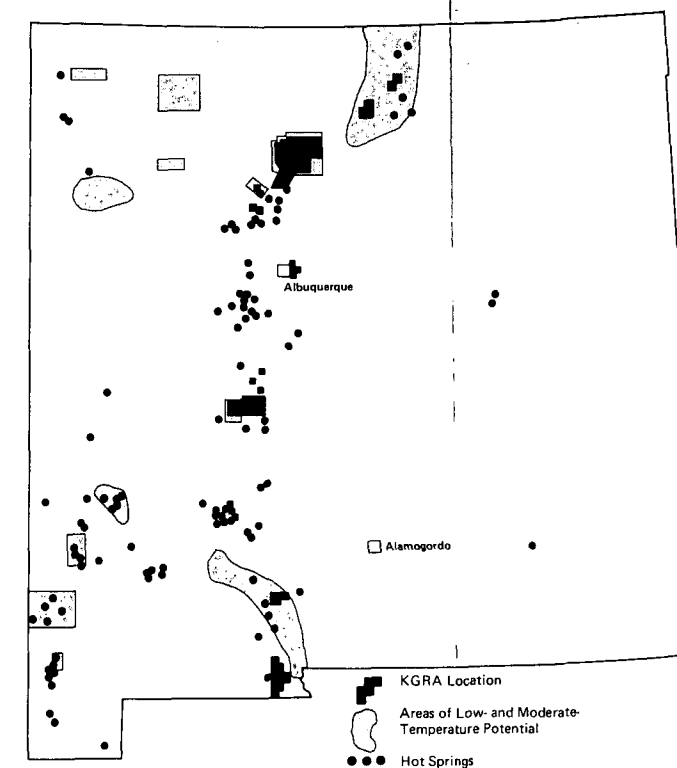
The Valles Caldera, west of Los Alamos, has been under development for several years. Geothermal resources have been proven to be adequate for electrical generation and a 50 MW plant is scheduled to be on line in 1982. Current exploration is expected to locate other high temperature resources along the Rio Grande Rift and in the Basin and Range Province in the southwest corner of New Mexico. Many low and moderate temperature resources are known but reservoirs have not been confirmed.

ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	164.5	10.1	254.1	132.5	22.8
RESIDENTIAL	4.1	5.4	28.7	0	6.5
COMMERCIAL	4.8	0.6	23.5	0	10.7
INDUSTRIAL	19.3	3.8	105.6	0	5.6
PERCENT	29	2	45	24	

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	See text.



PRIMARY CONTACTS

STATE GEOTHERMAL TEAM	
OPERATIONS RESEARCH: Ed Grisham, Team Leader	
RESOURCE ASSESSMENT: Chandler Swanberg, New Mexico State Univ.	
NEW MEXICO NATIONAL RESOURCES DEPARTMENT: Steve Reynolds, State Engineer; Bill Huiy, Secretary	
NEW MEXICO ENERGY AND MINERALS DEPARTMENT: Larry Kehoe, Administrator	
NEW MEXICO STATE LAND OFFICE: Alex Armijo, State Land Commissioner	

LEGISLATIVE CONTACTS

SENATORS	Pete V. Domenici (R) Harrison H. Schmitt (R)	GOVERNOR	Bruce King (D)
CONGRESSMEN (DIST.)			
1 - Manuel Lujan, Jr. (R)			
2 - Joe Skeen (I)			

State Geothermal Fact Sheet

NEW MEXICO

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 1,143,827 Area: 121,666 sq. mi. Density: 9.4 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	30	106	246	7	7
Residential	1	56	28	0	2
Commerical	1	6	23	0	3
Industrial	3	39	102	0	2

Trillion Btu

GROSS	164.5	10.1	254.1	132.5	22.8
Residential	4.1	5.4	28.7	0	6.5
Commercial	4.8	0.6	23.5	0	10.7
Industrial	19.3	3.8	105.6	0	5.6

Percentages 29 2 45 24

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

NM-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	6	9,070 thousand tons	209.3
Natural gas (liq.)	-	39,500 thousand bbl	159.3
Natural gas wells	9,711	1,218,749 million cu. ft.	1,332.1
Crude oil wells	17,099	100,986 thousand bbl	585.7

IV. GEOLOGY

Several hundred thermal springs and wells are found in New Mexico. These are concentrated in the Rio Grande Rift and the Basin and Range Province in the southwestern part of the state. Both areas exhibit characteristics associated with geothermal potential: active extensional tectonics, recent volcanism, active seismicity, high heat flow, and young hydrothermal mineral deposits in addition to the springs and wells.

The Rio Grande Rift extends from Colorado through southern New Mexico. The rift zone is composed of a series of en-echelon north-trending grabens and half-grabens. This rift borders, crosses, or merges with the four geologic provinces recognized in New Mexico. It passes through the Southern Rocky Mountains and partially adjoins the Colorado Plateau to the west. The Great Plains Province lies to the east of the rift and the Basin and Range abuts the rift to the west. Fault scarps with varying degrees of exposure are common along the length of the rift.

The Rio Grande Rift and adjacent regions have experienced volcanic activity through most of the Cenozoic era. Volcanism concurrent with rifting began about 20 to 26 million years ago, predominantly along the middle and western parts of the rift. Subsequent volcanic activity forms the Jemez Mountains, the Socorro and Magdalena Peaks. The youngest volcanic rocks in the state are about 10 thousand years old.

The hot spring activity in New Mexico corresponds, generally, to the regions of young volcanism and high heat flows (>2.5 HFU). These high flows coincide with the entire western part of the Rio Grande Rift, define an area in the vicinity of the McCarty's basalt and encompass a region in southwestern New Mexico and southeastern Arizona. A portion of the ribbon of high heat flow overlies an area near Socorro where an extensive (>660 sq. mi.) sill-like magma body is located a depth of about 11 miles. In southwestern New Mexico the thermal anomaly is associated with the north-trending Basin and Range structures. In this region Quaternary basaltic volcanism is widespread in addition to older silicic volcanic rocks.

V. RESOURCE DATA

Eight KGRAs, totaling about 500 sq. mi., have been designated by USGS. One of these, in Valles Caldera, has been confirmed as a high temperature resource. At least four others plus additional areas are considered to be potential high temperature resources. Many prospective low and moderate resources have yet to be confirmed.

VI. GEOHERMAL ACTIVITIES

In the Valles Caldera region (the Base Location No. 1 KGRA), Union Oil Company has drilled six producing wells with bottom hole temperatures ranging between 460 and 570°F. This confirmed reservoir is estimated to contain 3/4 cubic mile of water in its 32 cubic mile volume. Electrical potential is rated conservatively as 400 MW for 30 years. A joint venture of Union and the Public Service Co. of New Mexico, with 50% DOE funding, is to have a 50 MW demonstration plant on line in 1982.

Leases totalling 260,000 acres have been granted (1978), about 75% on Federal lands, 25% on state.

The Los Alamos Scientific Laboratory, under DOE sponsorship, has been performing hot dry rock experiments in New Mexico; the 1979 project was a 9 MW extraction loop.

State assisted geothermal heating demonstration projects include a center for the elderly, a hospital, and a greenhouse.

VII. LEGAL ACTIVITIES

In 1967 the state's Geothermal Resources Act was enacted and required all state lands to be leased through competitive bidding only and for terms of five years. 1973 legislation directed the Oil Conservation Division to regulate drilling, development, and production of geothermal resources and to conserve the resources in the same manner as the Division regulated natural gas. This action was followed in 1975 by enactment of the Geothermal Resources Conservation Act and gives the state access to drilling and abandonment records. Also enacted in 1975 was the Energy Research and Development Act, which created a fund to share costs of research and development projects. 1979 legislation clarified procedures and powers in the conservation act and authorized a review of geothermal leasing policies. Various relaxations of leasing policy were recommended for adaption at subsequent meetings of the legislature.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research, Ed Grisham, Team Leader;
 - b. Resource Assessment, Chandler Swanberg, New Mexico State University.
2. New Mexico National Resources Department, Steve Reynolds, State Engineer; Bill Huiy, Secretary.
3. New Mexico Energy and Minerals Department, Larry Kehoe, Administrator.
4. New Mexico State Land Office, Alex Armijo, State Land Commissioner.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "New Mexico Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., May 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**NEW YORK
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, New York)

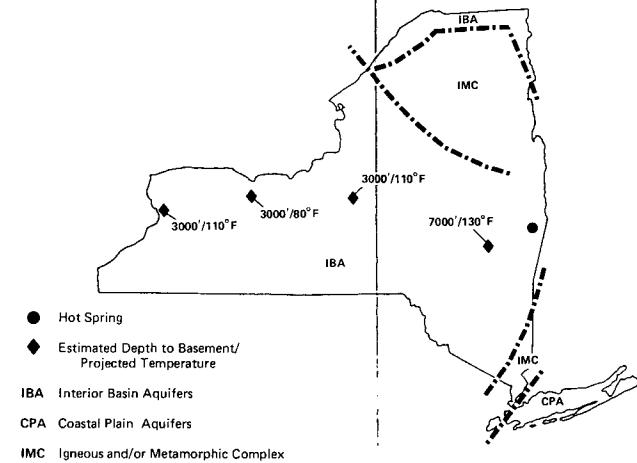
TOTAL POPULATION: 18,241,584 TOTAL AREA: 47,831 SQ. MI.
POPULATION DENSITY: 381 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	-	15,500 million cu. ft.	16
Crude Oil Wells	-	855 thousand bbl	0.0049

GEOTHERMAL OVERVIEW

Within New York, the Champlain Valley and the Appalachian Basin are deep sedimentary basins with above average geothermal gradients locally and may have potential as hydrothermal resources. The western part of the state has thinner sedimentary cover but higher gradients and may be attractive for hot dry rock development.



ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	2436.1	20.8	604.7	315.2	326.0
RESIDENTIAL	435.0	13.1	377.9	4.4	98.0
COMMERCIAL	380.0	1.5	132.4	2.8	126.3
INDUSTRIAL	68.0	6.1	117.4	64.2	93.5
PERCENT	72	1	18	9	

GEOTHERMAL ACTIVITIES

CURRENT USES	Saratoga Springs
RECENT OR CURRENT	<ol style="list-style-type: none"> 1. Joint NYSERDA and DOE/DGE state-coupled resource assessment program; Dunn Geoscience assessing capital area New York. 2. LASL funded study in three areas of the western half of state in cooperation with Dennis Hodges of University of Buffalo at Amherst. 3. Joint NYSERDA, DOE/DGE drilling resource continuation well at Clinton Corn Products plant, Montezuma, New York. 4. Analysis of potential geothermal resources and their use, Lebanon Springs Area, New York. (for NYSERDA by J. R. Dunn.) 5. Geothermal resource evaluation, eastern New York state: NYSERDA 79-6, by J. R. Young and J. R. Dunn.
PROPOSED STUDIES	JHU/APL proposal to NYSERDA on locating zones of enhanced permeability in the Appalachian Basin.
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Department of Environmental Conservation, Henry L. Diamond, Commissioner (518) 474-2121
DIVISION OF WATER RIGHTS:	Bureau of Water Management, Eldred Rich, Assistant Director (518) 474-2121
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Henry L. Diamond, Commissioner (518) 474-2121
OFFICE OF ENERGY POLICY:	New York State Energy Office, Ted Deboer
PLANNING BUREAU:	Office of Planning Services, Executive Department, Richard A. Wiebe, Director (518) 474-2121
GEOLOGICAL SURVEY:	Dr. Robert Fakunding, State Geologist (518) 474-5816
ERDA:	New York ERDA, Dr. Burton Krakow

LEGISLATIVE CONTACTS

SENATORS	Jacob K. Javitts (R) Daniel P. Moynihan (D)	GOVERNOR	Hugh L. Carey (D)
CONGRESSMEN (DIST.)		Counties:	((P) = part)
	3 - Greg Carman (R)		
	5 - Raymond J. McGrath (R)		
	6 - John Leboutillier (R)		
	16 - Charles E. Schumer (D)		
	17 - Guy V. Molinari (R)		
	29 - Gerald Soloman (R)	Rensselaer, Saratoga	
	30 - David Martin (R)	Oswego (P)	
	32 - George Wortley (R)	Onondaga (P)	
	33 - Gary Lee (R)	Cayuga, Onondaga (P), Ontario (P), Oswego (P), Schuyler, Seneca, Steuben (P), Tomkins (P), Yates	
	34 - Frank Horton (R)	Monroe (P), Wayne	
	35 - Barber B. Conable, Jr. (R)	Genesee, Livingston, Monroe (P), Ontario (P), Wyoming	
	36 - John J. LaFalce (D)	Erie (P), Monroe (P), Niagara, Orleans	
	37 - Henry J. Nowak (D-Lib)	Erie (P)	
	38 - Jack Kemp (R)	Erie (P)	
	39 - Stanley N. Lundine (D)	Allegheny, Cattaraugus, Chatauqua, Chemung (P), Erie (P), Steuben (P)	

State Geothermal Fact Sheet

NEW YORK

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 18,241,584 Area: 47,831 sq. mi. Density: 381 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 2,611,000 Area: 12,672 sq. mi. Density: 206 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	422	218	586	12	96
Residential	75	137	327	0.2	29
Commerical	62	15	128	0.1	37
Industrial	11	64	114	2	27

Trillion Btu

GROSS	2436.1	20.8	604.7	315.2	326.0
Residential	435.0	13.1	377.9	4.4	98.0
Commercial	380.0	1.5	132.4	2.8	126.3
Industrial	68.0	6.1	117.4	64.2	93.5

Percentages 72 1 18 9

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

NY-1

III. STATE FUEL PRODUCTION (1979) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	-	15,500 million cu. ft.	16
Crude oil wells	-	855 thousand bbl	0.0049

IV. GEOLOGY

Paleozoic sedimentary rocks on the northern limb of the Appalachian Basin underlie most of New York State. These rocks form a wedge that begins on the flanks of the Adirondack Dome and the Frontenac Axis to the north and thickens to more than 10,000 ft. along the New York-Pennsylvania border. The Adirondack Dome consists of Precambrian (Grenville age is about 1.1 billion years ago) rocks, similar in age to the belt of gneisses called the Hudson Highlands that crosses the southeastern part of the state and forms the eastern boundary to the Appalachian Basin. Southeast of this belt lies the Manhattan Prong, a series of late Precambrian to Paleozoic metamorphic rocks. Dropped between the Manhattan Prong and the Hudson Highlands is the Newark Basin, which is filled with more than 10,000 ft. of Triassic-Jurassic aged sedimentary and igneous rocks. Long Island is underlain by the unconsolidated sediments of the Coastal Plain that thicken to about 2000 ft. toward the east.

Several areas of New York State may have geothermal potential. High thermal gradients exist in the Appalachian Basin and are associated with varying amounts of sedimentary cover. Where the cover, which may act as insulation, is thin and coincides with an elevated gradient, such as at Buffalo (3000 ft. to basement), the potential for hot dry rock development is good. The thick sedimentary sequences of the Appalachian, Champlain, and Newark Basins, where they are associated with elevated gradients, may also be exploitable. If these sedimentary sequences contain extractable water at depth, they may contain hydrothermal systems.

V. RESOURCE DATA

High gradients ($>2.0^\circ/100$ ft.) have been measured in the western part of the state between Binghamton and Buffalo and Syracuse. In this area the sedimentary rocks thicken from 2000 ft. in the north to an excess of 12,000 ft. in the south.

No gradient data are available for the Champlain Valley. However, this basin is genetically, structurally, and magmatically related to the Montreal region, which has the highest gradients

(greater than 3.0°F/100 ft.) recorded in eastern North America. If similar gradients exist in this area, then the temperatures at the base of the 10,000 to 15,000 ft. sequence in the Albany area may be significant. The extensive faulting in the Champlain Valley may provide the framework for a regional convection system. Differential vertical movements across this 15,000-ft. deep basin are presently occurring. Locally, CO₂ is produced from shallow water wells, which may indicate a shallow heat source at the base of the sediment.

No gradient data are available for the northeastern end of the Newark Basin, which lies in southeastern New York. Although this part of the Basin is not known to exceed a depth of 5000 ft., its control by major crustal faults make it a likely insulating cap for a potential convection system.

VI. GEOHERMAL ACTIVITY

- Current studies:
1. New York ERDA together with DOE/DGE has funded Dunn Geoscience Corp. to study CO₂-rich waters in the capitol area (Rensselaer Co.) (4). Dunn also studied water-referenced heat pumps on a contract with the National Water Well Association. NYSERDA and Dunn Geoscience are studying space heating of public buildings with heat pumps and water from springs at Lebanon Springs, New York (8).
 2. DOE/DGE and NYSERDA are drilling a resource confirmation well near Clinton Corn Products Plant, Montezuma, NY (6) and (9).
 3. LASL has funded a study (5) of heat flow and thermal gradients in the western half of the state as a potential HDR demonstration site.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. New York ERDA, Agency Building No. 2, Empire State Plaza, Albany, NY 12223, Dr. B. Krakow.

2. Geologic Survey, New York State Education Building, Albany, NY 12224, Dr. Robert Fakunding, (518) 474-5816.
3. New York State Energy Office, Albany, NY, Ted Deboer.
4. Dunn Geoscience Corp., North Latham, NY 12110, James R. Dunn.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Y. W. Isachsen, "Investigations of Two Areas in New York State Which May Have Potential for Geothermal Energy," State University of New York, COO-2694-3.
- (2) Y. W. Isachsen, et al., "The Panther Mountain Circular Structure: A Possible Buried Meteorite," Guide Book to Field Excursions - 49th Annual Meeting N.Y. State Geological Association.
- (3) Y. M. Isachsen, "Contemporary Doming of the Adirondack Mountains, N.Y.," Trans. American Geophysics Union, EOS Vol. 57, No. 325, 1976.
- (4) "Geothermal Resource Evaluation - Eastern New York State," Dunn Geoscience Corp. Report NYSERDA 79-6, Aug 1979.
- (5) Geothermal Studies, Western New York, K. G. Hilfiker, State University, N.Y., Buffalo, Published in Common Ref. (C-8).
- (6) NYSERDA Proposal, Montezuma (Cayuga County, N.Y.).
- (7) "Requirements for Hydrologic Test Well in Western New York State," JHU/APL Letter CQO-2852 to Dr. B. Krakow, NYSERDA, Apr 3, 1980.
- (8) "Analysis of Potential Geothermal Resources and Their Use, Lebanon Springs Area, New York," Dunn Geoscience Corp. Draft Report to NYSERDA, 17 Jul 1980.
- (9) "Geothermal Energy in Cayuga County, New York," JHU/APL QM-80-082, 28 May 1980.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-8).

**NORTH CAROLINA
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, North Carolina)

TOTAL POPULATION: 5,082,059 TOTAL AREA: 48,798 SQ. MI.
POPULATION DENSITY: 104 PERSONS/SQ. MI.

GEOTHERMAL RESOURCE DATA

NAME	Coastal Plain Sediment
TYPE	Clastic and carbonate
DEPTH	Up to 10,000 ft.

GEOTHERMAL OVERVIEW

The thickness of sediments within the Atlantic Coastal Plain increases to greater than 10,000 feet to the east. Locations of high gradient do occur and therefore represent potential hydrothermal and hot dry rock resources.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

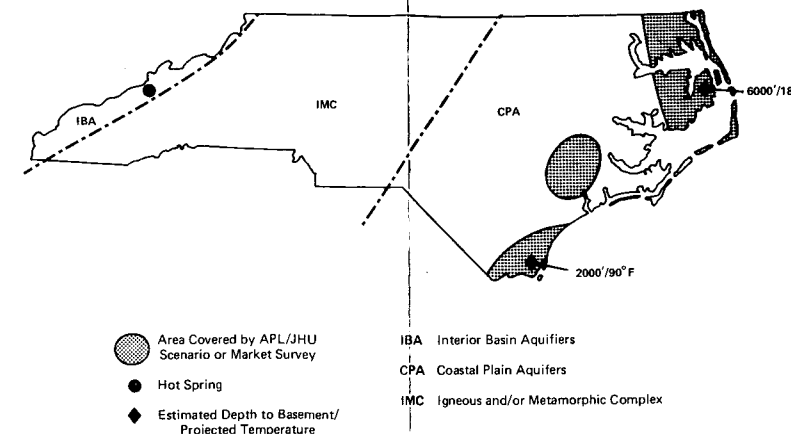
TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

ENERGY USE - 1975 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	731.	22.5	75.0	534.0	198.0
RESIDENTIAL	69.0	10.0	33.0	2.1	76.0
COMMERCIAL	32.0	1.1	19.0	1.6	49.0
INDUSTRIAL	95.0	11.1	20.0	46.0	72.0
PERCENT	50	2	5	36	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. VPI&SU Geothermal Targeting & Evaluation, Coastal Plain. 2. APL/JHU energy market analysis completed. 3. Coastal Plain Geothermal Gradient Drilling Project, DOE/DGE.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	NCSL may conduct workshop for state legislature to consider geothermal legislation.



PRIMARY CONTACTS

ENERGY DIVISION:	Brian Flattery, Director (919) 733-2230
GEOLOGICAL SURVEY SECTION:	James Sampair, Geologist (919) 733-7353
COAST ZONE MANAGEMENT:	Ken Stewart (919) 733-2293
LAND USE PLANNING:	Mark Sullivan (919) 733-3833
ENVIRONMENTAL IMPACT ASSESSMENT:	C. Baggitt, Supervisor (919) 733-7061
PUBLIC UTILITY REGULATION:	Robert K. Kroger, Chairman (919) 733-4249

LEGISLATIVE CONTACTS

SENATORS	Jesse A. Helms Robert B. Morgan	GOVERNOR	James B. Hunt (D)
CONGRESSMEN (DIST.)			
1 - Walter P. Jones (D)			
2 - L. H. Fountain (D)			
3 - Charles O. Whitley, Sr. (D)			
6 - Eugene Johnstone (R)			
7 - Charles Rose (D)			
11 - William M. Hendon (R)			

State Geothermal Fact Sheet

NORTH CAROLINA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 5,082,059 Area: 48,798 sq. mi. Density: 104 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 305,693 Area: 7,111 sq. mi. Density: 43 per sq. mi.

II. ENERGY CONSUMPTION* (1977) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	105	235	73	22	58
Residential	12	105	32	0.07	22
Commerical	5	12	18	0.04	14
Industrial	16	116	20	1.5	21

Trillion Btu

GROSS	731	22.5	75	534.0	198
Residential	69	10.0	33	2.1	76
Commercial	32	1.1	19	1.6	49
Industrial	95	11.1	20	46.	72
Percentages	50	2	5	36	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The surface of the basement complex to the north of Wilmington dips to the southeast attaining a maximum onshore depth of approximately 10,000 ft. in the vicinity of Cape Hatteras. Coastal plain sediments, which range in age from Cretaceous to Recent, form a southeasterly thickening wedge that overlies the Precretaceous basement complex. An onshore positive basement structure, trending northwest-southeast, is the dominant structural feature south of Wilmington. This feature, the Cape Fear Arch, is covered by a thin (about 1500 ft.) veneer of sedimentary rocks.

V. RESOURCE DATA

The DOE/DGE sponsored geothermal drilling program drilled eleven 1000 ft. gradient holes in the North Carolina coastal plain. The geothermal gradients varied from 22°C/km to 41°C/km (1.2°F/100 ft. to 2.2°F/100 ft.). Since the depth to basement is 2000 to 3000 ft. over much of the coastal plain, estimates of temperatures at basement are modest, i.e., 30°C to 44°C (86 to 112°F). However for several holes on the mainland, to the west of Cape Hatteras, and where the depth to basement is 4000 to 5000 ft., temperatures at basement are estimated to be as high as 85°C (185°F) (3).

VI. GEOHERMAL ACTIVITIES

The geothermal gradient test holes sponsored by the DOE/DGE drilling program have been completed and the results have been assessed by VPI&SU. APL/JHU has conducted and published a study of the energy markets in the northern coastal region of the state (6). APL has forwarded information to a utility (Carolina Power and Light) on the nature and prospects for geothermal energy.

VII. LEGAL ACTIVITIES

NCSL may conduct a workshop for state legislature to consider geothermal legislation.

VIII. CONTACTS

1. Energy Division, 430 N. Salisbury St., Raleigh, NC 27611, Brian Flattery, Director, (919) 733-2230.
2. Energy Policy Council, c/o Energy Division, 430 N. Salisbury St., Raleigh, NC 27611, (15 member council), (919) 733-2230.
3. Energy Facility Siting, N.C. Utilities Commission, Public Staff, 430 N. Salisbury St., Raleigh, NC 27611, Andrew W. Williams, Chief, Electric Division, (919) 733-2267.
4. Public Utility Regulation, N.C. Utilities Commission, 430 N. Salisbury St., Raleigh, NC 27611, Robert K. Koger, Chairman, (919) 733-4249.
5. Legislative Energy Related Committees, Legislative Building, Raleigh, NC 27603, (919) 733-7044.
 - a. Public Utilities and Energy Committee
State House of Representatives
Representative Dwight W. Quinn, Chairman
Terrence Sullivan, Director of Research
 - b. Public Utilities and Energy Committee
State Senate
Senator James B. Garrison, Chairman
Terrence Sullivan, Director of Research
6. Legislative Services, Legislative Services Office, Legislative Building, Raleigh, NC 27603, John Allen, Legislative Services Officer, (919) 733-7044.
7. Resource Planning and Inventory Section, Division of Land Resources, Dept. of Natural Resources & Community Development, P.O. Box 27687, Raleigh, NC 27611, Mark Sullivan, Chief, (919) 733-3833.
8. Geological Survey Section, Division of Land Resources, Dept. of Natural Resources & Community Development, P.O. Box 27687, Raleigh, NC 27611, James Sampair, Senior Geologist for the Coastal Plain, (919) 733-7353.
9. Coastal Zone Management, Dept. of Natural Resources and Community Development, P.O. Box 27687, Raleigh, NC 27611, David Owens, Chief of Planning and Technical Services, (919) 733-2293.

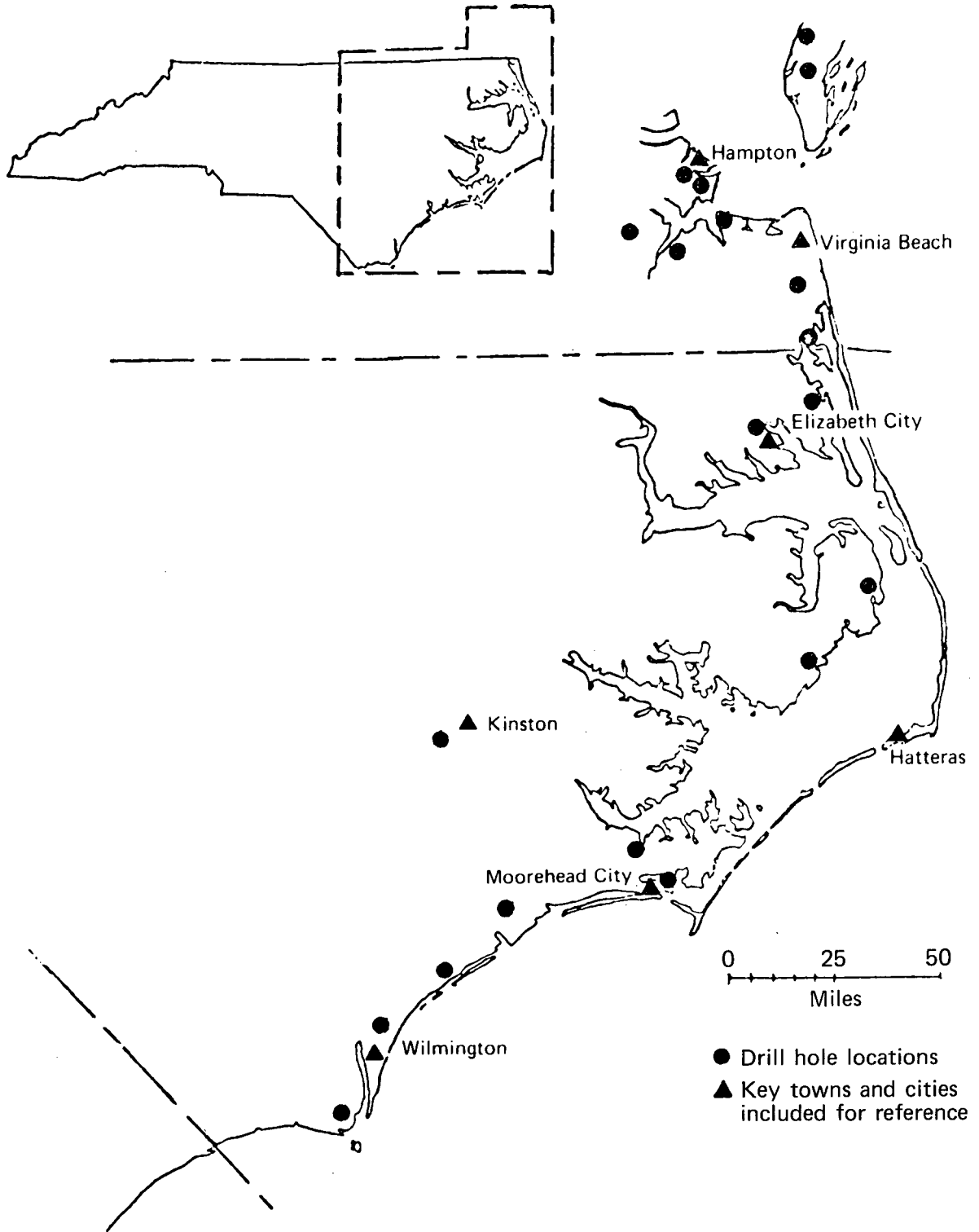
10. Environmental Impact Assessments, Division of Budget Management, 116 W. Jones St., Raleigh, NC 27603, Crys Baggett, Clearinghouse Supervisor, (919) 733-7061.
11. State Coupled Reservoir Assessment Program, VPI&SU, Blacksburg, VA 24061, Prof. John Costain, Geothermal Program, (703) 961-5096.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) P. M. Brown, J. A. Miller, and F. M. Swain, "Structural and Stratigraphic Framework and Spatial Distribution of Permeability of the Atlantic Coastal Plain, North Carolina to New York," U.S.G.S. Professional Paper 796, 1972.
- (2) "Evaluation and Targeting of Geothermal Energy Resources in the Southeastern United States, Progress Report Oct 1, 1978 - March 30, 1979," VPI&SU, Blacksburg, VA, DOE Report VPI-SU-5648-5.
- (3) "Geothermal Resources of the Eastern United States," Gruy Federal, Inc., Arlington, VA, DOE Report DOE/ET/28373-T2.
- (4) "Geothermal Energy Market Study in the Atlantic Coastal Plain, Definitions of Markets for Geothermal Energy in the Northern Atlantic Coastal Plain," APL/JHU GEM-002 (QM-80-075), May 1980.

COMMON REFERENCES

(C-1), (C-4), (C-5), (C-6), and (C-7).



Locations of gradient test holes — Eastern North Carolina.

**NORTH DAKOTA
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, North Dakota)

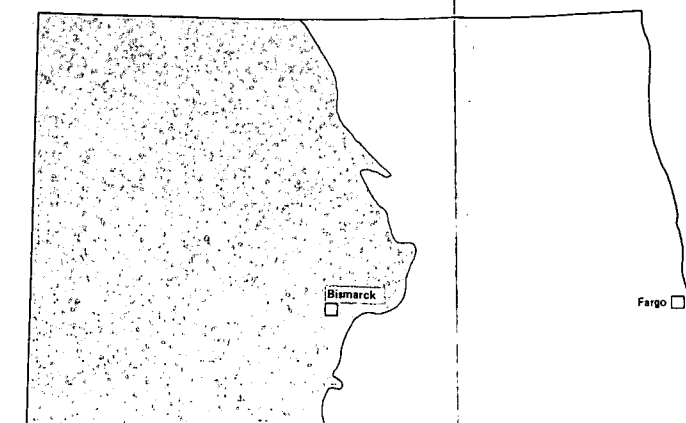
TOTAL POPULATION: 617,761 TOTAL AREA: 70,665 SQ. MI.
POPULATION DENSITY: 8.7 PERSONS/SQ. MI.


**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	12	6,905 thousand tons	97.8
Natural Gas (liq.)	-	1,889 thousand bbl	7.6
Natural Gas Wells	44	27,703 million cu. ft.	30.3
Crude Oil Wells	1,404	20,235 thousand bbl	117.4

GEOHERMAL OVERVIEW

Western North Dakota is underlain by the Madison aquifer and thus is thought to have some geothermal potential. However the present knowledge of the extent, quality, and temperature of the fluids is limited.



 Areas of Low and Moderate-Temperature Potential

ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	98.3	6.3	38.8	80.2	12.5
RESIDENTIAL	9.9	5.0	10.5	1.1	6.0
COMMERCIAL	7.6	0.6	12.8	0.6	4.5
INDUSTRIAL	17.2	0.8	15.2	8.1	1.9
PERCENT	44	3	17	36	

PRIMARY CONTACTS

STATE GEOHERMAL TEAM	
COMMERCIALIZATION PLANNING:	Clifford Ness, Robert Kaiser (State Energy Office)
RESOURCE ASSESSMENT:	Erling Brosteun, Ken Harris (North Dakota Geological Survey)
NORTH DAKOTA GEOLOGICAL SURVEY:	Lee Gerhard, Director
NORTH DAKOTA WATER COMMISSION:	Vernon Fahy, State Engineer
NORTH DAKOTA STATE LAND DEPARTMENT:	R. E. Lommen, Director
NORTH DAKOTA PUBLIC SERVICE COMMISSION:	Richard Elkin, President

LEGISLATIVE CONTACTS

SENATORS	Milton R. Young (R) Quentin N. Burdick (D)	GOVERNOR	Allen I. Olson (R)
CONGRESSMEN (DIST.)			
At large - Mark Andrews (R)			
1 - Byron L. Dorgan (D)			

GEOHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

State Geothermal Fact Sheet

NORTH DAKOTA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 617,761 Area: 70,665 sq. mi. Density: 8.7 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	18	66	38	6	4
Residential	2	53	10	0	2
Commerical	1	6	12	0	1
Industrial	3	8	15	0.5	0.6

Trillion Btu

GROSS	98.3	6.3	38.8	80.2	12.5
Residential	9.9	5.0	10.5	1.1	6.0
Commercial	7.6	0.6	12.8	0.6	4.5
Industrial	17.2	0.8	15.2	8.1	1.9

Percentages 44 3 17 36

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	12	6,905 thousand tons	97.8
Natural gas (liq.)	-	1,889 thousand bbl	7.6
Natural gas wells	44	27,703 million cu. ft.	30.3
Crude oil wells	1,404	20,235 thousand bbl	117.4

IV. GEOLOGY

North Dakota lies entirely in the Great Plains physiographic province. The geologic feature of interest with respect to geothermal energy is the Madison aquifer occurring in the western half of the state. The Madison contains a regionally connected system of fracture-and-solution-opening porosity with principal recharge at outcrops on the periphery of the Black Hills in South Dakota. These recharge waters flow outward and downward below the surface. In the Williston Basin region, the Madison is 10,000 ft. deep, and waters are estimated to be as hot as 230°F. Water quality ranges from good to poor due to the occurrence of evaporite beds in the upper part of the Madison. Current understanding of the extent and temperatures of waters in the Madison or other potential aquifers is very limited.

V. RESOURCE DATA

There are no designated KGRAs in North Dakota and there are no confirmed reservoirs. The Madison aquifer, however, must be classed as an excellent prospect for low and medium temperature applications.

VI. GEOHERMAL ACTIVITY

The only known operational geothermal system heats and air conditions a farm house and barn in south-central North Dakota.

No leasing of federal or state lands has been done. Some measurements of gradient and heat flow have been made at existing gas and oil wells and uranium test holes.

Several Area Development Plans are being prepared as part of the DOE commercialization effort.

VII. LEGAL ACTIVITIES

No state legislation has been developed to establish policies concerning geothermal exploration or utilization.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Commercialization Planning: Clifford Ness, Robert Kaiser (State Energy Office);
 - b. Resource Assessment: Erling Brosteun, Ken Harris (North Dakota Geological Survey).
2. North Dakota Geological Survey, Lee Gerhard, Director.
3. North Dakota Water Commission, Vernon Fahy, State Engineer.
4. North Dakota State Land Department, R. E. Lommen, Director.
5. North Dakota Public Service Commission, Richard Elkin, President.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "North Dakota Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Aug 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

OHIO
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Ohio)

TOTAL POPULATION: 10,651,848 TOTAL AREA: 40,975 SQ. MI.
POPULATION DENSITY: 260 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	Mt. Simon Formation
TYPE	Sandstone
DEPTH	3000 ft. in southeastern corner of Ohio
AVG. THICKNESS	200 ft.
WATER TEMP.	170°F (estimated)

GEOHERMAL OVERVIEW

The state is covered by an eastward thickening sedimentary sequence that may represent a potential hydrothermal resource (basal sandstones appear to contain water) - or hot dry rock resource where high thermal gradients occur.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

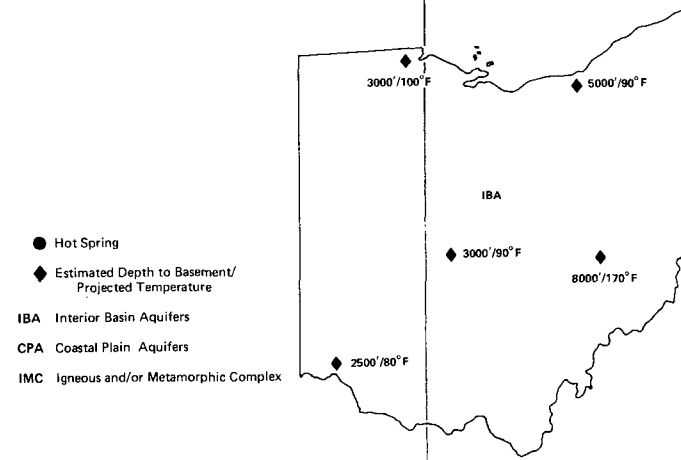
TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	235	45,785 thousand tons	1,126.3
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	9,406	93,610 million cu. ft.	102.3
Crude Oil Wells	15,236	8,796 thousand bbl	51.0

ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	993.4	29.8	996.1	1582.0	356.6
RESIDENTIAL	81.0	20.7	441.5	13.1	95.6
COMMERCIAL	53.4	2.3	174.8	7.1	76.4
INDUSTRIAL	89.0	6.6	364.2	218.2	184.5
PERCENT	28	1	28	44	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	LASL Funding Heat Flow Studies at Kent State.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	Amended Substitute House Bill No. 154.



PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	David LaValle, Acting Administrator (614) 466-6320
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Environmental Protection Agency, Ned E. Williams, Director (614) 466-8318
OFFICE OF ENERGY POLICY:	Energy Emergency Commission, Peter Susey, Chief of Policy Development (614) 466-8102
PLANNING BUREAU:	Department of Natural Resources, Planning Services, Dave LaValle, Acting Administrator (614) 466-6320
GEOLOGICAL SURVEY:	Division Chief and State Geologist, Horace R. Collins, (614) 466-5344
ENERGY ADVISORY COUNCIL:	Jack Hope, Chairman (614) 466-6797
(SELECTED MEMBERSHIP):	William Maddox, Ohio Dept. of Natural Resources : Robert S. Ryan, Ohio Energy Emergency Commission : Ned Williams, Ohio Environmental Protection Agency

LEGISLATIVE CONTACTS

SENATORS	John H. Glenn, Jr. (D) Howard M. Metzenbaum (D)	GOVERNOR	James A. Rhodes (R)
CONGRESSMEN (DIST.)			
	1 - Willis D. Gradison, Jr. (R)		14 - John F. Seiberling (D)
	2 - Thomas A. Luken (D)		15 - Chalmers P. Wylie (R)
	3 - Tony P. Hall (D)		16 - Ralph Regula (R)
	4 - Tennyson Guyer (R)		17 - John M. Ashbrook (R)
	5 - Delbert L. Latta (R)		18 - Douglas Applegate (D)
	6 - Bob McEwen (R)		19 - Lyle Williams (R)
	7 - Clarence J. Brown (R)		20 - Mary Rose Oakar (D)
	8 - Thomas N. Kindness (R)		21 - Louis Stokes (D)
	9 - Ed Weber (R)		22 - Dennis E. Eckhart (D)
	10 - Clarence E. Miller (R)		23 - Ronald M. Mottl (D)
	11 - John W. Stanton (R)		
	12 - Robert N. Shamansky (D)		
	13 - Donald J. Pease (D)		

State Geothermal Fact Sheet

OHIO

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 10,651,848 Area: 40,975 sq. mi. Density: 260 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	182	313	965	68	105
Residential	14	217	428	0.5	28
Commerical	9	24	169	0.3	22
Industrial	15	69	353	8.4	54

Trillion Btu

GROSS	993.4	29.8	996.1	1582.0	356.6
Residential	81.0	20.7	441.5	13.1	95.6
Commercial	53.4	2.3	174.8	7.1	76.4
Industrial	89.0	6.6	364.2	218.2	184.5

Percentages 28 1 28 44

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	235	45,785 thousand tons	1,126.3
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	9,406	93,610 million cu. ft.	102.3
Crude oil wells	15,236	8,796 thousand bbl	51.0

IV. GEOLOGY

An eastward thickening, Paleozoic, sedimentary wedge overlies the Precambrian basement complex throughout Ohio. This sequence of rocks belongs to the western limb of the Appalachian Basin and is 1000 ft. thick in the west, adjacent to Indiana, but thickens considerably, to 12,000 ft., in the eastern part of the state. The Cincinnati Arch is the north-south basement high that separates the Appalachian Basin from the Illinois Basin. The basement, where intersected by drilling, is composed largely of igneous rock to the west of the arch and of metamorphic rocks to the east.

The Paleozoic sedimentary rocks of the western two thirds of the state are overlain by Pleistocene glacial till. Fresh, shallow ground water is abundant in the till to a depth of 400 ft. Ground water becomes brackish at greater depths in the sedimentary sequence. The Mt. Simon sandstone, which is the basal sedimentary unit that underlies most of the state, is used for toxic waste disposal. It apparently contains copious amounts of water; however, the water is of high salinity, i.e., about 100,000 ppm.

V. RESOURCE DATA

Geothermal gradients in the eastern parts of the state commonly exceed 1.5°F/100 ft. In regions where the elevated gradients coincide with the deeper parts of the sedimentary sequence, temperatures may be as high as 200°F at 10,000 ft.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, David LaValle, Acting Administrator, (614) 466-6320.
2. Environmental Protection Agency, Ned E. Williams, Director, (614) 466-8318.
3. Energy Emergency Commission, Peter Susey, Chief of Policy Development, (614) 466-8102.
4. Department of Natural Resources, Planning Services, Dave LaValle, Acting Administrator, (614) 466-6320.
5. Geological Survey, Division Chief and State Geologist, Horace R. Collins, (614) 466-5344.
6. Energy Advisory Council (selected membership), Jack Hope, Chairman; William Maddox, Ohio Dept. of Natural Resources; Robert S. Ryan, Ohio Energy Emergency Commission; Ned Williams, Ohio Environmental Protection Agency; (614) 466-6797.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Geothermal Resources of the Eastern United States," Report for DOE, DOE/ET/28373-T2, Gruy Federal, Inc., Arlington, Va.
- (2) "Hot Dry Rock Geothermal Energy Development Project, Annual Report Fiscal Year 1977," Los Alamos Scientific Laboratory, LA-7109-PR.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

OKLAHOMA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Oklahoma)

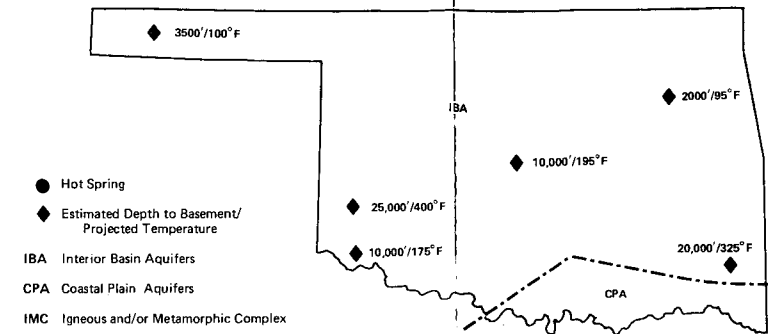
TOTAL POPULATION: 2,559,229 TOTAL AREA: 68,782 SQ. MI.
POPULATION DENSITY: 37 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	59	3,319 thousand tons	83.8
Natural Gas (liq.)	-	43,718 thousand bbl	176.3
Natural Gas Wells	8,868	1,770,980 million cu. ft.	1,935.7
Crude Oil Wells	72,880	191,204 thousand bbl	1,109.0

GEOHERMAL OVERVIEW

A fault bounded basin containing a thick sequence of consolidated sediments occurs in the lower half of the state. Some areas have gradients above normal and may represent a potential hydrothermal resource. High water yields have been obtained from oil wells.



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	35.3	34.0	359.6	0.5	78.3
RESIDENTIAL	2.1	23.9	82.5	0	30.5
COMMERCIAL	11.7	2.7	43.1	0	25.5
INDUSTRIAL	21.5	7.4	234.0	0.5	22.3
PERCENT	8	8	84	0	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	None
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	Water Resources Board, Forrest Nelson, Executive Director (405) 528-7807
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Department of Pollution Control, Fred F. Storer, Jr., Director (405) 528-2230
OFFICE OF ENERGY POLICY:	Governor's Advisory Council on Energy, Dr. Wm. W. Talley, II, Co-Chmn (w/Governor) (405) 521-3941
PLANNING BUREAU:	State Planning Coordination Office, Bobby A. McCullough, Director (405) 521-2881
GEOLOGICAL SURVEY:	Dr. Charles J. Mankin, Director (405) 325-3031
DEPARTMENT OF ENERGY:	Richard G. Hill, Director (405) 521-3941, 2995

LEGISLATIVE CONTACTS

SENATORS	Henry L. Bellmon (R) David L. Boren (D)	GOVERNOR	George Nigh (D)
CONGRESSMEN (DIST.)			
1 - James R. Jones (D)			
2 - Mike Synar (D)			
3 - Wesley W. Watkins (D)			
4 - Dave McCurdy (D)			
5 - Marvin H. (Mickey) Edwards (R)			
6 - Glenn English (D)			

State Geothermal Fact Sheet

OKLAHOMA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 2,559,229 Area: 68,782 sq. mi. Density: 37 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	64	355	349	0	23
Residential	0.4	250	80	0	9
Commerical	2	27	42	0	7
Industrial	4	77	227	0	7

Trillion Btu

GROSS	35.3	34.0	359.6	0.5	78.3
Residential	2.1	23.9	82.5	0	30.5
Commercial	11.7	2.7	43.1	0	25.5
Industrial	21.5	7.4	234.0	0.5	22.3

Percentages 8 8 84 0

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	59	3,319 thousand tons	83.8
Natural gas (liq.)	-	43,718 thousand bbl	176.3
Natural gas wells	8,868	1,770,980 million cu. ft.	1,935.7
Crude oil wells	72,880	191,204 thousand bbl	1,109.0

IV. GEOLOGY

The geologic setting of Oklahoma is dominated by the north-west trending Anadarko Basin, which attains depths in excess of 25,000 ft. in the central part of the state where it has been down-dropped (faulted) adjacent to the Wichita Uplift. In the south-eastern part of the state, the Ouachita Mountains have been thrust-faulted up and over the east-to-west trending Arkoma Basin, which also exceeds 25,000 ft. depth.

V. RESOURCE DATA

Oil and gas exploration in Oklahoma has defined the existence of hot water at depth. Thermal gradients above 1.6°F/100 ft. exist in several parts of the state. It is likely that water at temperatures above 200°F occurs at depths of 10,000 ft. in several parts of the state.

VI. GEOHERMAL ACTIVITY

1. State-Coupled Resource Assessment Program planned for FY 1980.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Water Resources Board, Forrest Nelson, Executive Director, (405) 528-7807.
2. Department of Pollution Control. Fred F. Storer, Jr., Director, (405) 528-2230.
3. Governor's Advisory Council on Energy. Dr. William W. Talley, II, Co-Chairman (w/Governor), (405) 521-3941.

4. State Planning Coordination Office, Bobby A. McCullough, Director, (405) 521-2881.
5. Geological Survey, Dr. Charles J. Mankin, Director, (405) 325-3031.
6. Department of Energy, Richard G. Hill, Director, (405) 521-3941, 2995.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**OREGON
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Oregon)

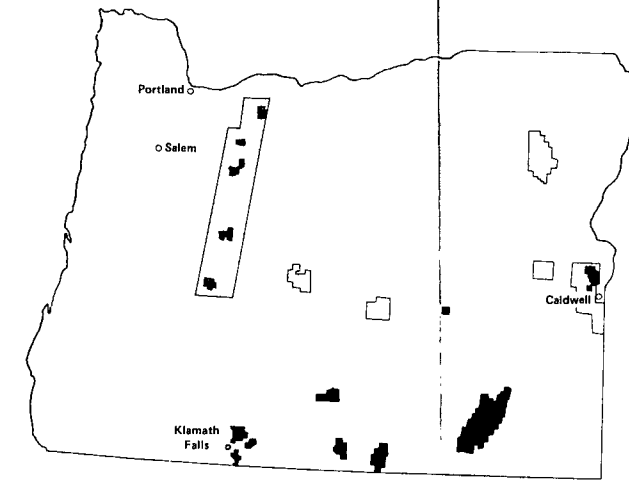
TOTAL POPULATION: 2,091,385 TOTAL AREA: 96,184 SQ. MI.
POPULATION DENSITY: 22 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand hbl	0

GEOTHERMAL OVERVIEW

The geologic provinces within Oregon containing geothermal resources are The Cascade Range, The Basin and Range Province, The High Lava Plains, and several provinces that lie in the northeastern part of the state. Many major volcanic centers and cones of late Tertiary to Quaternary age, hot springs, and associated KGRA's occur in all these areas.



○ Key Cities
■ KGRA'S
□ PGRA'S

From: "Geothermal Resources in Oregon:
site data base and development status"
OIT Geo-Heat Utilization Center Apr 1979

ENERGY USE — 1975 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	268.7	2.9	117.5	2.0	110.6
RESIDENTIAL	16.1	1.5	29.7	0.1	41.8
COMMERCIAL	26.2	0.2	16.4	0.1	27.2
INDUSTRIAL					
PERCENT	68	1	30	1	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	
OFFICE OF ENERGY POLICY:	
PLANNING BUREAU:	
GEOLOGICAL SURVEY:	

LEGISLATIVE CONTACTS

SENATORS Mark O. Hatfield (R) Bob Packwood (R)	GOVERNOR Victor Atiyeh (R)
CONGRESSMEN (DIST.)	
2 - Denny Smith (R)	
3 - Ron Wyden (D)	

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The geologic provinces within Oregon containing geothermal resources are the Cascade Range, the Basin-and-Range Province, the High Lava Plains, and several provinces that lie in the northeastern part of the state. Many major volcanic centers and cones of late Tertiary to Quaternary age, hot springs and associated KGRA's occur in all these areas. Pleistocene to Holocene volcanic flows and pyroclastic rocks cover large areas in the Cascades and High Lava Plains.

The north-south trending Cascade Range coincides with a large region of high heat flow (>2.5 HFU) and several smaller anomalies occur to the east. Many low temperature geothermal resource areas consisting of hydrothermal resources in aquifers at shallow depths (<1 km) also occur in these ranges.

In contrast to the volcanic centers, long-range-front, normal and strike-slip faults play a very important role in the circulation of fluids in the Basin-and-Range Province.

Several large geothermal resources in the High Lava Plains occur along the 300 km Brothers Fault Zone, which is the northern border of the Basin-and-Range Province and which consists of a series of en echelon normal faults above a major crustal shear.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

To be determined.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Debra Justus, "Geothermal Resources in Oregon: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Apr 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**PENNSYLVANIA
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Pennsylvania)

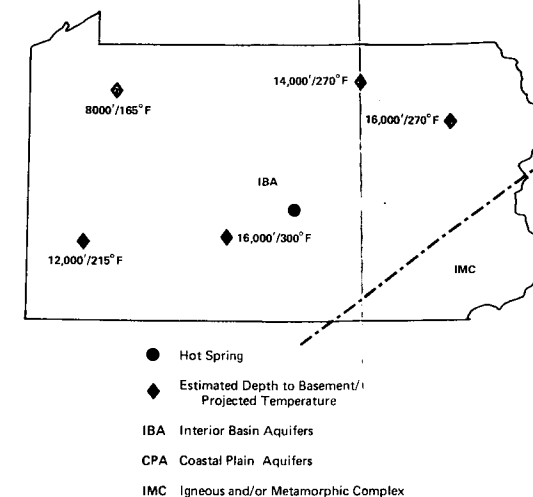
TOTAL POPULATION: 11,793,907 TOTAL AREA: 44,966 SQ. MI.
POPULATION DENSITY: 262 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	916	82,096 thousand tons	2,184.6
Natural Gas (liq.)	-	44 thousand bbl	0.2
Natural Gas Wells	16,600	78,514 million cu. ft.	85.8
Crude Oil Wells	31,539	3,282 thousand bbl	19

GEOHERMAL OVERVIEW

The Appalachian Basin lies beneath the western two-thirds of Pennsylvania. In this region, local areas of higher than average geothermal gradient coincide with great thicknesses of sedimentary rocks. Moreover, these areas also coincide with large load centers. These areas have potential for utilization of the thermal energy as a hydrothermal resource where water can be extracted from depth. If no water exists, a hot dry rock resource may also be exploitable.



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1284.9	21.2	676.8	1676.9	300.4
RESIDENTIAL	172.5	9.0	281.4	26.7	94.6
COMMERCIAL	142.7	1.0	102.2	17.3	61.8
INDUSTRIAL	140.3	11.0	273.8	156.1	141.0
PERCENT	35	1	18	46	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	<ol style="list-style-type: none"> 1. Ground water heat pump applications at Wellsboro and New Hope, Pa. 2. Preliminary Definition of the Geothermal Potential of Pa. by Gruy Federal, Inc. 3. LASL funded studies of geothermal gradient maps.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	Current (1977-78) legislation considering bill to regulate all bore holes in the state.

PRIMARY CONTACTS

GOVERNOR'S ENERGY COUNCIL:	G. J. Ridzon, Payne-Shoemaker Bldg., Harrisburg, PA 17120 (717) 787-9749
DEPARTMENT OF ENVIRONMENTAL RESOURCES:	Bureau of Topographic and Geologic Survey, P.O. Box 2357, Harrisburg, PA 17120 (717) 787-2169 Director: Dr. Art Socolow

LEGISLATIVE CONTACTS

SENATORS	H. John Heinz III (R) Richard S. Schweiker (R)	GOVERNOR	Richard L. Thornburgh (R)
CONGRESSMEN (DIST.)			
1 - Thomas M. Foglietta (I)		21 - Don Bailey (D)	
8 - James K. Coyne (R)		22 - Austin J. Murphy (D)	
9 - Bud Shuster (R)		23 - William F. Clinger (R)	
11 - James L. Nelligan (R)		24 - Marc L. Marks (R)	
12 - John P. Murtha (D)		25 - Eugene Atkinson (D)	
14 - William J. Coyne (D)			

State Geothermal Fact Sheet

PENNSYLVANIA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 11,793,907 Area: 44,966 sq. mi. Density: 262 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 2,000,000+ Area: 14,500+sq. mi. Density: 130 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	228	222	656	67	88
Residential	30	94	273	1	28
Commerical	24	10	99	1	18
Industrial	23	115	265	6	41

Trillion Btu

GROSS	1284.9	21.2	676.8	1676.9	300.4
Residential	172.5	9.0	281.4	26.7	94.6
Commercial	142.7	1.0	102.2	17.3	61.8
Industrial	140.3	11.0	273.8	156.1	141.0
Percentages	35	1	18	46	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	916	82,096 thousand tons	2,184.6
Natural gas (liq.)	-	44 thousand bbl	0.2
Natural gas wells	16,600	78,514 million cu. ft.	85.8
Crude oil wells	31,539	3,282 thousand bbl	19

IV. GEOLOGY

Pennsylvania spans four geologic provinces. In the southeast a thin veneer of Coastal Plain sediments (Cretaceous and younger) onlaps the metamorphic and igneous rocks of the Piedmont (late Precambrian to Paleozoic). West of the Piedmont lies a narrow belt of Precambrian rocks of Grenville age (about 1.1 billion years - bp) known to the south as the Blue Ridge and in eastern Pennsylvania as the Reading Prong. Two fault bounded basins occur along the boundary of the Piedmont and the Grenville age rocks. These basins (Newark and Gettysburg Basins) contain sedimentary and igneous rocks of Triassic and Jurassic age. The rest of the state is underlain by the Paleozoic sedimentary rocks of the Appalachian Basin. The thickness of this large asymmetric basin exceeds 30,000 ft. along its eastern margin but thins to less than 10,000 ft. in the northwest corner of the state. A few small Mesozoic dikes (kimberlites) do cross-cut the sedimentary rocks of this basin.

Potentially exploitable geothermal resources are most likely to exist beneath the Appalachian, Newark, and Gettysburg sedimentary basins.

V. RESOURCE DATA

Limited geothermal gradient data are available for the Newark and Gettysburg Basins, although project contours range from 1.2 to 2.2°F/100 ft. for this region. The sediments in these basins attain thicknesses greater than 15,000 ft. Thus, assuming a conservative estimate for the thermal gradient of 1.2°F/100 ft., in that area, temperatures at the base of the sedimentary pile may be predicted to be at least 230°F. If an ideal situation of a 2.2°F/100 ft. gradient coincident with the deeper parts of the basin (15,000 ft.) is assumed, temperatures may exist as high as 350°F. Since these basins are interpreted to have been formed by movement on deep crustal fault zones, higher gradients caused by circulation along deep seated faults may be expected locally.

The Appalachian Basin attains sedimentary thicknesses greater than 30,000 ft. A broad area of elevated thermal gradients ($>1.6^{\circ}\text{F}/100\text{ ft.}$) coincides with population centers and sedimentary sequences greater than 10,000 ft. thick. Near Scranton, with a $1.8^{\circ}\text{F}/100\text{ ft.}$ gradient, temperatures of 230°F to 320°F (at 10,000 ft. and 15,000 ft., respectively) may be encountered.

The availability of extractable water at these depths and in these places is unknown, but large quantities have been encountered in deep oil and gas exploration.

VI. GEOHERMAL ACTIVITY

- Recent studies:
1. Ground water heat pump applications at Wellsboro and New Hope, Pa.
 2. Preliminary Definition of the Geothermal Potential of Pa. by Gruy Federal, Inc.
 3. LASL funded studies of geothermal gradient maps.

VII. LEGAL ACTIVITIES

Current (1977-78) legislature is considering a bill to regulate all bore holes in the state.

VIII. CONTACTS

1. Governor's Energy Council, Payne-Shoemaker Bldg., Harrisburg, PA 17120, G. J. Ridzon, (712) 787-9749.
2. Department of Environmental Resources, Bureau of Topographic and Geologic Survey, P.O. Box 2357, Harrisburg, PA 17120, A. A. Socolow, Director, (717) 787-2169.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Preliminary Definition of the Geothermal Resources Potential of Pennsylvania: 1979," Gruy Federal Inc., NVO-1558-6.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**RHODE ISLAND
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Rhode Island)

TOTAL POPULATION: 948,845 TOTAL AREA: 1,049 SQ. MI.
POPULATION DENSITY: 905 PERSONS/SQ. MI.

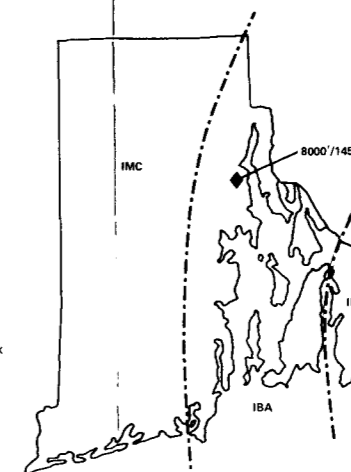
**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

The north-south trending Narragansett Basin in the middle of the state may have potential as a hydrothermal resource.

- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex



ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	123.3	2.0	22.5	0.1	15.1
RESIDENTIAL	27.8	0.6	13.5	0.01	5.7
COMMERCIAL	21.5	0.1	4.4	0.01	5.2
INDUSTRIAL	7.7	1.3	4.6	0.04	4.2
PERCENT	3	1	15	0	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Eward Wood, Director (401) 277-2771
DIVISION OF WATER RIGHTS:	Robert Russ, General Manager (401) 277-2217
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	
OFFICE OF ENERGY POLICY:	State Energy Office, Dante Jonata, Director (401) 277-3374
PLANNING BUREAU:	Statewide Planning Program, Daniel Varin, Chief (401) 277-2656
GEOLOGICAL SURVEY:	Robert L. McMaster, Associate State Geologist for Marine Affairs (401) 722-3142

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	None
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

LEGISLATIVE CONTACTS

SENATORS	Claiborne Pell (D) John H. Chafee (R)	GOVERNOR	J. Joseph Garrahy (D)
CONGRESSMEN (DIST.)	1 - Fernand J. St. Germain (D) 2 - Claudine Schneider (R)		

State Geothermal Fact Sheet
 RHODE ISLAND

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 948,845 Area: 1,049 sq. mi. Density: 905 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	30	21	22	0.00	5
Residential	5	7	13	0.00	2
Commerical	4	1	4	0.00	2
Industrial	1	13	4	0.00	1

Trillion Btu

GROSS	123.3	2.0	22.5	0.1	15.1
Residential	27.8	0.6	13.5	0.01	5.7
Commercial	21.5	0.1	4.4	0.01	5.2
Industrial	7.7	1.3	4.6	0.04	4.2
Percentages	83	1	15	0	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

RI-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, Edward Wood, Director, (401) 277-2771.
2. Division of Water Rights, Robert Russ, General Manager, (401) 277-2217.
3. State Energy Office, Dante Jonata, Director, (401) 277-3374.
4. Statewide Planning Program. Daniel Varin, Chief, (401) 277-2656.
5. Geological Survey, Robert L. McMaster, Associate State Geologist for Marine Affairs, (401) 722-3142.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), and (C-10).

SOUTH CAROLINA

(December 1980)

SOUTH CAROLINA GEOHERMAL DATA SUMMARY SHEET

(cf. State Geothermal Fact Sheet, South Carolina)

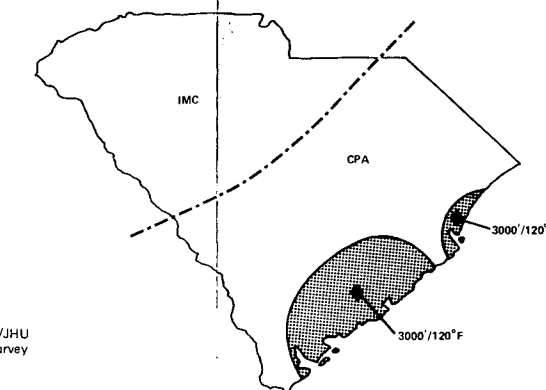
TOTAL POPULATION: 2,591,516 TOTAL AREA: 30,325 SQ. MI.
POPULATION DENSITY: 86 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	Coastal Plain-Charleston, Georgetown Area
TYPE	Clastic and carbonate sediments
DEPTH	3000 ft.
WATER TEMP.	107 to 103°F
EST. STORED WATER	
EST. ENERGY CONTENT	<1.0 quad

GEOHERMAL OVERVIEW

Above average geothermal gradients occur in the Coastal Plain sediments; however, this sequence is shallow and the potential for hydrothermal resource is restricted.



- Area Covered by APL/JHU Scenario or Market Survey
- Hot Spring
- ◆ Estimated Depth to Basement/Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

ENERGY RESOURCES - 1973 ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

ENERGY USE - 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	306.0	12.7	131.2	141.3	101.1
RESIDENTIAL	19.7	7.4	18.8	3.0	33.1
COMMERCIAL	3.5	0.8	17.8	1.6	21.8
INDUSTRIAL	25.1	4.3	76.9	28.8	46.2
PERCENT	52	2	22	24	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. APL/JHU scenario for DOE/DGE - "The Atlantic Coastal Plain." 2. VPI&SU Targeting and Evaluation of Geothermal Resources.
PROPOSED STUDIES	1. APL/JHU - DOE - Market Analysis. 2. VPI&SU to complete gradient drilling program.
LEGAL ACTIVITIES	NCSL - conducting workshops in 1980.

PRIMARY CONTACTS

OFFICE OF ENERGY RESOURCES:	Dr. Lamar E. Priester, Jr., Director (803) 758-8490
DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL:	Water Quality, Charles Jeter (803) 758-3877; Air Quality, William A. Crosley (803) 758-5406
WATER RESOURCES COMMISSION:	Clair P. Guess, Executive Director (803) 758-2514
DIVISION OF GEOLOGY:	Norman K. Olson, Geologist (803) 758-6431
STATE PLANNING COMMISSION:	Patrick S. Smith, Director (803) 758-8608

LEGISLATIVE CONTACTS

SENATORS	Strom Thurmond (R); G. A. Campbell, Asst. (202) 224-5972 Ernest F. Hollings (D); M. J. Copps, Asst. (202) 224-6121	GOVERNOR Richard W. Riley (D)
CONGRESSMEN (DIST.)	1 - Thomas F. Hartnett (R) 2 - Floyd Spense (R); W. A. Cook, Adm. Assist. (202) 225-2452 2 - Floyd Spense (R); W. A. Cook, Adm. Assist. (202) 225-2452 6 - John Napier (R)	

State Geothermal Fact Sheet

SOUTH CAROLINA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 2,591,516 Area: 30,325 sq. mi. Density: 86 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 460,268 Area: 5,110 sq. mi. Density: 91 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	56	133	127	6	30
Residential	3	78	18	0.1	10
Commerical	0.6	9	17	0.06	7
Industrial	4	45	74	1	13

Trillion Btu

GROSS	306.0	12.7	131.2	141.3	101.1
Residential	19.7	7.4	18.8	3.0	33.1
Commercial	3.5	0.8	17.8	1.6	21.8
Industrial	25.1	4.3	76.9	28.8	46.2
Percentages	52	2	22	24	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

Detailed coastal zone information not known at this time. For piedmont geology see (1).

V. RESOURCE DATA

The promising areas for geothermal development are the Georgetown and Charleston areas where maximum well temperatures of 107 and 123°F have been measured. Basement in those areas is rather shallow, 2000 to 3000 ft. Available energy is estimated to be small, a fraction of a quad. The Charleston area is an area of significant seismic activity.

VI. GEOHERMAL ACTIVITY

The DOE/DGE Gradient Well Program, conducted by Gruy Federal, did not extend into South Carolina. During CY 1980, VPI&SU planned to drill five 1000 ft. gradient wells in the South Carolina Coastal Plain. This program is in process, but its contributions to the information of the gradient map in references (C-1) or (3) are not yet available. As stated in item V, the estimated basement depth for the coastal plains does not exceed 2000 to 3000 ft. anywhere and is less over most of the coastal plain.

VII. LEGAL ACTIVITIES

None, but a NCSL geothermal workshop is scheduled for 1980.

VIII. CONTACTS

1. Office of Energy Resources, 1205 Pendleton St., Columbia, SC 29201, Lamar E. Priestor, Jr., Director, (803) 758-8490.
2. Natural Resources (Dept. of Wildlife and Marine Resources), Dutch Plaza, #150, Box 167, Columbia, SC 29202, James A. Timmerman, Executive Director, (803) 758-6291.

3. Water Resources Commission, 3830 Forest Drive, Box 4515, Columbia, SC 29204, Clair P. Guess, Executive Director, (803) 758-2514.
4. Department of Health and Environmental Control, 2600 Bull St., Columbia, SC 29201, William A. Crosby, Air Quality Control, (803) 758-5406; Charles Jetor, Water Quality Control, (803) 758-3877.
5. State Planning Division, 211 Wade Hampton Office Bldg., P.O. Box 11333, Columbia, SC 29211, Patrick C. Smith, Director, (803) 758-8608.
6. Division of Geology, State Development Board, Harbison Forest Road, Columbia, SC 29210, Norman K. Olson, Geologist, (803) 758-6431.
7. Public Service Commission, Owen Building, Drawer 11649, Columbia, SC 29211, Fred A. Fuller, Chairman, (803) 758-3621.
8. State Coupled Reservoir Assessment Program, VPI&SU, Dr. John Costain, Geothermal Program Director, Blacksburg, VA, (703) 961-5096.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Evaluating and Targeting of Geothermal Resources in the Southeastern United States," VPI&SU, DOE Report VPI-SU-5103-2, 1976.
- (2) Evaluating and Targeting of Geothermal Energy Resources in the Southeastern United States," VPI&SU, DOE Report VPI&SU-78ET-27001,-7, 30 Sep 1979.
- (3) "Geothermal Energy and the Eastern U.S., A Scenario for Geothermal Energy Development, The Atlantic Coastal Plain," APL/JHU QM-77-129, Oct 1977.
- (4) "Geothermal Resources of the Eastern United States," Gruy Federal, Inc., Arlington, VA, DOE Report DOE/ET/28373-T2.
- (5) "Mid-Atlantic and Southeastern Low-to-Moderate Temperature Program: Geologic Setting and Targeting Procedures," (VPI&SU, Chapter VII, Geothermal Energy and the Eastern U.S., Technical Exchange Meeting, Minutes), JHU/APL QM-79-261, Dec 1979.

COMMON REFERENCES

(C-1), (C-4), (C-6), and (C-7).

**SOUTH DAKOTA
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, South Dakota)

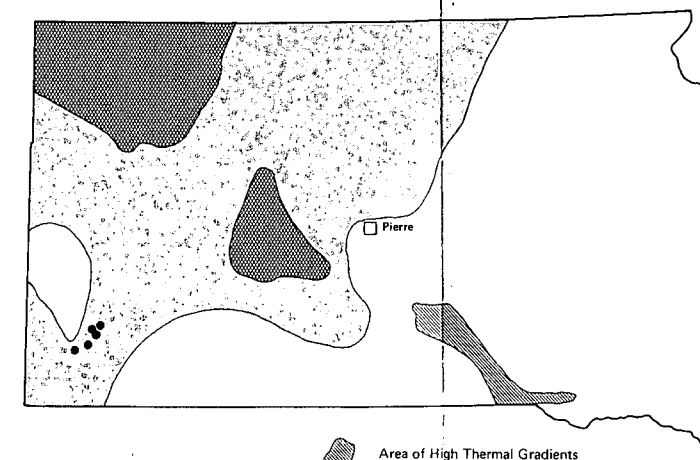
TOTAL POPULATION: 666,257 TOTAL AREA: 77,047 SQ. MI.
POPULATION DENSITY: 8.6 PERSONS/SQ. MI.

**ENERGY RESOURCES -- 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	27	275 thousand bbl	1.6

GEOTHERMAL OVERVIEW

The Madison Aquifer occurs at depth throughout western South Dakota. Most properly completed wells encounter artesian waterflow at surface deviations of about 2100 feet or less. Temperatures are low to moderate with reasonable potential for space heating applications.



- Area of High Thermal Gradients in the Dakota Formation
- Areas of Low- and Moderate-Temperature Potential
- > 60°C (140°F) Water in the Madison Formation
- Hot Springs

ENERGY USE -- 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	86.8	11.8	34.3	28.5	12.6
RESIDENTIAL	9.6	8.5	12.4	0.2	6.7
COMMERCIAL	2.6	0.9	11.9	0.1	4.3
INDUSTRIAL	11.0	2.3	6.7	0.8	1.7
PERCENT	54	7	21	18	

PRIMARY CONTACTS

STATE GEOTHERMAL TEAM	
OPERATIONS RESEARCH:	Harry Christianson (Office of Energy Policy)
RESOURCE ASSESSMENT:	no contract yet (1979)
SOUTH DAKOTA GEOLOGICAL SURVEY:	Duncan J. McGregor, State Geologist
DEPARTMENT OF AGRICULTURE, DIVISION OF CONSERVATION:	Myron Lindquist, Program Chief
STATE PLANNING BUREAU:	James Richardson, Commissioner
DEPARTMENT OF WATER AND NATURAL RESOURCES:	Warren Newfield, Secretary
WATER RIGHTS DIVISION:	John Hatch, Chief Engineer
EARTH RESOURCES GROUP:	Larry Kyte

LEGISLATIVE CONTACTS

SENATORS	George McGovern (D) Larry Pressler (R)	GOVERNOR	William J. Janklow (R)
CONGRESSMEN (DIST.)			
1 - Thomas A. Daschle (D)			
2 - Clint Roberts (R)			

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	

State Geothermal Fact Sheet

SOUTH DAKOTA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 666,257 Area: 77,047 sq. mi. Density: 8.6 per sq. mi.

GEOTHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	16	123	33	2	4
Residential	2	89	12	0	2
Commerical	0.5	10	11	0	1
Industrial	2	24	7	0	0.5

Trillion Btu

GROSS	86.8	11.8	34.3	28.5	12.6
Residential	9.6	8.5	12.4	0.2	6.7
Commercial	2.6	0.9	11.9	0.1	4.3
Industrial	11.0	2.3	6.7	0.8	1.7

Percentages 54 7 21 18

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	27	275 thousand bbl	1.6

IV. GEOLOGY

All of South Dakota lies in the Great Plains physiographic province. Two main geologic features are of interest: The Black Hills and the Madison group aquifer. The Madison group occurs at depth throughout the western part of the state. It is composed of Mississippian carbonate rocks containing a regionally interconnected network of fracture-and-solution-opening porosity. Artesian waterflow occurs in almost every properly completed well at surface elevation of about 2100 ft. or less. Recharge of the Madison comes from the Black Hills where melting snows and rains enter the highly porous rocks that outcrop around the Black Hills uplift. Water flows through the Madison to a depth of more than 3000 ft. and, in general, is heated from normal gradient. Water quality tends to deteriorate to the northwest where evaporite beds occur in the upper part of the aquifer. The Dakota Formation in south-central South Dakota contains Inyan Kara Sandstone and Red River Dolomite in which hydrothermal waters have been found.

V. RESOURCE DATA

The major hydrothermal resource is the Madison aquifer, which must be considered both as confirmed and of great size. Other zones of porosity exist above and below the Madison group and may be of some future use.

VI. GEOHERMAL ACTIVITY

Four PONs were awarded in 1977 by the Department of Energy. Three of these experimental programs have met with reasonable success and have progressed to system design or construction phases (1979).

Two PRDAs were awarded by DOE. One, completed in 1977, was a general assessment of the geologic hydrologic and chemical data for the Madison aquifer and suggested legislative items pertaining to geothermal development. The second, completed in 1979, concentrated on the use of the Madison waters in the town of Edgemont.

No federal or state lands have been leased for geothermal applications.

A number of systems is operational: heating schools, homes, and farm and industrial buildings.

VII. LEGAL ACTIVITIES

Specific legislation concerning geothermal resources and applications does not exist.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research, Harry Christianson (Office of Energy Policy);
 - b. Resource Assessment, no contract yet (1979).
2. South Dakota Geological Survey, Duncan J. McGregor, State Geologist.
3. Department of Agriculture, Division of Conservation, Myron Lindquist, Program Chief.
4. State Planning Bureau, James Richardson, Commissioner.
5. Department of Water and Natural Resources, Warren Newfield, Secretary.
6. Water Rights Division, John Hatch, Chief Engineer.
7. Earth Resources Group, Larry Kyte.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "South Dakota Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Aug 1979.

COMMON REFERENCES

- (C-4), (C-6), and (C-7).

**TENNESSEE
GEOHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Tennessee)

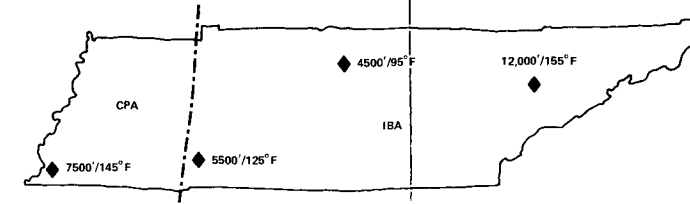
TOTAL POPULATION: 3,923,780 TOTAL AREA: 41,328 SQ. MI.
POPULATION DENSITY: 95 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	119	8,217 thousand tons	215.3
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	6	20 million cu. ft.	0.0
Crude Oil Wells	67	201 thousand bbl	1.2

GEOHERMAL OVERVIEW

A thick sequence of sediments in the eastern and western portions of the state may represent hydrothermal resource areas.



- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

ENERGY USE — 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	423.1	15.4	227.9	591.2	221.7
RESIDENTIAL	16.9	11.8	45.4	3.7	76.7
COMMERCIAL	12.8	1.3	43.9	2.0	14.8
INDUSTRIAL	22.8	2.1	118.9	41.9	130.2
PERCENT	34	1	18	47	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. Gruy - DOE Study Geothermal Potential. 2. Institute for Energy Analysis. 3. ORAU - "Geothermal Application Assessment for TVA Region".
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	
URBAN AND FEDERAL AFFAIRS:	Claire Weinberger, Grant Applications (615) 741-2714
OFFICE OF ENERGY POLICY:	Tennessee Energy Authority, Edward J. Spitzer, Executive Director (615) 741-2994
PLANNING BUREAU:	State Planning Office, Stephan H. Norris (615) 741-1676
GEOLOGICAL SURVEY:	Robert E. Hershey, State Geologist (615) 741-2726

LEGISLATIVE CONTACTS

SENATORS	Howard H. Baker, Jr. (R) James R. Sasser (D)	GOVERNOR	Lamar Alexander (R)
CONGRESSMEN (DIST.)	1 - James H. Quillen (R) 2 - John J. Duncan (R) 3 - Marilyn L. Bouguard (D) 4 - Albert Gore, Jr. (D) 5 - Bill Boner (D) 6 - Robin L. Beard, Jr. (R) 7 - Ed Jones (D) 8 - Harold Ford (D)		

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	119	8,217 thousand tons	215.3
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	6	20 million cu. ft.	0.0
Crude oil wells	67	201 thousand bbl	1.2

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

Current studies:

1. Gruy - DOE Study Geothermal Potential.
2. Institute for Energy Analysis.
3. ORAU - "Geothermal Application Assessment for TVA Region."

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Urban and Federal Affairs, Claire Weinberger, Grant Applications (615) 741-2714.
2. Office of Energy Policy, Tennessee Energy Authority, Edward J. Spitzer, Executive Director, (615) 741-2994.
3. Planning Bureau, State Planning Office, Stephan H. Norris, (615) 741-1676.
4. Geological Survey, Robert E. Hershey, State Geologist, (615) 741-2726.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

TEXAS
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Texas)

TOTAL POPULATION: 11,199,385 TOTAL AREA: 267,339 SQ. MI.
POPULATION DENSITY: 41.9 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	(1) Central Texas Resource	(2) Trans-Pecos Region	(3) Gulf Coast Region
TYPE	Cretaceous	Bolson	Geopressed/ sedimentary
DEPTH	2,500 to 3,500 ft. (approx.)	3,000 to 9,000 ft.	
WATER TEMP.	<150°F	100 to 190°F	>300°F
EST. STORED WATER			
EST. ENERGY CONTENT			

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	3	6,944 thousand tons	91.7
Natural Gas (liq.)	-	314,429 thousand bbl	1,268.0
Natural Gas Wells	23,805	8,513,850 million cu. ft.	9,305.0
Crude Oil Wells	159,090	1,294,671 thousand bbl	7,509.1

ENERGY USE — 1976 (10¹² BTU)

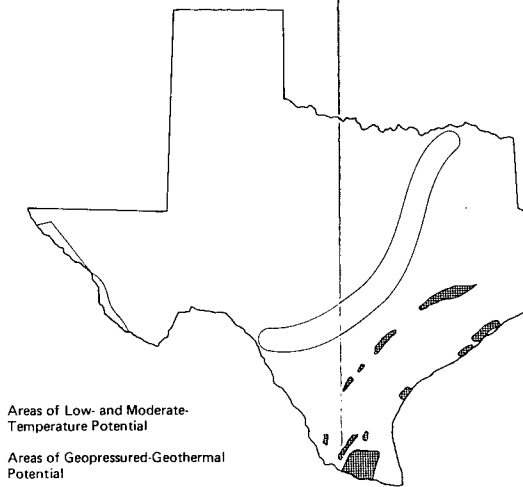
SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	1691.5	115.0	4095.8	181.5	438.0
RESIDENTIAL	42.7	48.5	239.8	0	137.1
COMMERCIAL	60.6	5.4	120.5	0	122.7
INDUSTRIAL	122.3	53.3	2254.2	36.7	178.3
PERCENT	28	2	67	3	

GEOHERMAL ACTIVITIES

CURRENT USES	1. Space and water heating, Cotulla High School. 2. Water use for balneological purposes.
RECENT OR CURRENT STUDIES	1. Hydrothermal resource assessment at University of Texas, Austin, and El Paso. 2. DOE/DGE PON for space and water heating of THS Memorial Hospital, Marlin. 3. DOE/DGE PON for space and water heating Navarro College and Hospital, Corsicana. 4. State Coupled Program and Industry Coupled programs to assess potential in central and west Texas.
PROPOSED STUDIES	Resource assessment, utilization studies, legal, and institutional analyses given results of 3, above.
LEGAL ACTIVITIES	1979 legislation provided that geopressed geothermal resources be treated and produced as mineral resources.

GEOHERMAL OVERVIEW

Parts of five physiographic provinces cover Texas; three of these have significant geothermal potential: the Trans-Pecos region (or Basin and Range Province) consists of bolsons with above normal heat flow and gradient measurements, the Great Plains Province with an aquifer that may encompass as many as 47,000 sq. mi. in central Texas, and the Coastal Province which contains a geopressed area.



PRIMARY CONTACTS

GEOHERMAL TEAM	
COMMERCIALIZATION PLANNING:	None
OPERATIONS, RESEARCH (GEOPRESSED RESOURCE):	Myron Dorfman (University of Texas Center for Energy Studies)
RESOURCE ASSESSMENT:	C. D. Henry (University of Texas (Austin))
ENERGY AND NATURAL RESOURCE ADVISORY COUNCIL:	E. Vetter, Executive Director
ANALYSIS AND DEVELOPMENT DIVISION:	Milton Holloway, Director
DEPARTMENT OF WATER AND NATURAL RESOURCES:	Harvey Davis, Executive Director
UNIVERSITY OF TEXAS (EL PASO):	Dr. Robert Roy (Dept. of Geological Sciences)
UNIVERSITY OF TEXAS (AUSTIN):	Dr. R. A. Motrin (Bureau of Economic Geology)

LEGISLATIVE CONTACTS

SENATORS	John Tower (R) Lloyd Bentsen (D)	GOVERNOR	William P. Clements, Jr. (R)
CONGRESSMEN (DIST.)			
1 - Sam B. Hall, Jr. (D)		13 - Jack Hightower (D)	
2 - Charles Wilson (D)		14 - William N. Patman (D)	
3 - James M. Collins (R)		15 - E. de la Garza (D)	
4 - Ralph M. Hall (D)		16 - Richard C. White (D)	
5 - James A. Mattox (D)		17 - Charles W. Stenholm (D)	
6 - Phil Gramm (D)		18 - Mickey Leland (D)	
7 - Bill Archer (R)		19 - Kent Hance (D)	
8 - Jack Fields (R)		20 - Henry B. Gonzalez (D)	
9 - Jack Brooks (D)		21 - Tom Loeffler (R)	
10 - J. J. Pickle (D)		22 - Ron Paul (R)	
11 - Marvin Leath (D)		23 - Abraham Kazen, Jr. (D)	
12 - Jim Wright (D)		24 - Martin Frost (D)	

State Geothermal Fact Sheet

TEXAS

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 11,199,385 Area: 267,339 sq. mi. Density: 41.9 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	306	1205	3969	12	128
Residential	8	508	232	0	40
Commerical	10	56	117	0	36
Industrial	20	558	2184	2	52

Trillion Btu

GROSS	1691.5	115.0	4095.8	181.5	438.0
Residential	42.7	48.5	239.8	0	137.1
Commercial	60.6	5.4	120.5	0	122.7
Industrial	122.3	53.3	2254.2	36.7	178.3
Percentages	28	2	67	3	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

TX-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	3	6,944 thousand tons	91.7
Natural gas (liq.)	-	314,429 thousand bbl	1,268.0
Natural gas wells	23,805	8,513,850 million cu. ft.	9,305.6
Crude oil wells	159,090	1,294,671 thousand bbl	7,509.1

IV. GEOLOGY

Texas is covered by five physiographic provinces some of which, at least in parts, are considered to have considerable geothermal potential.

The Trans-Pecos region of the state displays rifts and faults associated with the Rio Grande and the Basin and Range provinces, respectively. This area consists of linear series of sediment filled basins having measured heat flows of 1 to 3.1 HFU and gradients of 1.6 to 3.8°F/100 ft. Geochemical estimates of subsurface temperatures range from 140 to 320°F. These hot waters are considered to result from fault-controlled circulation of ground waters to depths of 2000 to 7000 ft.

In central Texas the Balcones and associated fault zones extend approximately southwestward from Fannin county in the north through the Austin and San Antonio areas and curve to Kinney county at the Mexican border. Gradients range from 1.3 to 2.5°F/100 ft. Wells in the area produce water in excess of 120°F from depths of about 3500 ft. The hot waters from the Balcones Fault come from Cretaceous aquifers, primarily, the Trinity Sandstone of the Edwards Formation. The extent of the aquifers is estimated to be as large as 60,000 sq. mi.

The Gulf Coast area consists of many deep sedimentary filled aquifers, some of which contain geopressured fluids. Average temperatures are in excess of 270°F. Thermal gradients range from 1.1 to over 5°F/100 ft.

V. RESOURCE DATA

There are no confirmed reservoirs (Nov 1979) in Texas and no state or federal lands have been leased for geothermal development.

VI. GEOHERMAL ACTIVITY

The University of Texas has conducted geochemical studies in the Trans-Pecos area and has made measurements of heat flow, thermal gradient, and electrical resistivity.

In the central Texas belt the university has defined areas considered to have optimum geothermal potential.

DOE and General Crude Oil Company shared the cost of a 16,500 ft. geopressured well drilled in Brazoria county on the Gulf coast. Temperature at depth was over 300°F. Tests made at 14,700 ft. in 1979 produced 2,500 barrels of hot saline water at 4,500 psi.

DOE (PON) and Texas Energy Development Fund moneys provided for a test well for a hospital in Marlin, Falls County, Texas. Bottom hole temperature (at 3885 ft.) was 140°F. Artesian pressure produced 152°F water at the surface.

Another DOE (PON) funded test well is being drilled (Nov 1979) in Corsicana, Navarro County, Texas for the Navarro Junior College. At 2300 ft. the measured temperature was 120°F.

VII. LEGAL ACTIVITIES

A Geothermal Energy Resources Act (1975) defined the resource and authorized the Railroad Commission to regulate the exploration, development, and production of geothermal energy and associated resources in public and private land. Legislation in 1979 provided that geopressured geothermal resources be treated and produced as mineral resources, and expanded the duties of the Railroad Commission to include responsibility for control and disposition of waste and the issuing of permits for waste discharge.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research (geopressured resource), Myron Dorfman (University of Texas Center for Energy Studies);
 - b. Resource Assessment, C. D. Henry (University of Texas (Austin)).
2. Energy and Natural Resource Advisory Council, E. Vetter, Executive Director.
3. Analysis and Development Division, Milton Holloway, Director.
4. Department of Water and Natural Resources, Harvey Davis, Executive Director.

5. University of Texas (El Paso), Dr. Robert Roy (Dept. of Geological Sciences).
6. University of Texas (Austin), Dr. R. A. Motrin (Bureau of Economic Geology).

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Texas Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Nov 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

UTAH
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Utah)

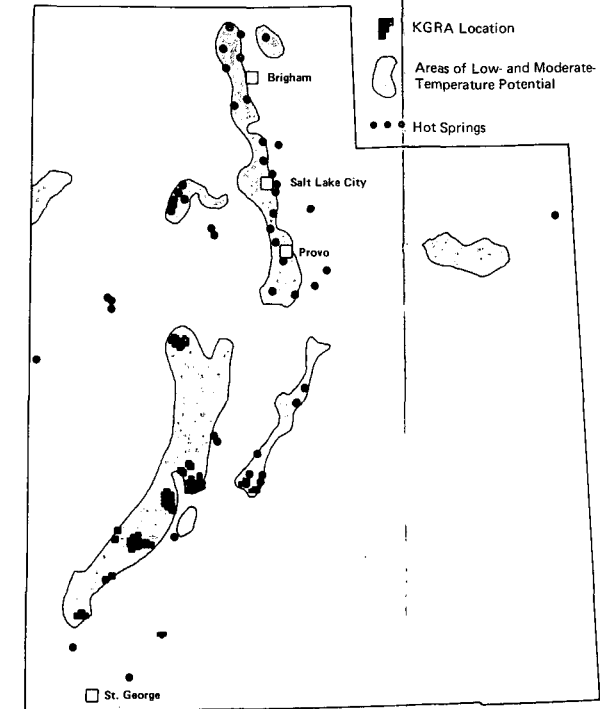
TOTAL POPULATION: 1,271,000 TOTAL AREA: 84,916 SQ. MI.
POPULATION DENSITY: 15 PERSONS/SQ. MI.

ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	44	7,984 thousand tons	203.1
Natural Gas (liq.)	-	2,432 thousand bbl	9.8
Natural Gas Wells	158	42,715 million cu. ft.	46.7
Crude Oil Wells	989	32,656 thousand bbl	189.4

GEOHERMAL OVERVIEW

The eastern boundary zone of the Basin and Range physiographic province, including the Wasatch Front, contains the major geothermally important areas in Utah. Eight KGRAs have been designated by the USGS. These include low, moderate, and high temperature resources. Geothermal leases for more than 690,000 acres of federal and state land have been granted through March 1979.



ENERGY USE - 1976 (10¹⁴ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	171.3	4.7	130.4	116.1	25.9
RESIDENTIAL	4.0	2.4	61.7	1.6	8.6
COMMERCIAL	16.6	0.3	6.3	0.9	9.3
INDUSTRIAL	39.6	2.0	59.4	13.2	8.0
PERCENT	41	1	31	27	

PRIMARY CONTACTS

DEPARTMENT OF NATUREAL RESOURCES:	Gordon Harmstrom, Executive Director
DIVISION OF WATER RIGHTS:	Dee C. Hanse, State Engineer
UTAH GEOLOGICAL AND MINERAL SURVEY:	Donald T. McMillan, Director
STATE PLANNING COORDINATOR'S OFFICE:	Kent Briggs, Coordinator
UTAH ENERGY OFFICE:	Reed Searle, Staff Director
DEPARTMENT OF SOCIAL SERVICES:	Anthony W. Mitchell, Executive Director
STATE GEOTHERMAL TEAM:	
OPERATIONS RESEARCH:	Stanley Green, Team Leader
RESOURCE ASSESSMENT:	Don T. McMillan, Project Manager
ENERGY CONSERVATION AND DEVELOPMENT COUNCIL:	Moroni Jensen, Chairman

GEOHERMAL ACTIVITIES

CURRENT USES	Space heating, aquaculture, greenhouses, swimming pools, and balneology.
RECENT OR CURRENT STUDIES	1. PON project in Monroe City for space heating. 2. Two PONs in contract negotiation phase (1978).
PROPOSED STUDIES	Continued preparation of Time Phased Project, Site Specific Development, Area Development Plans.
LEGAL ACTIVITIES	New legislation (1979) failed because of lack of House amendment confirmation.

LEGISLATIVE CONTACTS

SENATORS	Jake Garn (R) Orrin G. Hatch (R)	GOVERNOR	Scott M. Matheson (D)
CONGRESSMEN (DIST.)	1 - Gunn McKay (D) 2 - Dan Marriott (R) 4 - James V. Hansen (R)		

State Geothermal Fact Sheet

UTAH

I. DEMOGRAPHIC INFORMATION (1977) (C-4)

TOTAL STATE

Population: 1,271,000 Area: 84,916 sq. mi. Density: 15 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 1,059,273 Area: 82,096 sq. mi. Density: 13 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	31	49	126	5	8
Residential	1	25	60	0	3
Commerical	3	3	6	0	3
Industrial	7	21	58	0.5	2

Trillion Btu

GROSS	171.3	4.7	130.4	116.1	25.9
Residential	4.0	2.4	61.7	1.6	8.6
Commercial	16.6	0.3	6.3	0.9	9.3
Industrial	39.6	2.0	59.4	13.2	8.0

Percentages	41	1	31	27	
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*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	44	7,984 thousand tons	203.1
Natural gas (liq.)	-	2,432 thousand bbl	9.8
Natural gas wells	158	42,715 million cu. ft.	46.7
Crude oil wells	989	32,656 thousand bbl	189.4

IV. GEOLOGY

The Basin and Range physiographic province occurs in the western part of Utah. This province is characterized by northward-trending mountain blocks separated by flat valleys filled with unconsolidated alluvial debris to depths of several thousands of feet. The Basin and Range is still tectonically active as indicated by recent fault scarps, young volcanic rocks, and observed seismic activity.

The Colorado Plateau, in the central, eastern, and southern part of the state, is an area of flat-laying sedimentary rocks and several rugged mountain ranges that are cored by laccolithic intrusions. This area is mostly inactive geologically.

In the northeastern part of the state, the Middle Rocky Mountains province contains folded and faulted sedimentary, intrusive, extrusive, and metamorphic rocks. In some portions of the province, seismic evidence of tectonic activity has been identified.

The transition zones between these provinces contain hydrothermally important features. Hydrothermal areas, such as Roosevelt Hot Springs, occur in west central and southwestern Utah. To the north many warm springs are found in fault zones.

V. RESOURCE DATA

One confirmed water-dominated hydrothermal reservoir occurs at the Roosevelt Hot Springs KGRA. About 50% of the wells drilled (1974) are considered to be useful to industry. Water temperatures are about 500°F at depths from about 1,000 ft. to more than 4,500 ft.

Two other KGRAs are considered to be excellent prospects for high temperature resources: Cove Fort/Sulphurdale and Thermo. Industrial drillers claim to have located seven significant spots in the southwestern counties of Millard, Beaver, and Iron.

Many prospects for space heating are considered to exist in Utah. A large number of warm springs and water wells are found mainly along the transition of the Basin and Range province with the Colorado Plateau in the south and the Rocky Mountains in the north.

VI. GEOHERMAL ACTIVITY

Current use: From the 19th century geothermal springs have been used for spas and greenhouses. The LDS church in Salt Lake City uses a ground-water fed heat pump for space conditioning of an office building.

Studies:

1. The city of Monroe is participating with DOE (PON) in a program for space heating several public buildings. The University of Utah (Earth Science Laboratory) is coordinating (for DOE) contractor assessment of geothermal resources in Utah as well as in other western states.
2. Time Phase Project, Site Specific Development Plans, and Area Development Plans continue to be prepared by the state in cooperation with DOE.
3. A preliminary study for geothermal applications at Hill Air Force Base was completed in 1978.

VII. LEGAL ACTIVITIES

Current law assigns responsibility of overseeing geothermal development to the Division of Water Rights. Water appropriation laws have been used to define rules and regulations for geothermal exploration and development.

Legislation intended to clarify and amplify state policy concerning geothermal energy was submitted during 1979. Some of the items included were the definition of a resource, municipal powers, and the relationship between the doctrine of appropriation and geothermal resources. A House amendment, precluding implementation of the new law until all pending geothermal water well applications were processed and approved, caused the bill not to be passed.

VIII. CONTRACTS

1. State Geothermal Team:
 - a. Operations Research, Stanley Green, Team Leader;
 - b. Resource Assessment, Don T. McMillan, Project Manager.
2. Department of Natural Resources, Gordon Harmstron, Executive Director.
3. Division of Water Rights, Dee C. Hanse, State Engineer.
4. Utah Geological and Mineral Survey, Donald T. McMillan, Director.
5. State Planning Coordinator's Office, Kent Briggs, Coordinator.
6. Utah Energy Office, Reed Searle, Staff Director.
7. Department of Social Services, Anthony W. Mitchell, Executive Director.
8. Energy Conservation and Development Council, Moroni Jensen, Chairman.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Utah Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Jun 1979.
- (2) David V. McClain, "Geothermal Energy in Idaho: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Jul 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**VERMONT
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Vermont)

TOTAL POPULATION: 444,732 TOTAL AREA: 9,267 SQ. MI.
POPULATION DENSITY: 48 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

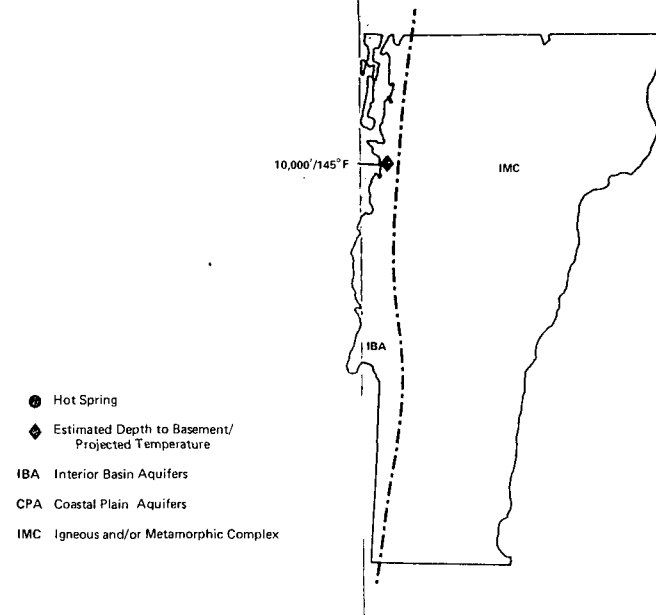
The western edge of the state shares a deep sedimentary basin, the Champlain Valley, with New York State. Warm springs in this area may represent a hydrothermal resource.

ENERGY USE - 1976 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	59.9	2.23	3.975	0.6	11.55
RESIDENTIAL	15.62	1.67	1.8	0.01	5.47
COMMERCIAL	7.87	0.4	1.1	0.03	3.18
INDUSTRIAL	3.47	0.13	0.88	0.15	3.22
PERCENT	87	4	8	1	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	Study of forced storage of warm river water - for space heating with heat pumps, Bellows Falls.
PROPOSED STUDIES	NYERDA - Study of Champlain Valley.
LEGAL ACTIVITIES	None



- Hot Spring
- ◆ Estimated Depth to Basement/
Projected Temperature
- IBA Interior Basin Aquifers
- CPA Coastal Plain Aquifers
- IMC Igneous and/or Metamorphic Complex

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Brendan Whittaker, Secretary (802) 828-3130
DIVISION OF WATER RIGHTS:	Reginald LaRosa, Act. Commissioner (802) 828-3361
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	State Planning Office, Martin Johnson, Secretary (802) 828-3357
OFFICE OF ENERGY POLICY:	State Energy Office, Ronald A. Allbee, Director (802) 828-2393
PLANNING BUREAU:	State Planning Office, John Simson, Asst. Director (802) 828-3326
GEOLOGICAL SURVEY:	Dr. Charles A. Ratte, State Geologist (802) 828-5763

LEGISLATIVE CONTACTS

SENATORS	Robert T. Stafford (R) Patrick J. Leahy (D)	GOVERNOR	Richard A. Snelling (R)
CONGRESSMEN (DIST.)	At Large - James M. Jeffords (R)		

State Geothermal Fact Sheet

VERMONT

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 444,732 Area: 9,267 sq. mi. Density: 48 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

T-14

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	11	35	4	0.02	3
Residential	2	25	1	0.00	1
Commerical	2	3	1	0.00	1
Industrial	1	8	2	0.00	1

Trillion Btu

GROSS	59.9	2.23	3.975	0.6	11.55
Residential	15.62	1.67	1.8	0.01	5.47
Commercial	7.87	0.4	1.1	0.03	3.18
Industrial	3.47	0.13	0.88	0.15	3.22

Percentages 87 4 8 1

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Numbers	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

Vermont is underlain by rocks of Precambrian and Paleozoic age. Throughout most of the state these rocks have been metamorphosed and intruded by igneous bodies during the Paleozoic orogenies. However, along the western border of the state the Champlain Valley is underlain by a thick sequence of sedimentary rocks (greater than 10,000 ft. deep). This area is highly faulted and fault controlled warm springs occur in several areas.

Large amounts of water flow from surface springs, but the temperatures are low. Little is known about water availability at depth or subsurface temperatures. However, the Champlain Valley is genetically, structurally, and magmatically similar to the area near Montreal, Canada, where the highest thermal gradient in eastern North America occurs. Therefore, this deep and highly faulted sedimentary basin appears to merit evaluation for geothermal resources.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

Current studies: Study of forced storage of warm river water for space heating with heat pumps (Bellows Falls) (C-6).

Proposed studies: NYERDA - Study of Champlain Valley.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Department of Natural Resources, Brendan Whittaker, Secretary, (802) 828-3130.

2. Division of Water Rights, Reginald LaRosa, Acting Commissioner, (802) 828-3361.
3. Department of Environmental Protection, State Planning Office, Martin Johnson, Secretary, (802) 828-3357.
4. Office of Energy Policy, State Energy Office, Ronald A. Allbee, Director, (802) 828-2393.
5. Planning Bureau, State Planning Office, John Simson, Asst. Director, (802) 828-2393.
6. Geological Survey, Dr. Charles A. Ratte, State Geologist, (802) 828-5763.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Geothermal Potential of Bellows Falls, Vermont," JHU/APL QM-79-157-1, Jun 1979.
- (2) "Rockingham Town Hall Utilization and Energy Management Study, Bellows Falls, Vermont October 1978," John Sharratt Assoc./BFH & Assoc.

COMMON REFERENCES

(C-1), (C-4), (C-6), (C-7), (C-8), and (C-10).

VIRGINIA
GEOHERMAL DATA SUMMARY SHEET
(cf. State Geothermal Fact Sheet, Virginia)

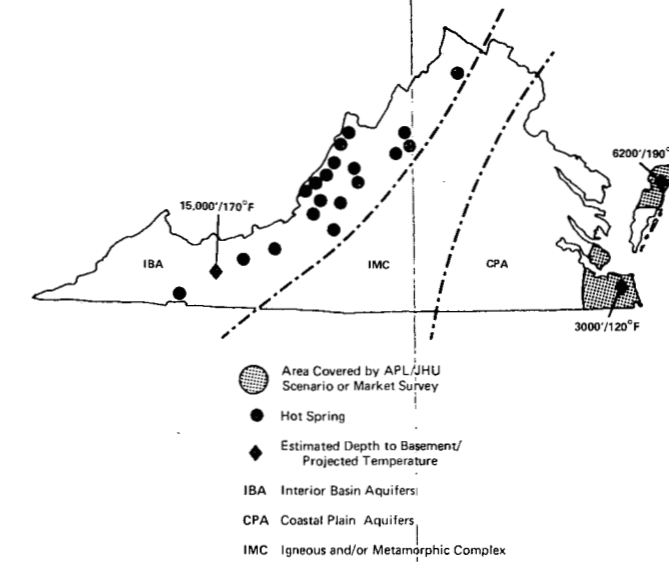
TOTAL POPULATION: 4,648,494 TOTAL AREA: 39,780 SQ. MI.
POPULATION DENSITY: 117 PERSONS/SQ. MI.

GEOHERMAL RESOURCE DATA

NAME	Coastal Plain
TYPE	Sand, clay, marl, consolidated sedimentary strata
THICKNESS	Approximately 6200 ft.
WATER TEMP.	Unknown
EST. STORED WATER	Unknown
EST. ENERGY CONTENT	Unknown

GEOHERMAL OVERVIEW

Coastal Plains sediment in the eastern portion of the state reaches a thickness of approximately 6200 feet and has a higher than average gradient there. This may be a potential hydrothermal and hot dry rock resource.



ENERGY RESOURCES - 1973
ANNUAL PRODUCTION

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	1,068	37,513 thousand tons	988.8
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	202	8,220 million cu. ft.	9.0
Crude Oil Wells	4	2 thousand bbl	0.01

ENERGY USE - 1975 (10¹¹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	776.6	12.1	130.9	170.3	132.7
RESIDENTIAL	55.0	6.6	50.4	4.0	52.7
COMMERCIAL	26.8	0.7	33.4	2.2	50.1
INDUSTRIAL	63.1	4.7	43.4	68.4	29.8
PERCENT	71	1	12	16	

GEOHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. APL/JHU Scenario - Atlantic Coastal Plain. 2. VPI&SU Targeting and Evaluation of Geothermal Resources. DOE/DGE Coastal Plain Drilling Project. 3. APL/JHU - Market Analysis. 4. State team to write prospectus on process of formation. 5. LASL - Evaluation for HDR Demonstration.
PROPOSED STUDIES	None
LEGAL ACTIVITIES	NSCL conducting workshop. 1981 Legislature to consider geothermal legislation.

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Dept. of Conservation and Economic Development, Fred W. Walker, Director (804) 786-2121
DIVISION OF WATER RIGHTS:	Water Control Board, R. V. Davis, Exec. Sec. (804) 257-0056
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	Council on the Environment, Office of the Governor, J. B. Jackson, Jr. Acting Administrator (804) 786-4500
OFFICE OF ENERGY POLICY:	Office of Emergency and Energy Services, George L. Jones, Coord. (804) 745-3305
PLANNING BUREAU:	Department of Planning and Budget, Steward Connock, Director (804) 786-3154
GEOLOGICAL SURVEY:	Virginia Div. of Mineral Resources (804) 293-5121 Robert C. Milici, State Geologist

LEGISLATIVE CONTACTS

SENATORS	Harry F. Byrd, Jr. (Ind.) John W. Warner (R)	GOVERNOR	John Dalton (R)
CONGRESSMEN (DIST.)			
1 - Paul S. Trible, Jr. (R)			
2 - G. William Whitehurst (R)			
3 - Thomas J. Bliley, Jr. (R)			
4 - Robert W. Daniel, Jr. (R)			
8 - Stan Parris (R)			
10 - Frank Wolf (R)			

State Geothermal Fact Sheet

VIRGINIA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 4,648,494 Area: 39,780 sq. mi. Density: 117 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: 1,079,514 Area: 2,438 sq. mi. Density: 443 per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	137	127	127	7	39
Residential	10	69	49	0.1	15
Commerical	5	8	32	0.1	15
Industrial	10	49	42	2	9

Trillion Btu

GROSS	776.6	12.1	130.9	170.3	132.7
Residential	55.0	6.6	50.4	4.0	52.7
Commercial	26.8	0.7	33.4	2.2	50.1
Industrial	63.1	4.7	43.4	68.4	29.8
Percentages	71	1	12	16	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Numbers	Units	Trillion Btu
Coal mines	1068	37,513 thousand tons	988.8
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	202	8,220 million cu. ft.	9.0
Crude oil wells	4	2 thousand bbl	0.01

IV. GEOLOGY

The State of Virginia has at least two regions that are of geothermal interest. The first is the Delmarva Peninsula, the northeast coastal region of the State. The geology of the region consists of a thickening wedge of Mesozoic and Cenozoic sedimentary rocks and unconsolidated strata. These deposits have a maximum thickness of approximately 6200 ft. and cover an igneous and metamorphic basement, the surface of which slopes to the east. The principal structural feature is the Salisbury embayment that lies between Newport News, Virginia and Atlantic City, New Jersey. This embayment is fairly prominent in the basement rock, but it loses form in the overlying sedimentary rocks and the unconsolidated deposits.

The second region extends South along the Atlantic sea coast from Norfolk to North Carolina. Basement surface probably occurs at depths of less than 4000 ft. in southeast Virginia. Preliminary modeling of negative gravity anomalies in the Coastal Plain supports the interpretation of a deep granitic pluton near Norfolk, buried beneath the insulating sedimentary rocks and unconsolidated deposits of the Coastal Plain. There are also numerous warm springs (60°F to 106°F) located primarily in a six-country area of west-central Virginia that may offer local resources.

V. RESOURCE DATA

Temperatures as high as 130°F may be found at depth in the sediments of the southern Virginia Beach region. A number of hot springs exist in western Virginia.

New coastal region data will result from the DOE/DGE drilling program.

VI. GEOHERMAL ACTIVITY

Geothermal gradient test holes have been completed as part of the DOE/DGE sponsored drilling program. Data are being assessed by VPI&SU. Drilling sites in the Virginia portion of the Delmarva

Peninsula and those in the Norfolk/Virginia Beach area are shown on page VA-5.

The Warm Springs, Virginia area has been analyzed specifically by VPI&SU and by consultant Dr. D. Gysers. The Warm Springs Hotel is considering geothermal space heating (C-15).

LASL in its HDR Program is studying the coastal plain as a potential HDR demonstration site (C-8).

APL is conducting a study of geothermal applications in coastal regions of the state.

VII. LEGAL ACTIVITIES

1. NCSL is conducting legislative geothermal workshops.
2. The state is organizing a state team to write a geothermal prospectus (5).

VIII. CONTACTS

1. Virginia Office of Emergency and Energy Services, 310 Turner Rd., Richmond, VA 23225, George L. Jones, Coordinator, (804) 745-3305.
2. Division of Mineral Resources, Natural Resources Bldg., P.O. Box 3667, Charlottesville, VA 22901, Robert C. Milici, State Geologist, (804) 293-5121.
3. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, John K. Costain, Professor of Geophysics, (803) 961-5096.
4. Virginia Institute of Marine Sciences, Gloucester Point, VA, Thomas A. Barnard, Jr., (804) 642-2111, ext. 186.
5. Council on the Environment, Office of the Governor, 903 Ninth St. Office Bldg., Richmond, VA 23219, J. B. Jackson, Jr., Acting Administrator (804) 786-4500.
6. State Water Control Board, R. V. Davis, Executive Secretary, (804) 257-0056.

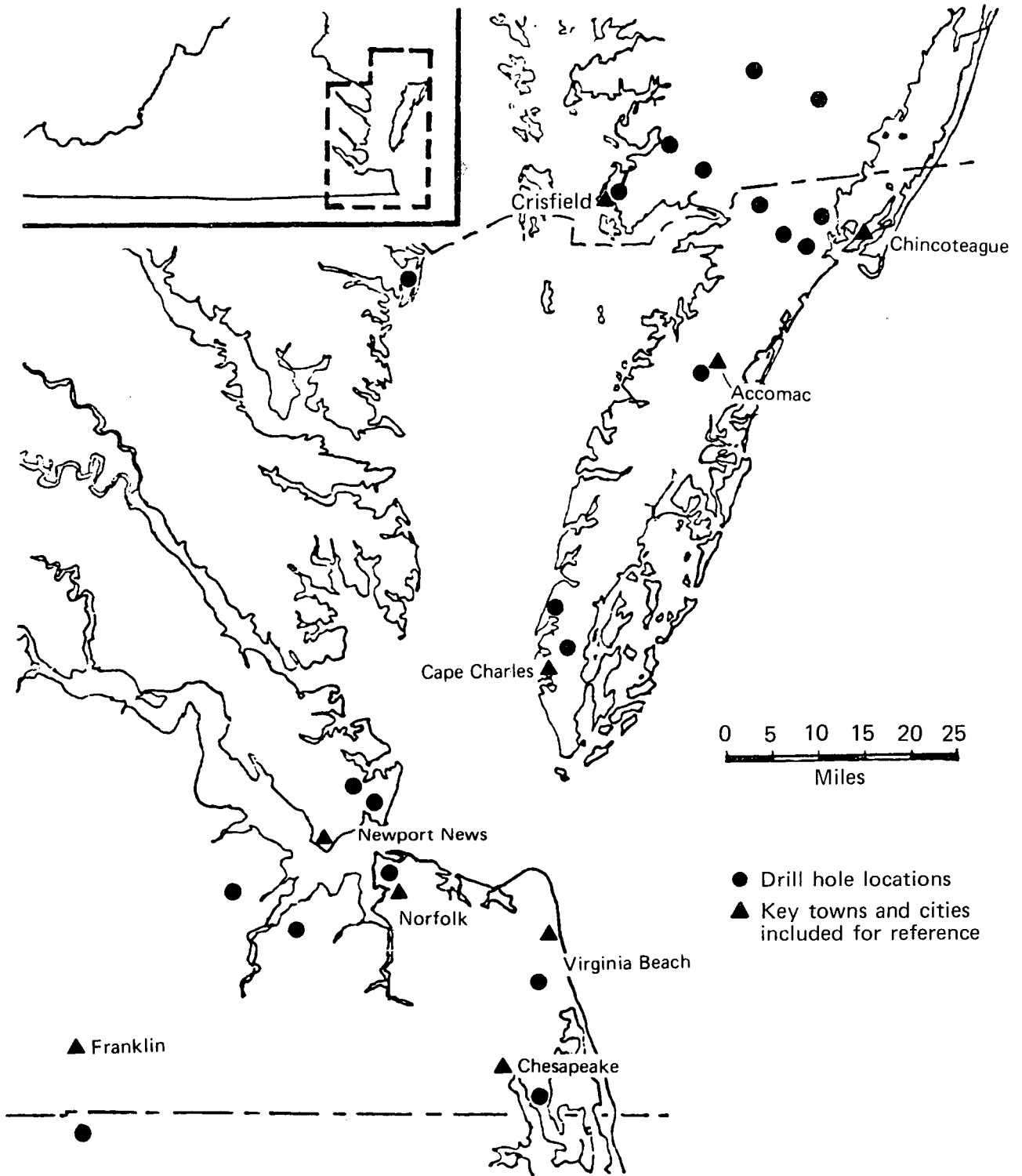
REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Division of Mines and Quarries, 1977 Annual Report of Virginia Department of Labor and Industry.

- (2) P. M. Brown, J. A. Miller, and F. M. Swain, "Structural and Stratigraphic Framework, and Spatial Distribution of Permeability of the Atlantic Coastal Plain, North Carolina to New York," U.S.G.C. Professional Paper 796, 1972.
- (3) U. S. Department of the Interior, "Geologic Framework and Petroleum Potential of the Atlantic Coastal Plain and Continental Shelf," Geological Survey Professional Paper 659, 1972.
- (4) G. A. Waring, R. R. Blankenship, and R. Bentall, "Thermal Springs of the United States and Other Countries of the World - A Summary," U. S. Geological Survey Professional Paper 492, 1965.
- (5) "Geothermal Policy Report - Issues and Options," Prepared for the Virginia Legislative 1980 Geothermal Policy Review, NCSL, May 1980.

COMMON REFERENCES

(C-4), (C-6), (C-7), (C-8), and (C-15).



Locations of gradient test holes — Virginia.

**WASHINGTON
GEOTHERMAL DATA SUMMARY SHEET**

(cf. State Geothermal Fact Sheet, Washington)

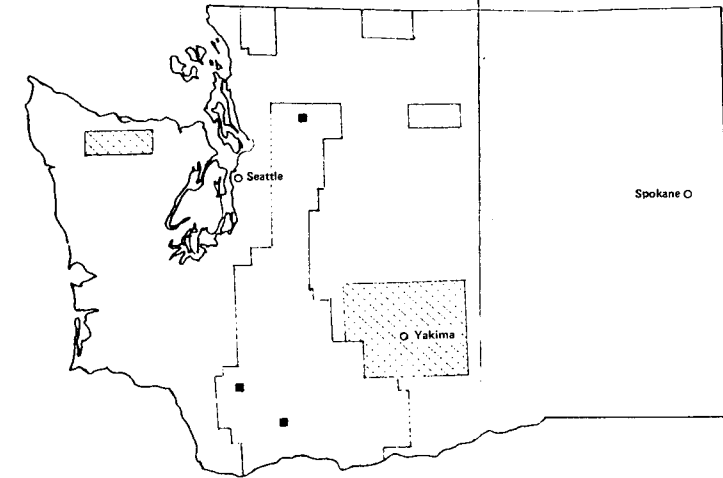
TOTAL POPULATION: 3,409,169 TOTAL AREA: 66,570 SQ. MI.
POPULATION DENSITY: 51 PERSONS/SQ. MI.

**ENERGY RESOURCES — 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	3	3,270 thousand tons	63.2
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

The principal geologic province in Washington for geothermal resource is the north-south trending Cascade Range which contains Tertiary to Recent Andesitic strato-volcanoes and basaltic volcanic centers. Three Known Geothermal Resource Areas (KGRA's), Mount St. Helens, Indian Heaven fissure zone area, and Kennedy Hot Springs and three Potential Geothermal Resource Areas (PGRA's), Mount Adams, Mount Rainier, and Mount Baker occur in the Cascades and are of interest since they yield strong geologic evidence of recent volcanism or thermal activity.



- Key Cities
- KGRA'S
- ▨ PGRA'S
Lands Valuable Prospectively
for Geothermal Resources
- ▩ Area of Known Warm Water Use

From: "Geothermal Energy in Washington:
Site Data Base and Development Status"
OIT Geo-Heat Utilization Center, Apr 1979

ENERGY USE — 1976 (10¹² BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	439.5	3.1	172.4	65.7	202.4
RESIDENTIAL	24.9	1.7	35.5	0.2	71.7
COMMERCIAL	35.8	0.2	33.0	0.1	40.5
INDUSTRIAL	47.2	1.1	97.9	7.4	90.1
PERCENT	65	0	25	10	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
DIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	
OFFICE OF ENERGY POLICY:	
PLANNING BUREAU:	
GEOLOGICAL SURVEY:	

LEGISLATIVE CONTACTS

SENATORS	Warren G. Magnuson (D) Henry M. Jackson (D)	GOVERNOR	Dixy Lee Ray (D)
CONGRESSMEN (DIST.)	1 - Joel Pritchard (R) 2 - Al Swift (D) 3 - Don Bonker (D) 4 - Mike McCormack (D) 5 - Thomas S. Foley (D) 6 - Norman D. Dicks (D) 7 - Mike Lowry (D)		

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSES STUDIES	
LEGAL ACTIVITIES	

State Geothermal Fact Sheet

WASHINGTON

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 3,409,169 Area: 66,570 sq. mi. Density: 51 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	80	32	167	4	59
Residential	4	18	34	0	21
Commerical	6	2	32	0	12
Industrial	8	11	95	0	26

Trillion Btu

GROSS	439.5	3.1	172.4	65.7	202.4
Residential	24.9	1.7	35.5	0.2	71.7
Commercial	35.8	0.2	33.0	0.1	40.5
Industrial	47.2	1.1	97.9	7.4	90.1

Percentages 65 0 25 10

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

WZ-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	3	3,270 thousand tons	63.2
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

The principal geologic province in Washington for geothermal resource is the north-south trending Cascade Range, which contains Tertiary to Recent Andesitic strato-volcanoes and basaltic volcanic centers. Three KGRA's, Mount St. Helens, Indian Heaven fissure zone area, and Kennedy Hot Springs and three PGRA's, Mount Adams, Mount Rainier, and Mount Baker occur in the Cascades and are of interest since they yield strong geologic evidence of recent volcanism or thermal activity. In addition to the GRA's, two other regions are of interest because they are areas of known warm water use. The city of Yakima which overlies Miocene basalts contains warm springs with chemistries that indicate temperatures of about 100°C at depth. In the northern part of the Olympic Peninsula, the Olympic and Sol Duc Hot Springs chemistries indicate temperatures of 90° to 105°C. This area is underlain by greatly faulted Tertiary sedimentary rocks. A region of anomalously high geothermal gradients underlie the large area of Pleistocene loess deposits in east central Washington.

V. RESOURCE DATA

To be determined.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

To be determined.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) R. Gordon Bloomquist, "Geothermal Energy in Washington: Site Data Base and Development Status," Geo-Heat Utilization Center, Klamath Falls, OR, Apr 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**WEST VIRGINIA
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, West Virginia)

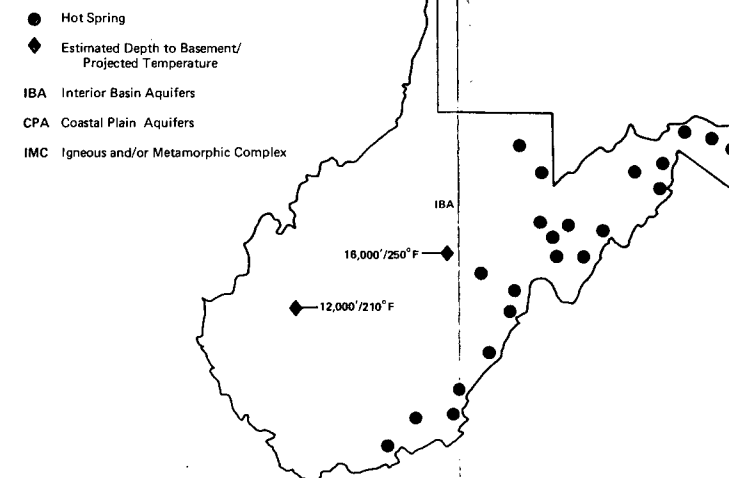
TOTAL POPULATION: 1,744,237 TOTAL AREA: 24,070 SQ. MI.
POPULATION DENSITY: 72 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	932	115,446 thousand tons	3,094
Natural Gas (liq.)	-	0 thousand bbl	0
Natural Gas Wells	21,400	208,676 million cu. ft.	228.1
Crude Oil Wells	13,600	2,385 thousand bbl	13.8

GEOTHERMAL OVERVIEW

The deep sedimentary Appalachian Basin runs through the center of the state, and may represent a hydrothermal resource with normal gradients.



ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	151.5	3.4	162.3	831.9	57.8
RESIDENTIAL	8.4	1.4	52.9	3.1	16.6
COMMERCIAL	4.0	0.2	25.6	1.7	10.0
INDUSTRIAL	13.2	1.9	68.9	95.0	31.2
PERCENT	13	1	14	72	

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	1. HDR sponsored study of heat flow and thermal gradients, West Virginia University. 2. DOE/DGE Report "Geothermal Resources of the Eastern U.S."
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	Ira S. Latimer, Jr., Director (304) 348-2754
DIVISION OF WATER RIGHTS:	Division of Water Resources, Edgar N. Henry, Chief (304) 348-2107
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	State Clearinghouse, Robert V. Barill, Director (304) 348-3878
OFFICE OF ENERGY POLICY:	Fuel and Energy Office, W. Keith Zillifro, Director (304) 348-8860
PLANNING BUREAU:	Department of Planning and Development, Robert Gall, Operations Coordinator (304) 348-2246
GEOLOGICAL SURVEY:	Dr. Robert B. Erwin, Dir. & State Geologist (304) 292-6331 Dr. D. G. Patchen, Oil and Gas Geologist

LEGISLATIVE CONTACTS

SENATORS	Jennings Randolph (D) Robert C. Byrd (D)	GOVERNOR	John D. Rockefeller 4th (D)
CONGRESSMEN (DIST.)	1 - Robert H. Mollohan (D) 2 - Cleve Benedict (R) 3 - Mick Staton (R) 4 - Nick J. Rahall II (D)		

State Geothermal Fact Sheet

WEST VIRGINIA

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 1,744,237 Area: 24,070 sq. mi. Density: 72 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	28	36	157	34.4	17
Residential	1	15	51	0.1	5
Commerical	0.7	2	25	0.06	3
Industrial	2	19	67	3.4	9

Trillion Btu

GROSS	151.5	3.4	162.3	831.9	57.8
Residential	8.4	1.4	52.9	3.1	16.6
Commercial	4.0	0.2	25.6	1.7	10.0
Industrial	13.2	1.9	68.9	95.0	31.2
Percentages	13	1	14	72	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	932	115,446 thousand tons	3,094
Natural gas (liq.)	-	0 thousand bbl	0
Natural gas wells	21,400	208,676 million cu. ft.	228.1
Crude oil wells	13,600	2,385 thousand bbl	13.8

IV. GEOLOGY

West Virginia is underlain by sedimentary rocks of Paleozoic age. These sedimentary rocks, which lie in the Appalachian Basin, thicken from 10,000 ft. in the western part of the state to over 20,000 ft. in the east. Major structures (faults) have deformed and controlled the deposition of the sediments. One of these, the Rome Trough, coincides with the occurrence of geopressured wells. These rocks are highly indurated at depth, but are pervasively fractured. Thus oil and gas recovery is a function of the secondary permeability. Large quantities of water have been produced from some deep wells although dry holes are more commonly encountered at depth. The deep holes have been drilled predominantly in the Rome Trough Area. Precambrian through Tertiary igneous intrusives and extrusives occur along the eastern border of the state in an area that is now dotted by warm springs.

V. RESOURCE DATA

In the Appalachian Basin geothermal gradients as high as 1.8°F/100 ft. have been reported.

At a depth of 10,000 ft. beneath Morgantown or Huntington where the gradient is about 1.5°F/100 ft., temperatures of about 200°F may occur. Temperatures as high as 106°F and flow rates of 1500 gal/min exist at the surface in the area of the warm springs.

VI. GEOHERMAL ACTIVITY

1. Study of geothermal gradient and heat flow sponsored by LASL HDR Program, at University of West Virginia (1).
2. Analysis of the state as part of Gruy Federal DOE/DGE - Eastern Resource Definition Program (2).

VII. LEGAL ACTIVITIES

None at present.

VI

VIII. CONTACTS

1. West Virginia Geological and Economic Survey, P.O. Box 879, Morgantown, WV 26505, Dr. Robert Erwin, Director, (304) 292-6331; Dr. Larry Woodford, Assistant Director; and Dr. D. G. Patchen, Oil and Gas Geologist.
2. Dr. H. H. Ieike, Petroleum Engineer
3. Fuel and Energy Office, 1262½ Greenbriar St., Charleston, WV 25311, W. Keith Zillifro, Director, (304) 348-8860.
4. Department of Natural Resources, Ira S. Latimer, Jr., Director, (304) 348-2754.
5. Division of Water Resources, Edgar N. Henry, Chief, (304) 348-2107.
6. Department of Environmental Protection, State Clearinghouse, Robert V. Barill, Director (304) 348-3878.
7. Department of Planning and Development, Robert Gall, Operations Coordinator, (304) 348-2246.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) Herman H. Rieke III, "Recent Determinations of Geothermal Gradients and Heat Flow Values for Well-Sites in West Virginia using an Exact Computation of Methods," University of West Virginia (published in C-8).
- (2) J. L. Renner and Tracy L. Vaught, Preliminary Definition of the Geothermal Resource Potential of West Virginia, Jan 1979, NVO-1558-8, Gruy Federal, Inc., Arlington, VA.

COMMON REFERENCES

(C-4), (C-6), (C-7), and (C-8).

**WISCONSIN
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Wisconsin)

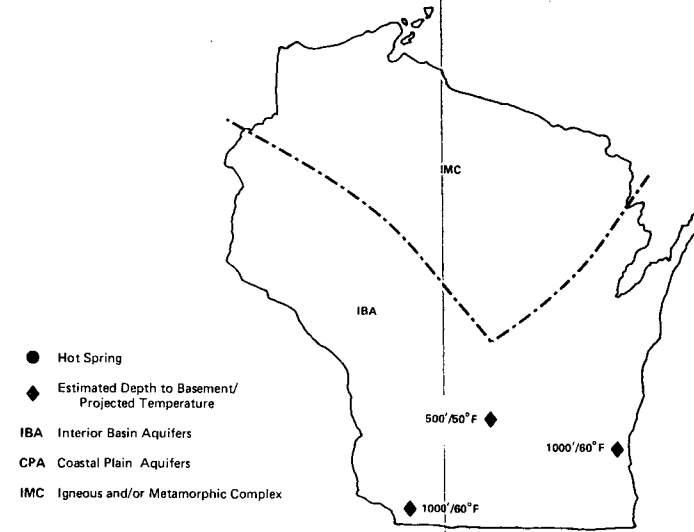
TOTAL POPULATION: 4,417,731 TOTAL AREA: 54,464 SQ. MI.
POPULATION DENSITY: 81 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	0	0 thousand tons	0
Natural Gas (liq.)	0	0 thousand bbl	0
Natural Gas Wells	0	0 million cu. ft.	0
Crude Oil Wells	0	0 thousand bbl	0

GEOTHERMAL OVERVIEW

Only a shallow sedimentary cover exists in part of this state. That, combined with low thermal gradients, limits the potential for use as a geothermal resource in the near future.



ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	453.3	33.9	383.4	317.5	106.3
RESIDENTIAL	87.6	23.0	123.8	6.6	40.6
COMMERCIAL	32.2	2.6	69.6	3.5	29.3
INDUSTRIAL	22.8	8.2	164.3	48.4	36.4
PERCENT	38	3	32	27	

PRIMARY CONTACTS

DEPARTMENT OF NATURAL RESOURCES:	
SIVISION OF WATER RIGHTS:	
DEPARTMENT OF ENVIRONMENTAL PROTECTION:	State Planning Office
OFFICE OF ENERGY POLICY:	State Planning Office Stephen Bojn, Director (608) 266-7958
PLANNING BUREAU:	State Planning Office John Armstrong, Energy Planner (608) 266-6850
GEOLOGICAL SURVEY:	Dr. Meredith E. Ostrom, Dir. and State Geologist (608) 262-1705
OFFICE OF ENERGY EMERGENCY ASSISTANCE:	Dr. Charles J. Cicehetti, Dir. (608) 266-8234

LEGISLATIVE CONTACTS

SENATORS	William Proxmire (D) Gaylord Nelson (D)	GOVERNOR	Lee Sherman Dreyfus (R)
CONGRESSMEN (DIST.)			
1 - Les Aspin (D)			
2 - Robert W. Kastenmeier (D)			
3 - Steven Gunderson (R)			
4 - Clement J. Zablocki (D)			
5 - Henry S. Reuss (D)			
6 - Thomas E. Petri (R)			
7 - David R. Obey (D)			
8 - Tobias Roth (R)			
9 - James Sensenbrenner (R)			

GEOTHERMAL ACTIVITIES

CURRENT USES	None
RECENT OR CURRENT STUDIES	None
PROPOSED STUDIES	None
LEGAL ACTIVITIES	None

State Geothermal Fact Sheet

WISCONSIN

I. DEMOGRAPHIC INFORMATION (1970) (C-4)

TOTAL STATE

Population: 4,417,731 Area: 54,464 sq. mi. Density: 81 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	83	355	372	14	31
Residential	15	240	120	0.3	12
Commerical	5	27	67	0.1	9
Industrial	4	86	159	2	10

Trillion Btu

GROSS	453.3	33.9	383.4	317.5	106.3
Residential	87.6	23.0	123.8	6.6	40.6
Commercial	32.2	2.6	69.6	3.5	29.3
Industrial	22.8	8.2	164.3	48.4	36.4
Percentages	38	3	32	27	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	0	0 thousand tons	0
Natural gas (liq.)	0	0 thousand bbl	0
Natural gas wells	0	0 million cu. ft.	0
Crude oil wells	0	0 thousand bbl	0

IV. GEOLOGY

To be supplied.

V. RESOURCE DATA

To be supplied.

VI. GEOHERMAL ACTIVITY

To be determined.

VII. LEGAL ACTIVITIES

To be determined.

VIII. CONTACTS

1. Office of Energy Policy, State Planning Office, Stephen Born, Director, (608) 266-7958.
2. Planning Bureau, State Planning Office, John Armstrong, Energy Planner, (608) 266-6850.
3. Geological Survey, Dr. Meredith E. Ostrom, Director and State Geologist, (608) 262-1705.
4. Office of Energy Emergency Assistance, Dr. Charles J. Cicehetti, Director, (608) 266-8234.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

Common references only, see below.

COMMON REFERENCES

(C-4), (C-6), and (C-7).

**WYOMING
GEOTHERMAL DATA SUMMARY SHEET**
(cf. State Geothermal Fact Sheet, Wyoming)

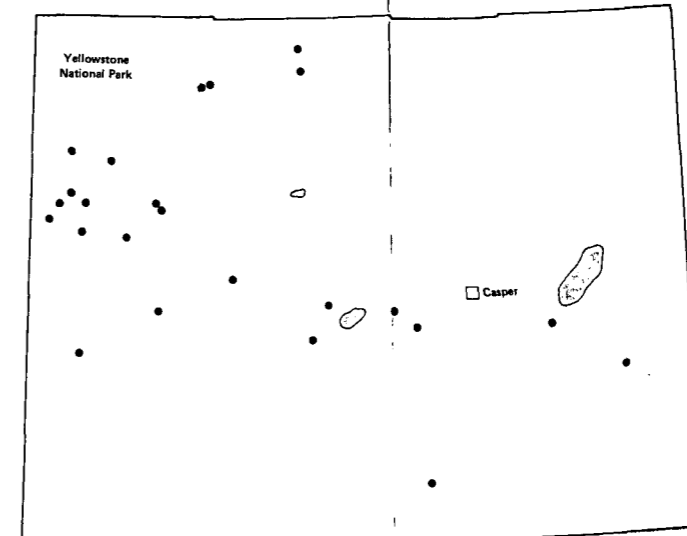
TOTAL POPULATION: 374,000 TOTAL AREA: 97,914 SQ. MI.
POPULATION DENSITY: 3.8 PERSONS/SQ. MI.

**ENERGY RESOURCES - 1973
ANNUAL PRODUCTION**

TYPE	NUMBER	STATUS	10 ¹² Btu
Coal Mines	17	14,887 thousand tons	307.0
Natural Gas (liq.)	-	10,588 thousand bbl	42.7
Natural Gas Wells	850	357,731 million cu. ft.	391.0
Crude Oil Wells	7,642	141,914 thousand bbl	823.1

GEOTHERMAL OVERVIEW

Wyoming has numerous hot springs which are some of the largest in the world, and includes those at Thermopolis. Recent data in central Wyoming indicate the potential for generating electrical power from geothermal resources. Oil and gas drilling activities have found some waters that appear to be useful for direct applications. Leasing activity has been very limited and very little has been done in geothermal legislation.



ENERGY USE - 1976 (10⁹ BTU)

SECTOR	OIL	LPG	GAS	COAL	ELECT. PURCH.
GROSS	98.0	6.5	99.8	131.8	15.1
RESIDENTIAL	1.7	4.1	12.5	0.4	3.0
COMMERCIAL	11.5	0.5	10.6	0.2	5.4
INDUSTRIAL	24.8	1.8	70.4	10.8	6.7
PERCENT	29	2	30	39	

GEOTHERMAL ACTIVITIES

CURRENT USES	
RECENT OR CURRENT STUDIES	
PROPOSED STUDIES	
LEGAL ACTIVITIES	Geothermal legislation is being drafted for presentation in 1980.

PRIMARY CONTACTS

STATE GEOTHERMAL TEAM	
OPERATIONS RESEARCH:	Dr. E. Gerald Meyer (University of Wyoming)
RESOURCE ASSESSMENT:	Dr. Edward Decker (Department of Geology, University of Wyoming)
DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT:	John Niland, Executive Director
STATE ENGINEER:	George L. Christopoulos
DEPARTMENT OF ENVIRONMENTAL QUALITY:	Robert E. Sundin, Director
GAS AND OIL COMMISSION:	Donald B. Basko, State Oil and Gas Supervisor
WYOMING GEOLOGICAL SURVEY:	Dr. Daniel N. Miller, Jr., State Geologist

LEGISLATIVE CONTACTS

SENATORS	Malcolm Wallop (R) Alan K. Simpson (R)	GOVERNOR	Ed Herschler (D)
CONGRESSMEN (DIST.)	At large - Richard Bruce Cheney (R)		

State Geothermal Fact Sheet

WYOMING

I. DEMOGRAPHIC INFORMATION (1977) (C-4)

TOTAL STATE

Population: 374,000 Area: 97,914 sq. mi. Density: 3.8 per sq. mi.

GEOHERMAL RESOURCE AREA

Population: Area: sq. mi. Density: per sq. mi.

II. ENERGY CONSUMPTION* (1975) (C-7)

	OIL (million bbl)	LPG (million gal.)	GAS (trillion cu.ft.)	COAL (million tons)	ELECTRICITY PURCHASED (billion kWh)
GROSS	17	68	97	8	4
Residential	0	43	12	0	1
Commerical	2	5	10	0	2
Industrial	4	18	68	0.5	2

Trillion Btu

GROSS	98.0	6.5	99.8	131.8	15.1
Residential	1.7	4.1	12.5	0.4	3.0
Commercial	11.5	0.5	10.6	0.2	5.4
Industrial	24.8	1.8	70.4	10.8	6.7
Percentages	29	2	30	39	

*Excluding nuclear and hydro electricity, coking coal and petroleum coke, and other petroleum products not used as fuels.

WY-1

III. STATE FUEL PRODUCTION (1973) (C-6)

Type	Number	Units	Trillion Btu
Coal mines	17	14,887 thousand tons	307.0
Natural gas (liq.)	-	10,588 thousand bbl	42.7
Natural gas wells	850	357,731 million cu. ft.	391.0
Crude oil wells	7,642	141,914 thousand bbl	823.1

IV. GEOLOGY

Four geologic provinces exist within the borders of Wyoming: the Middle Rocky Mountains in the north central, northwestern, and western regions; the Great Plains in the northeastern and eastern parts; the Wyoming Basin in the central and southern parts; and the Middle Rocky Mountains extending into the state between the Basin and the Great Plains.

V. RESOURCE DATA

There are no KGRAs designated in Wyoming; however, six low to moderate temperature resources have been confirmed: Audubon and Huckleberry Hot Springs, Saratoga, Countryman Well (near Lander), Thermopolis, and Cody. The northeastern portion of the state, which is underlain by the Madison aquifer, displays some near-boiling waters and is thus considered to offer potential.

Yellowstone National Park, in the northwest corner of the state, contains the world's largest concentration of hydrothermal features. Huckleberry and Audubon Hot Springs to the south of the park area, indicate temperatures suitable for generation of electricity but at depths that exceed present drilling capabilities.

VI. GEOHERMAL ACTIVITY

Large quantities of hot water from the Madison aquifer are being used in secondary and tertiary oil recovery operations.

Four leases, totaling about 7500 acres, have been granted on federal lands, one lease (1150 acres) on state land.

A few shallow wells are used for home space heating, spas, agriculture, and fish farming.

Area development plans and site specific development plans, part of the DOE Operations Research Geothermal Planning Project are being prepared for a number of regions in the state.

VII. LEGAL ACTIVITIES

Legislation concerning geothermal energy is being drafted for presentation in 1980.

VIII. CONTACTS

1. State Geothermal Team:
 - a. Operations Research, Dr. E. Gerald Meyer (University of Wyoming);
 - b. Resource Assessment, Dr. Edward Decker (Department of Geology, University of Wyoming).
2. Department of Economic Planning and Development, John Niland, Executive Director.
3. State Engineer, George L. Christopulos.
4. Department of Environmental Quality, Robert E. Sundin, Director.
5. Gas and Oil Commission, Donald B. Basko, State Oil and Gas Supervisor.
6. Wyoming Geological Survey, Dr. Daniel N. Miller, Jr., State Geologist.

REFERENCES AND LIST OF SIGNIFICANT REPORTS

- (1) "Wyoming Hydrothermal Commercialization Baseline," EG&G Idaho, Inc., Jun 1979.

COMMON REFERENCES

(C-4), (C-6), and (C-7).