GL01723

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NORTH DAKOTA HYDROTHERMAL COMMERCIALIZATION BASELINE

PREPARED FOR

DEPARTMENT OF ENERGY - IDAHO OPERATIONS OFFICE

DEPARTMENT OF ENERGY - RESOURCE APPLICATIONS,
GEOTHERMAL RESOURCE OFFICE

BY

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CONTENTS

		Page
ACKNOWLEDGEMENTS		iv
1.	INTRODUCTION	1-1
2.	BASIC STATE DATA	2-1
	A. Government Contacts	2-1
	B. Statistical Data	2-3
3.	HYDROTHERMAL RESOURCES	3-1
	A. Geologic Setting	3-1
	B. High-Temperature Resources	3-3
	C. Low- and Moderate-Temperature Resources	3-3
	D. Comments	3-3
	E. Hydrothermal Springs and Wells	3-3
	F. References	3-6
4.	COMMERCIALIZATION ACTIVITIES	4-1
	A. Highlights	4-1
	B. Leases	4-2
	C. Test Wells	4-8
	D. Other Exploratory Activity	4-8
	E. Operational Systems	4-8
	F. References	4-15
5.	DEVELOPMENT PLANS	5-1
	A. Description	5-1
	B. References	5-4
6.	GOVERNMENT ASSISTED ACTIVITIES	6-1
	A. Geothermal Direct Use PON Program	6-1
	B. Program Research and Development Announcement	6-2

CONTENTS (contd)

		Page
	C. Demonstration Projects and Experiments	6-2
	D. Geothermal Loan Guaranty Program	6-2
	E. National Conference of State Legislatures	6-2
	F. State Coupled Program	6-3
	G. Industry Coupled Program	6-4
	H. Technical Assistance	6-6
	I. State Assisted Activities	6-6
	J. References	6-6
7.	ENERGY USE PATTERNS	7-1
	A. Energy Use Summary	7-1
	B. References	7-5
8.	LEASING AND PERMITTING POLICIES	8-1
	A. General	8-1
	B. Time Table of Institutional Procedures	8-7
	C. References	8-7
9.	BIBLIOGRAPHY	9-1

FIGURES

		Page
3.1	Physiographic provinces	3-2
3.2	Counties and geothermal springs and resource areas	3-4
4.1	Summary of federal leasing activities	4-4
7.1	Energy supply and use	7-2
7.2	Energy usage map	7-3
7.3	Total energy use projection	7-4

TABLES

3.1	Hydrothermal Springs and Wells	3-5
4.1	Total Acreages of Geothermal Leases	4-3
4.2	Federal Active Noncompetitive Geothermal Leases	4-5
4.3	Summary of Bidding History of Competitive Leases	4-6
4.4	Federal Active Competitive Geothermal Leases	4-7
4.5	State Leases	4-9
4.6	Test Wells	4-10
4.7	Other Exploratory Activity	4-11
4.8	Operational Systems	4-14
5.1	Development Plans	5-3
7.1	1975 Energy Use by County	7-6
7.2	Industrial Process Heat Requirements	7-9
8.1	Time Table of Institutional Procedures	8-8

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2. BASIC STATE DATA (NORTH DAKOTA)

A. Government Contacts

Governor - Arthur A. Link (D).

Legislature

Senate Natural Resources Committee:
Garvin J. Jacobson (R), Chairman.

Senate President: Wayne Sanstead (D).

House Natural Resources Committee:
Richard Klaubec (R), Chairman.

House Speaker: Vernon Wagner (R).

State Geothermal Team

Operations Research: Dwight Connor and Robert Kaiser, State Energy Office.

Resource Assessment: Erling Brosteun and Ken Harris, North Dakota Geological Survey.

State Agencies

North Dakota Department of Agriculture:
Myron Just, Commissioner.

North Dakota State Land Department:
R. E. Lommen, Director.

North Dakota Legislative Council:
John A. Graham, Director.

North Dakota Public Service Commission:
Richard Elkin, President.

North Dakota Water Commission:
Vernon Fahy, State Engineer.

North Dakota Geological Survey:
Wes Norton, Director.

North Dakota Tax Department:
Byron L. Dorgan, Commissioner.

North Dakota Business and Industrial Development Department:
Bruce L. Bartch, Director.

Energy

Supply (1975): 288×10^{12} Btu; 18% exported; 5% imported

Use (1975): 226×10^{12} Btu

Potential Conversion to Geothermal (1975): 10×10^{12} Btu

3. HYDROTHERMAL RESOURCES

The terms "confirmed reservoirs" and "prospects", as used in describing resources below, are defined only for the purpose of this baseline document. For a more complete discussion of geothermal terminology, see Reference 1.

"Confirmed reservoirs" are those hydrothermal systems that have a "demonstrated" resource. In Reference 1, "demonstrated" resources are defined as being composed of the "measured" (i.e., "...computed from drill hole data and reservoir engineering measurements") and "indicated" (i.e., "...estimated by a combination of drilling data and extrapolation using geochemical, geophysical or geological data") portions of the resource base.

"Prospects" are defined as those hydrothermal systems that have identified hydrothermal features or a geologic setting that is considered favorable for the discovery of hydrothermal resources. These areas have generally not been tested by exploratory drilling and therefore are largely composed of the "inferred" portion of the "useful accessible resource base" of Reference 1.

A. Geologic Setting[2]

North Dakota is located entirely within the Great Plains geologic province (see Figure 3.1). The principal geologic feature of interest in terms of hydrothermal energy is the Madison group aquifer, which occurs in the Williston Basin and elsewhere in western North Dakota. The Madison group contains a regionally interconnected system of fracture- and solution-opening porosity, with recharge at Madison outcrops on the periphery of South Dakota's Black Hills and elsewhere. Water flowing into the Madison aquifer spreads outward and downward below the surface. In the Williston Basin the Madison is more than a thousand meters deep and contains waters up to about 80°C in temperature. Water quality ranges from good to poor,

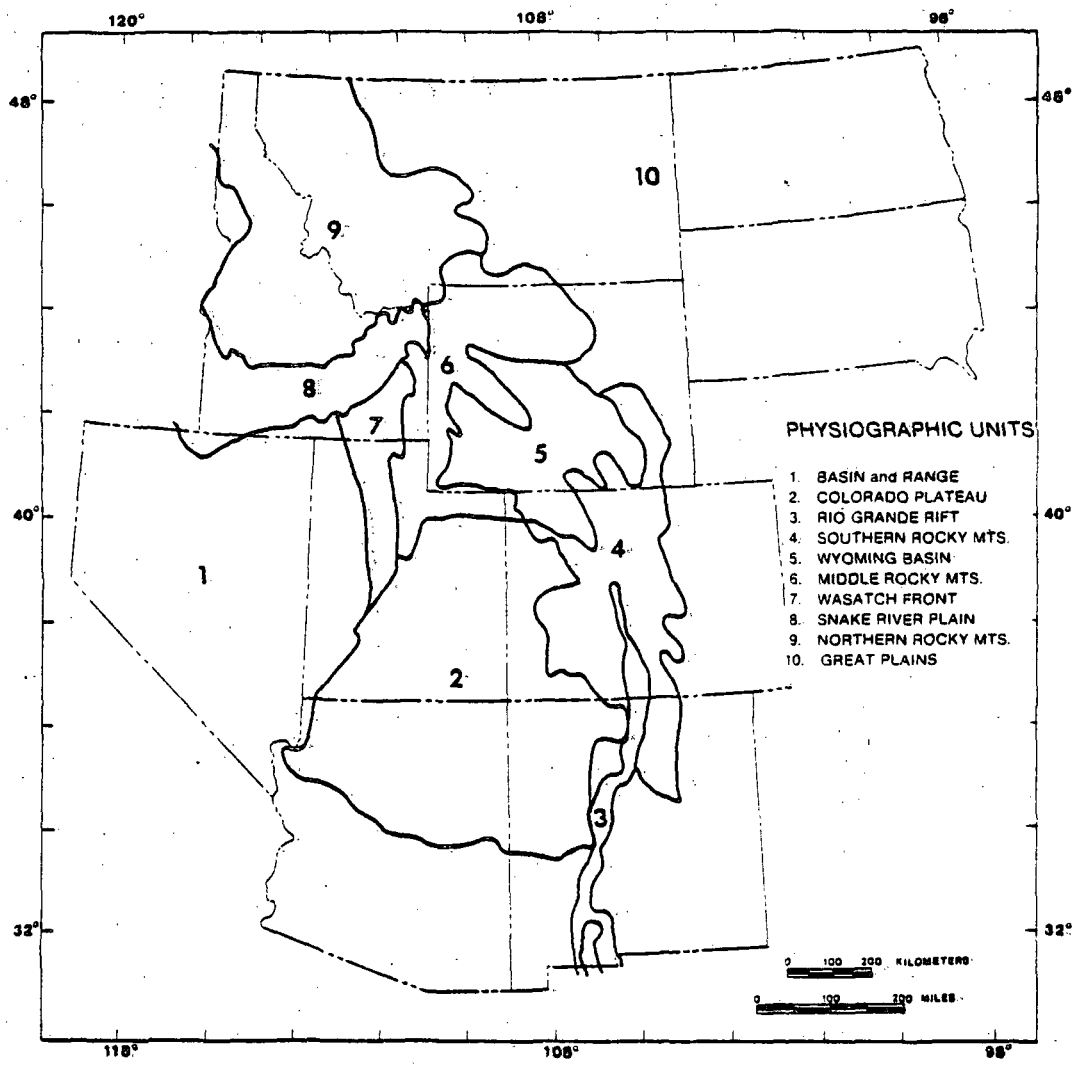

Fig. 3.1 Physiographic provinces

due to the occurrence of evaporite beds in the upper part of the Madison in and near the Williston Basin. None of the Madison hydrothermal water is now being used in North Dakota. Current understanding of the extent and temperature of fluids in the Madison and other potential geothermal reservoirs is limited.

B. High-Temperature Resources (>150°C) (See Figure 3.2)[2,3]

Confirmed Reservoirs: None

Prospects: None

C. Low- and Moderate-Temperature Resources (<150°C) (See Figure 3.2)[2,3]

Confirmed Reservoirs: None

Prospects: The Madison aquifer is an excellent prospect, and could perhaps be considered a confirmed reservoir if broader economic use were presently being made of its waters in North Dakota.

D. Comments

Potential for discovery of high-temperature resources is small. Other than in the Madison group and similar aquifers, there is limited potential for discovery of lower-temperature resources.

E. Hydrothermal Springs and Wells

A listing of hydrothermal springs and wells with measured temperatures in excess of 40°C is given in Table 3.1 for North Dakota[4].

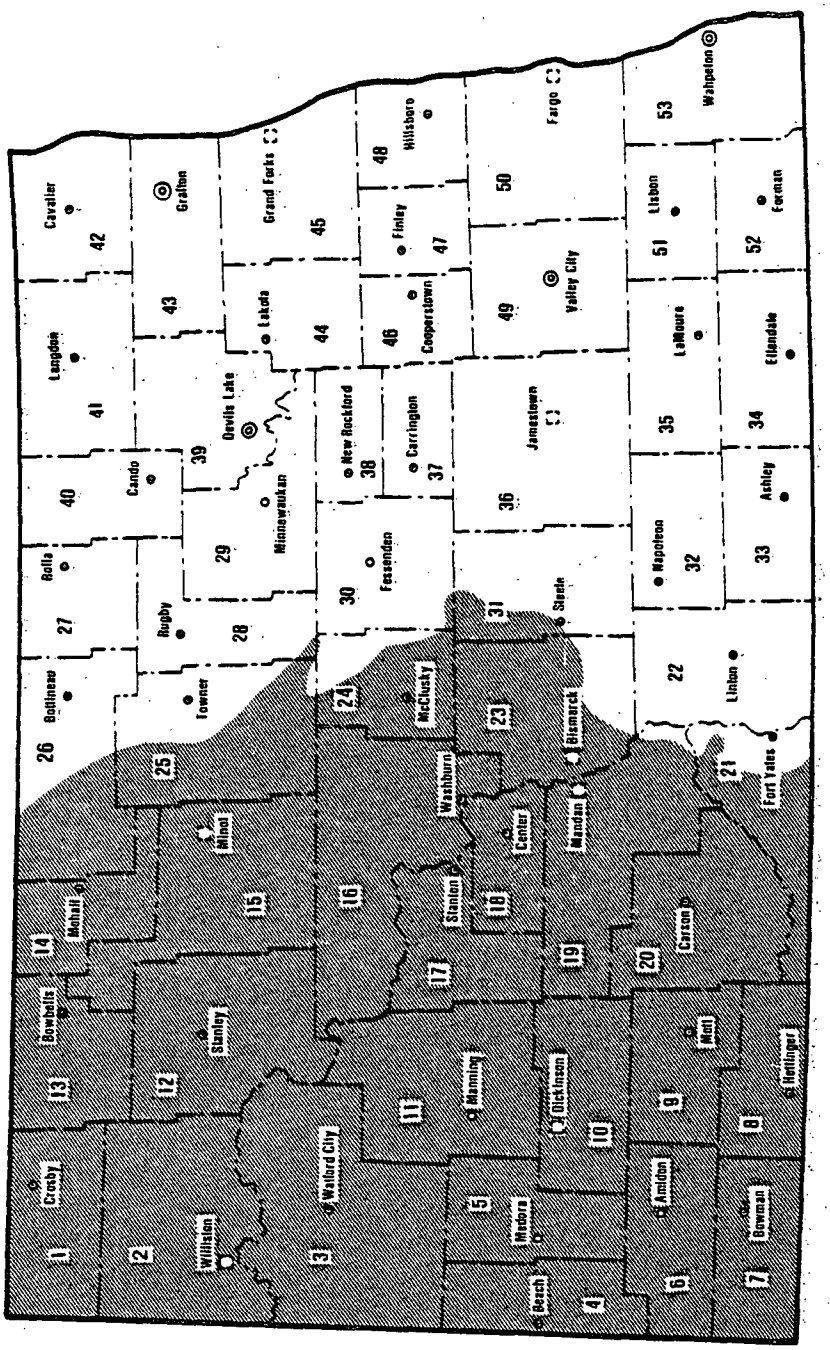

Fig. 3.2 North Dakota counties and geothermal springs and resource areas

TABLE 3.1

HYDROTHERMAL SPRINGS AND WELLS - NORTH DAKOTA
(Source: USGS File GEOTHERM)

COUNTY, NAME, AND TYPE	LOCATION	TEMP (°C)	FLOW (L/min)	TOTAL DISSOLVED SOLIDS (ppm)
None Identified				

F. References

[1] L. J. P. Muffler, and R. Cataldi, Methods for Regional Assessment of Geothermal Resources, Geothermics, v. 7, No. 2-4, 1979, (In Press).

[2] Regional Hydrothermal Commercialization Plan, Department of Energy-Division of Geothermal Energy and Idaho Operations Office, EG&G, Idaho, Inc., and the University of Utah Research Institute Earth Science Laboratory.

[3] L. J. P. Muffler (ed.), Assessment of Geothermal Resources of the United States - 1978, Geological Survey Circular 790, 1979.

[4] USGS File GEOTHERM, as of March 1979.

4. COMMERCIALIZATION ACTIVITIES

A. Highlights

The one operational hydrothermal system in North Dakota is the Adam and Agnes Vetter Farm. It uses geothermal to heat and air-condition the farm home, to heat a dairy barn, and to provide water for cattle.

There has been no geothermal test drilling in North Dakota. However, temperature gradients and other types of data have been collected from test holes drilled for uranium prospecting and from oil and gas wells.

The 1979 legislative session has passed two bills which could affect geothermal development. HR 3068 is a concurrent resolution directing the Legislative Council to study the energy tax of the state. HCR 3071 is also a concurrent resolution directing the Legislative Council to study the effects of energy development on state and local government.

One recently drilled oil well in McKenzie County with a depth of 14,000 feet has been found to have a bottom hole temperature of 230°F.

The Uniform Standards Code for Energy Conservation in New Buildings Construction (NDCC 54-21.2-03) has set standards for energy conservation. Alternative heating and cooling systems may be approved by the building official providing that the proposed energy consumption will not exceed that of a similar building with similar forms of energy conservation. When the alternative systems utilize solar, geothermal, wind or other nondepletable energy sources, the energy supplied may be excluded from the total energy chargeable to the proposed design.

B. Leases

No leasing activity has occurred in North Dakota either on federal or state lands. Tables 4.1 - 4.5 and Figure 4.1 are provided as a framework for summarizing future leases on these lands. Table 4.1 provides latest totals of federal and state acreages leased to private organizations for geothermal development.

For federal lands in North Dakota, Figure 4.1 is a synopsis of various leasing summaries produced by Automatic Data Processing (ADP) of the Conservation Division[1] of the USGS. It traces the three types of federal leases (noncompetitive, competitive, and Indian Land) from inception to production. For noncompetitive leases it summarizes: (1) applications, (2) withdrawals, (3) rejections, (4) pending actions, (5) total leases, (6) terminations, (7) active leases, (8) production status, and (9) unitization. For competitive leases, the figure summarizes the lease offerings and the same items (5) through (9) of the noncompetitive leases. For Indian land leases, it shows the same items (5) through (9). Some entries appear in more than one ADP format and minor discrepancies exist for these entries, possibly because the summaries are run on different dates. These discrepancies should be correctible in updates of the baseline document. Table 4.2 is a county-by-county listing of the holders of active noncompetitive federal leases, the size and location of holdings.

Table 4.3 summarizes by KGRA the bidding history of federal competitive geothermal lease sales in North Dakota. It lists the KGRA, the county, number of sale dates, number of tracts and acreage offered, number of offerings culminating in leases, acreage leased, and average cost per acre in successful bids.

Table 4.4 is a county-by-county listing of the holders of active competitive federal leases, the size and location of

TABLE 4.1

TOTAL ACREAGES OF GEOTHERMAL LEASES - NORTH DAKOTA

(as of May 1979)

Federal Leases:	
Total Acreages of Competitive Leases in KGRAs:	None
Total Acreages of Noncompetitive Leases:	None
State Leases:	
Total Acreages of State Leases:	None
TOTAL OF ALL ACREAGES LEASED	None

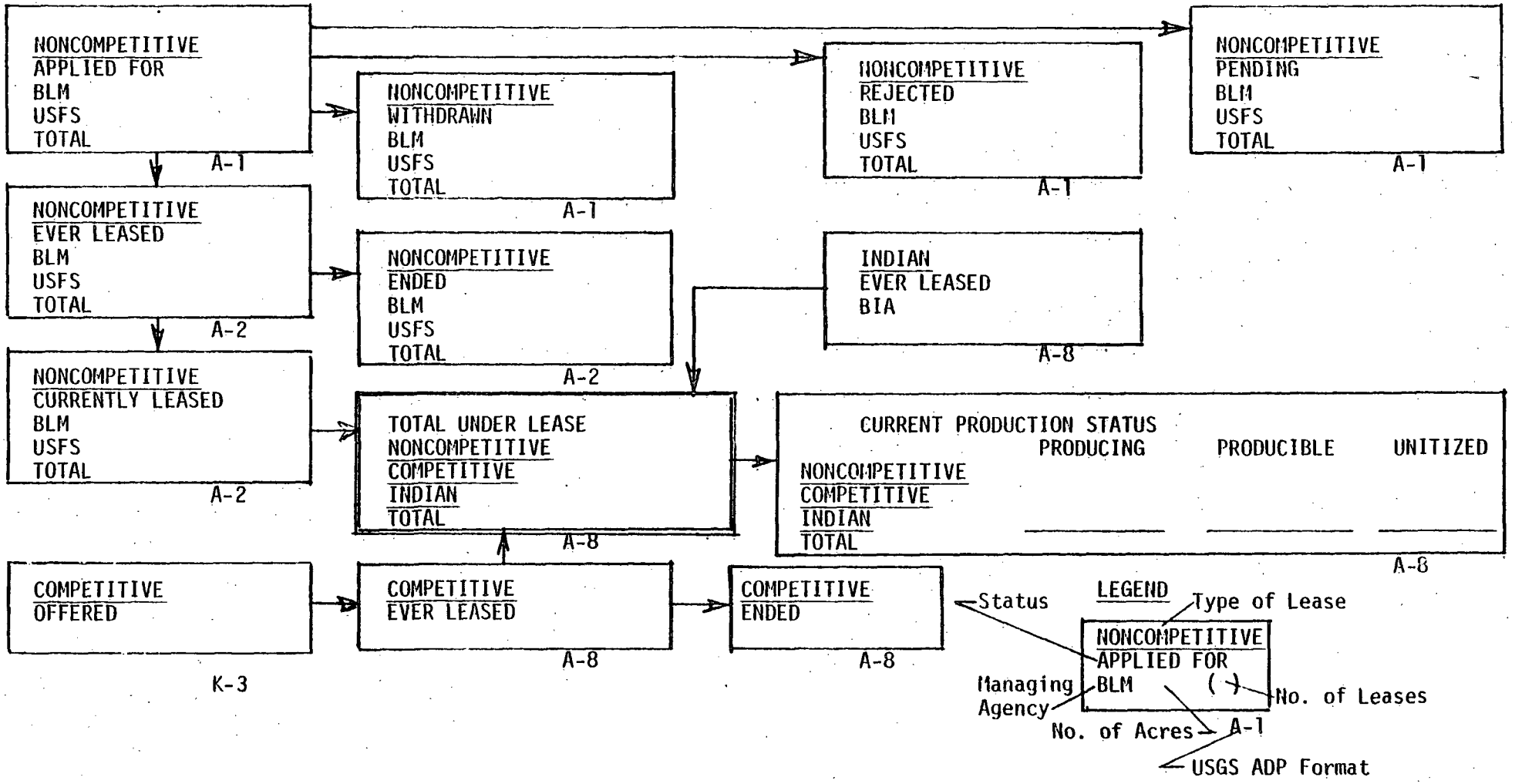

Figure 4.1 Summary of federal leasing activity - North Dakota

(Source - USGS ADP File)[1]

NO ACTIVITY

TABLE 4.2

FEDERAL ACTIVE NONCOMPETITIVE GEOTHERMAL LEASES - NORTH DAKOTA

(as of 3/14/79)

COUNTY & LESSEE	SIZE, ACRES & (NO. OF LEASES)	LOCATION
None		

TABLE 4.3

SUMMARY OF BIDDING HISTORY FOR COMPETITIVE GEOTHERMAL LEASE SALES ON FEDERAL LANDS - NORTH DAKOTA
(Source USGS ADP File - Format K-4)

COUNTY	KGRA	OFFERED (INC. REOFFERS) SALES	TRACTS	ACREAGE	LEASES ISSUED NUMBER	ACREAGE	AVG. $/ ACRE
NONE							

TABLE 4.4

FEDERAL ACTIVE COMPETITIVE GEOTHERMAL LEASES - NORTH DAKOTA

(as of 4/13/79)

COUNTY & LESSEE	SIZE, ACRES & (NO. OF LEASES)	LOCATION
NONE		

their holdings, the effective date, and cost per acre of the lease.

Table 4.5 lists the holders of active state leases in North Dakota and the size of their holdings. No state leases have been applied for or issued in North Dakota. The state controls the surface rights for 708,000 acres and the subsurface mineral rights for 3.25 million acres[2].

C. Test Wells

Test wells in North Dakota are listed in Table 4.6[2]. No test holes have so far been specifically drilled for geothermal exploration.

D. Other Exploratory Activity

Other exploratory activity in North Dakota for geothermal resources is given in Table 4.7. This activity thus far consists of thermal gradient and heat flow testing of existing oil and gas wells and uranium test holes[2,3].

E. Operational Systems

Table 4.8 provides a summary of operational systems using geothermal energy in North Dakota[4].

TABLE 4.5

STATE GEOTHERMAL LEASES - NORTH DAKOTA

(as of June 1979)

COUNTY & LESSEE	SIZE, ACRES & (NO. OF LEASES)	LOCATION	DATE ISSUED & (COST/ACRE)
NONE			

TABLE 4.6

TEST WELLS - NORTH DAKOTA

COUNTY & LOCATION	COMMENTS
NONE	

TABLE 4.7

OTHER EXPLORATORY ACTIVITY - NORTH DAKOTA

COUNTY & LOCATION		COMMENTS	
Well No.	Location	Avg. Thermal Gradient (°C/Km)	Heat Flow Unit, HFU (10^{-6} cal/cm^2-sec)
BILLINGS			
A 3268	46° 52' N, 103° 25' W	---	1.7
B 4814	47° 17' N, 103° 18' W	39	1.7
B 4815	47° 17' N, 103° 18' W	36	1.6
BOTTINEAU			
A 1139	48° 50' N, 101° 2' W	24	1.0
A 2219	48° 48', 100° 58' W		1.3
BOWMAN			
B 4462	46° 11' N, 103° 29' W	42	1.9
BURKE			
A 3479	48° 55' N, 102° 20' W	47	---
A 1280	48° 55' N, 102° 26' W	---	1.6
A 3342	48° 56' N, 100° 40' W	47	---
A 2491	48° 56' N, 100° 40' W	---	1.7
CASS			
RRVD #8A*[a]	T140N, R53W, Sec. 33, SE 1/4	42	---
DUNN			
B 3433	41° 1' N, 102° 8' W	29	1.0
B 4662	47° 2' N, 102° 28' W	27	1.2
B 4599	47° 19' N, 102° 38' W	31	1.1
B 3575	47° 27' N, 102° 11' W	23	0.7
B 4597	47° 28' N, 102° 53' W	37	1.3
EMMONS			
B 4501	46° 2' N, 100° 7' W	32	1.2
B 8912	46° 14' N, 100° 19' W	35	1.2
B 8117	46° 22' N, 100° 30' W	38	1.5

*[a] These are uranium test holes; all others are oil and gas wells.

TABLE 4.7 (Continued)

OTHER EXPLORATORY ACTIVITY - NORTH DAKOTA

COUNTY & LOCATION		COMMENTS	
GOLDEN VALLEY			
A 2894	47° 7' N, 103° 40' W	44	1.5
B 4812	47° 10' N, 104° 0' W	37	1.6
GRAND FORK			
B 2615	47° 47' N, 97° 3' W	21	0.7
B 2430	47° 47' N, 97° 4' W	13	0.6
GRANT			
B 4526	46° 9' N, 101° 20' W	30	1.2
B 4509	46° 30' N, 101° 58' W	35	2.2
B 4585	46° 40' N, 101° 47' W	57	1.9
HETTINGER			
B 3622	46° 13' N, 102° 4' W	27	1.6
MCKENZIE			
A 5086	47° 28' N, 103° 48' W	45	1.6
MORTON			
B 4511	46° 42' N, 101° 55' W	35	1.2
A 16	46° 17' N, 100° 43' W	---	1.2
OLIVER			
B 3558	47° 7' N, 101° 16' W	25	1.1
PEMBINA			
	48° 42' N, 97° 32' W	---	0.9
B 3830	48° 38' N, 97° 40' W	26	1.1
B 3825	48° 41' N, 97° 52' W	45	1.4
B 3842	48° 46' N, 97° 45' W	19	0.9

TABLE 4.7 (Continued)

OTHER EXPLORATORY ACTIVITY - NORTH DAKOTA

COUNTY & LOCATION		COMMENTS	
RICHLAND			
B 3164	46° 16' N, 96° 57' W	18	0.8
RRVD #2*	T130N, R51W, Sec. 19	∿ 44 (240' to 305') ∿ 22 (650' to 842')	---
SLOPE			
B 4810	46° 24' N, 103° 41' W	35	1.5
B 4811	46° 33' N, 103° 17' W	34	1.7
STARK			
B 3690	46° 45' N, 103° 8' W	39	1.1
STEELE			
B 3991	47° 20' N, 97° 32' W	35	1.0
TRAILL			
RRVD #10*	T145N, R52W, Sec. 27, NW 1/4	15 (190' to 296') 15 (321' to 372') 11 (557' to 574')	--- --- ---
WILLIAMS			
A 35	48° 17' N, 102° 57' W	34	1.4
A 424	48° 19' N, 102° 54' W	33	1.3
A 591	48° 13' N, 102° 59' W	24	1.0
A 1099	48° 12' N, 102° 57' W	27	1.1
A 1231	48° 17' N, 102° 59' W	---	1.2

TABLE 4.8

OPERATIONAL HYDROTHERMAL SYSTEMS - NORTH DAKOTA

COUNTY AND USE	LOCATION	COMMENTS
EMMOS, LOGAN & MCINTOSH		
Various	Junction of three counties	Adam and Agnes Vetter Farm; heat and air-condition 3000-sq. ft. home, heat dairy barn, water for cattle; 82°F at well, 76°F at farm.

F. References

[1] USGS Conservation Division, Office of Geothermal Supervisor, Automatic Data Processing File.

[2] R. Scattolini, Heat Flow and Heat Production Studies in North Dakota, Ph.D. Dissertation, University of North Dakota, December 1978.

[3] D. Zabel, and F. L. Howell, Report to USGS, January 1979.

[4] Fargo Forum, June 25, 1978.

5. DEVELOPMENT PLANS

A. Description

A contract is being negotiated with the Energy Office of North Dakota so the state can participate in the Department of Energy's (DOE) Operations Research Geothermal Planning Project. One major objective of this DOE/State geothermal planning process has been to generate specific plans for prospective development and commercialization of geothermal energy through the year 2020.

The present planning process for other states in the Rocky Mountain/Basin and Range Region consists of three categories of plans for prospective and actual geothermal developments. The three are called Area Development Plans (ADP), Site Specific Development Plans (SSDP), and Time Phase Project Plans (TPPP).

Area Development Plans are plans for prospective development of geothermal resources and utilization of the geothermal energy in a multicounty substate area. The plan encompasses several geothermal resource sites and all potential residential, commercial, industrial and agricultural uses of geothermal energy. The resource sites for an ADP include confirmed (proven) reservoirs and reservoir prospects (potential and inferred resources). In most cases no private sector action has been taken toward development or commercialization. The time table for an ADP is a best estimate of when increments of geothermal energy will come on line from the several geothermal prospects and applications in the plan area.

Site Specific Development Plans are plans for development of specific geothermal single or integrated applications of the geothermal energy. The plans are restricted to confirmed (proven) reservoirs and potential reservoirs. Applications may be for any electric and/or direct thermal use of geothermal

energy which is compatible with the quality of the confirmed (proven) or potential resource. In most cases, either some level of development or commercialization activity is already underway or is deserving of consideration by the community of geothermal energy developers and users. The time schedule of events in a SSDP represents a possible sequence of technological and institutional achievements under an atmosphere generally favorable for geothermal development of the specific site and application.

Time Phased Project Plans are plans for geothermal developments that are now at a commercialization level of activity or are in advanced stages of planning by the public and private sectors. The plans are confined to site-specific confirmed reservoirs or high potential geothermal prospects and to specific energy consumptive applications, either electric or direct thermal. The TPPP portrays or reproduces as closely as possible the actual planning and construction array of events and the associated time schedule of the commercial developer and user of the geothermal energy. The TPPP reveals actions by both the private and government sectors that must be accomplished on time in order to achieve successful geothermal energy production and utilization of a specific site for a committed application.

Table 5.1 identifies for North Dakota the geothermal resource sites and applications for which development plans have been prepared or which are candidates (designated by asterisk) for the preparation of development plans by the State Planning Teams in 1979. (This table is to be defined during the second half of 1979).

TABLE 5.1

DEVELOPMENT PLANS - NORTH DAKOTA

TIME PHASED PROJECT PLANS	SITE SPECIFIC DEVELOPMENT PLANS	AREA DEVELOPMENT PLANS
To be defined during second half of 1979.		

B. References

None.

6. GOVERNMENT ASSISTED ACTIVITIES

A. Geothermal Direct Use PON Program

Background: In September 1977 and April 1978, the Department of Energy, Division of Geothermal Energy, in conjunction with the San Francisco Operations Office, issued a document which indicated DOE's desire to receive and consider for partial support proposals for direct heat utilization or combined electric/direct heat utilization field experiments demonstrating single or multiple usages of geothermal energy. These documents were issued under the title, "Program Opportunity Notice - Direct Utilization of Geothermal Energy Resources - Field Experiments." The Program Opportunity Notice (PON) is the name of this offering document, but it has become common practice to call any program which results from these notices a PON.

These solicitations are part of DOE's national geothermal energy program plan, which has as its goal the near-term commercialization by the private sector of hydrothermal resources for direct use purposes. Encouragement is being given to the private sector by DOE's cost sharing of a significant portion of the front-end financial risk in a limited number of field experiments.

DOE's primary interest under these PONs is to encourage field experiments in space/water heating and cooling for residential and commercial buildings, agricultural and aquacultural uses, and industrial processing application.

Current Status: No activity so far in North Dakota.

B. Program Research and Development Announcement

Background: This program, commonly referred to as the PRDA program, is to provide funding for engineering and economic studies for direct applications of geothermal energy. The last announcement had a closing date of January 16, 1979, for applications. The cost of the studies is up to $125,000 each, and covers a study period of 6 to 12 months.

Current Status: No activity so far in North Dakota.

C. Demonstration Projects and Experiments

No projects so far in North Dakota.

D. Geothermal Loan Guaranty Program (GLGP)

Background: Congress authorized $300,000,000 for loan guaranties. Each loan can be up to 75% of the total development cost. Nationally, DOE has received eleven applications to date, totalling $150,000,000 in loan guaranties. Of those eleven, three have been approved (two electric and one direct application); two turned down; one withdrawn; one is obtaining more information, and four are in the review process.

Current Status: In North Dakota, there has been no activity on this program.

E. National Conference of State Legislatures (NCSL)

Background: After a preliminary study on geothermal energy in 1976, the National Conference of State Legislatures (NCSL) launched the Geothermal Policy Project in January 1978. The

objective of the project is to stimulate and assist the review of state policies that affect the development of geothermal resources. Successful completion of the project is to facilitate state statutory and regulatory environments that are consistent with efficient development of geothermal resources.

Current Status: The project selected six states in which to concentrate its efforts in 1978. North Dakota is not one of these states. Therefore there has been no activity on this project in North Dakota.

F. State-Coupled Program

Background: The objectives of the State-Coupled Program are: (a) to assist the U.S. Geological Survey in its ongoing geothermal resource assessment effort, and (b) to stimulate confirmation of low- and intermediate-temperature reservoirs at sites with an apparent but unquantified potential for direct heat application development. Major energy companies have generally shown little interest in lower grade resources because of a national and industrial focus on electrical power generation.

The State-Coupled Program consists of cooperative effort among: (a) DOE, (b) an agency, or institution in each state, (c) the U.S. Geological Survey, (d) the National Atmospheric and Oceanic Administration (NOAA), and (e) the Earth Science Laboratory of the University of Utah Research Institute. DOE provides overall program management and direction. The State Agency manages and performs the project within the state. The U.S. Geological Survey interfaces with the program through the local Water Resources Division Offices, through the U.S. Geological Survey Geothermal Program Office, and by providing the use of computer file GEOTHERM. NOAA will publish the state map. The Earth Science Laboratory provides management assistance to DOE.

In order to accomplish this work, contracts are written between DOE and each participating state. A separate contract for overall management assistance and program coordination is negotiated between DOE and the University of Utah/University of Utah Research Institute.

Each state project consists of: (a) Phase I, geothermal data compilation, with emphasis on low- and intermediate-temperature systems, culminating in publication of state maps and reports on the location and possible viability of geothermal resources, and (b) Phase II, investigation of specific geothermal sites, with drilling to demonstrate reservoir characteristics.

Current Status: The North Dakota Geological Survey is responsible for the state-coupled resource assessment work.

The program is currently in the initial stages of Phase I. Studies to date have emphasized compilation of petroleum well bottom hole temperature data. Geothermal resource and thermal gradient maps will be produced during FY 1980 using these data. An investigation of aquifer water quality is in progress. Phase I resource data will be contributed to the USGS file GEOTHERM.

G. Industry-Coupled Program

Background: The purpose of DOE's Industry-Coupled Program is to foster a viable geothermal electrical power generation industry in the United States. Development by industry has been seriously lagging due to a number of problems. Front-end costs are high in geothermal development due to leasing costs, regulatory costs, and the high cost of exploration, particularly for drilling. In addition, geothermal electrical power generation is a high-risk venture given the uncertainties of reservoir longevity. As a result of these factors, industry has made

H. Technical Assistance

Background: Technical assistance is provided to potential geothermal users as an on-call service by EG&G Idaho's Geothermal Program Office and by the Earth Science Laboratory of UURI. The strategy of this program is to provide a catalytic agent in fostering geothermal energy use, particularly for direct applications. The amount of assistance given is limited so as to protect the interest of private engineering organizations and others working in the field. Generally, enough information is provided so that a potential user can make an evaluation of how or where to proceed. The technical assistance activity is extensive: 115 separate requests were handled for the 10-state Rocky Mountain Basin and Range Region during the first half of FY 1979.

Current Status: There has been no technical assistance requested by, or provided to, North Dakota organizations and residents.

I. State-Assisted Activities

None.

J. References

None.

7. ENERGY USE PATTERNS

A. Energy Use Summary

North Dakota is a net energy exporter, exporting coal, oil, and electricity and importing approximately 40% of its natural gas (see Figure 7.1). Transportation is the largest energy-consuming sector in North Dakota, accounting for 31% of the total energy consumption. The other sectors--industrial, residential, and commercial--consume approximately equal proportions of North Dakota's energy, with oil and natural gas constituting the major energy sources. Figure 7.2 indicates how much energy is used by the state's communities.

North Dakota's industrial sector is quite small, relative to other states in the region. Over half of the industrial energy consumption is by the state's food and kindred-products industries.

North Dakota is sparsely populated (635,000), with very few major population centers. Oil is the major energy source for the residental and commercial sectors; it supplies over half the energy needed by each sector. North Dakota's climate is predominantly cold, and it requires two to two-and-one-half times as much space-heating energy per volume as the national average.

North Dakota lies in the northcentral census region which is expected to show a 2.8% increase per year in energy use with a business-as-usual basis. This rate will almost double the current energy consumption, with residential and industrial sectors expected to see the majority of growth as shown in Figure 7.3.

Counties overlying hydrothermal resources (Figure 3.2) have been assessed to determine how many manufacturers could use

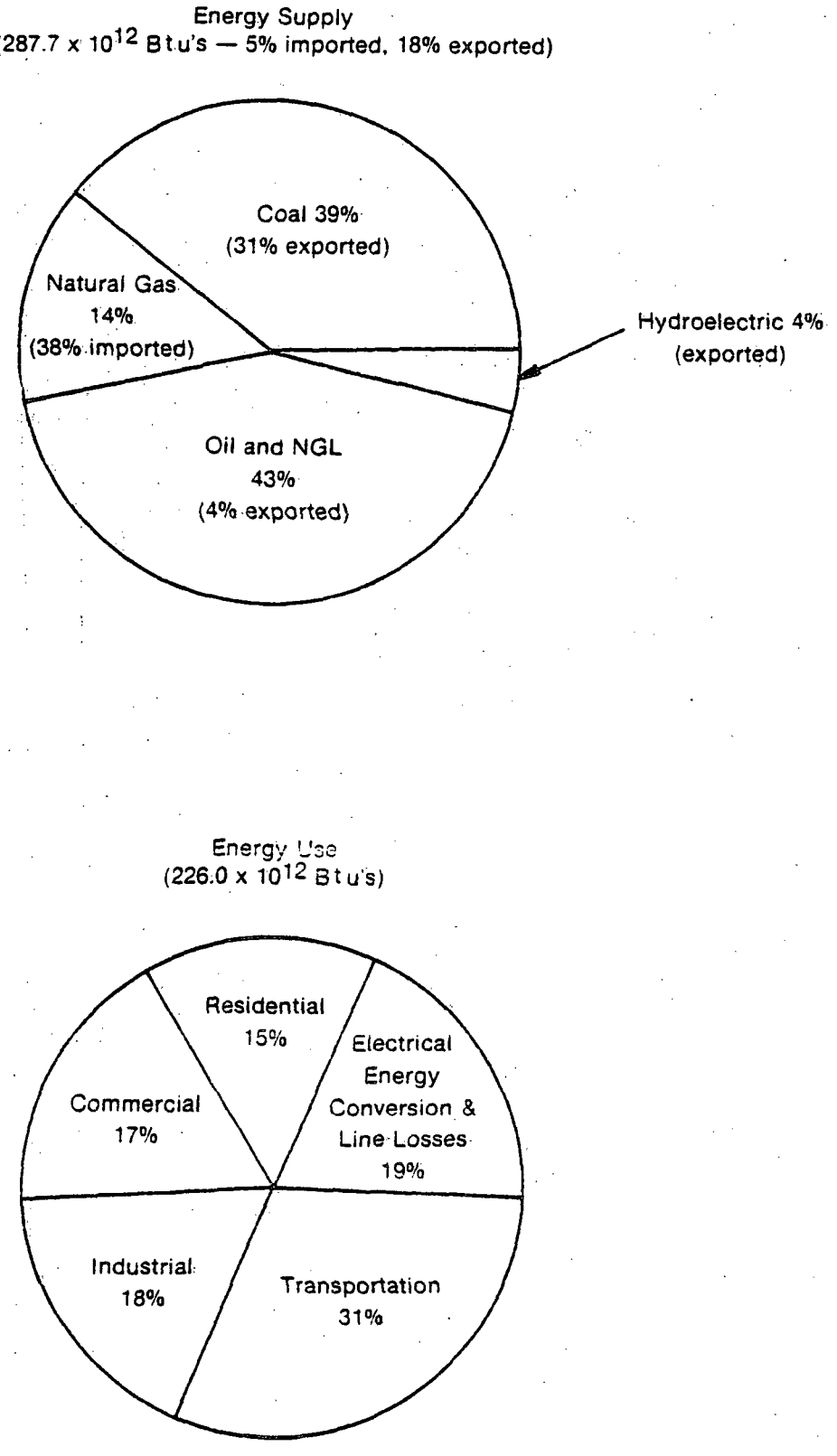

Fig. 7.1 North Dakota energy supply and use[1]

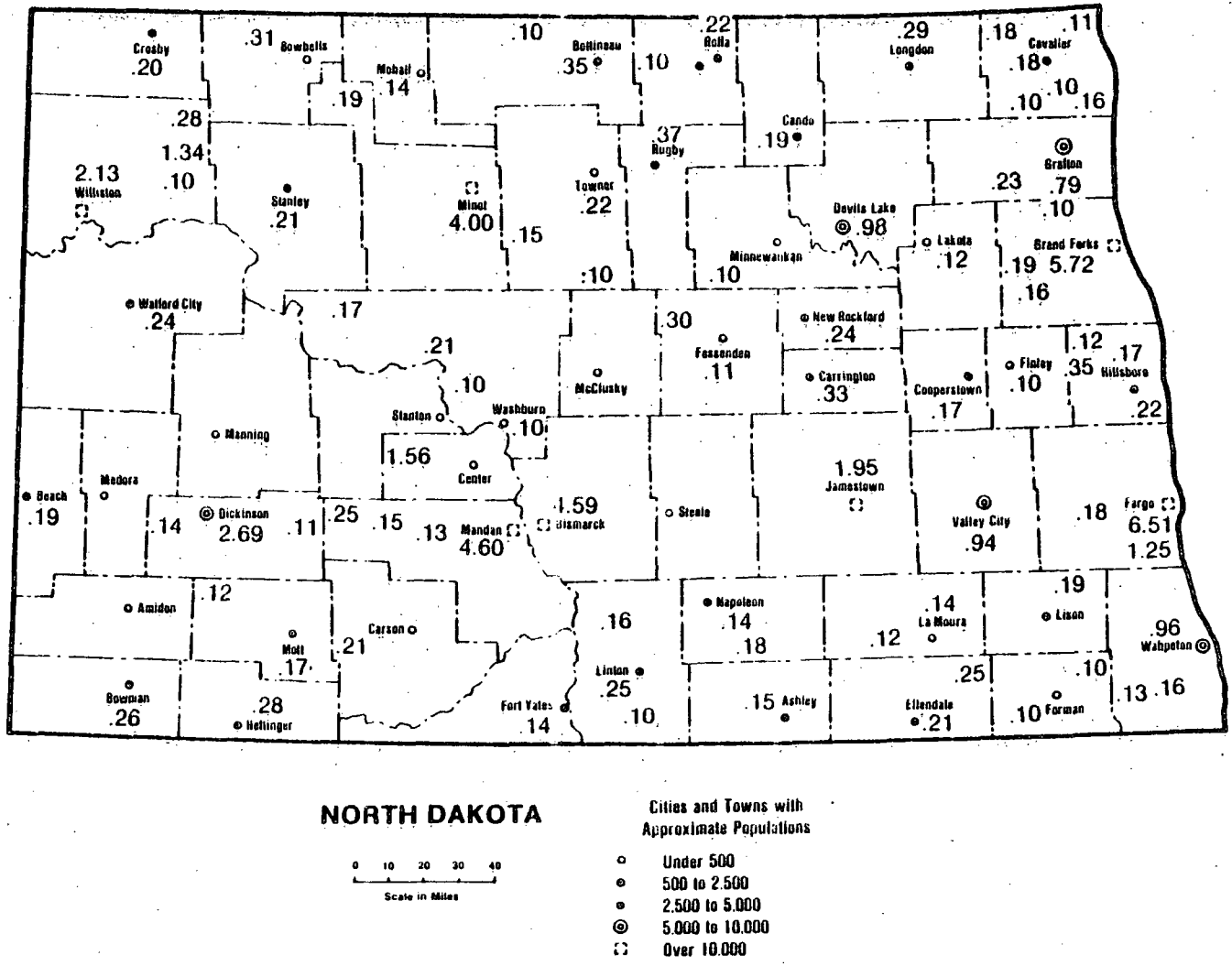

Fig. 7.2 North Dakota energy usage map[1]

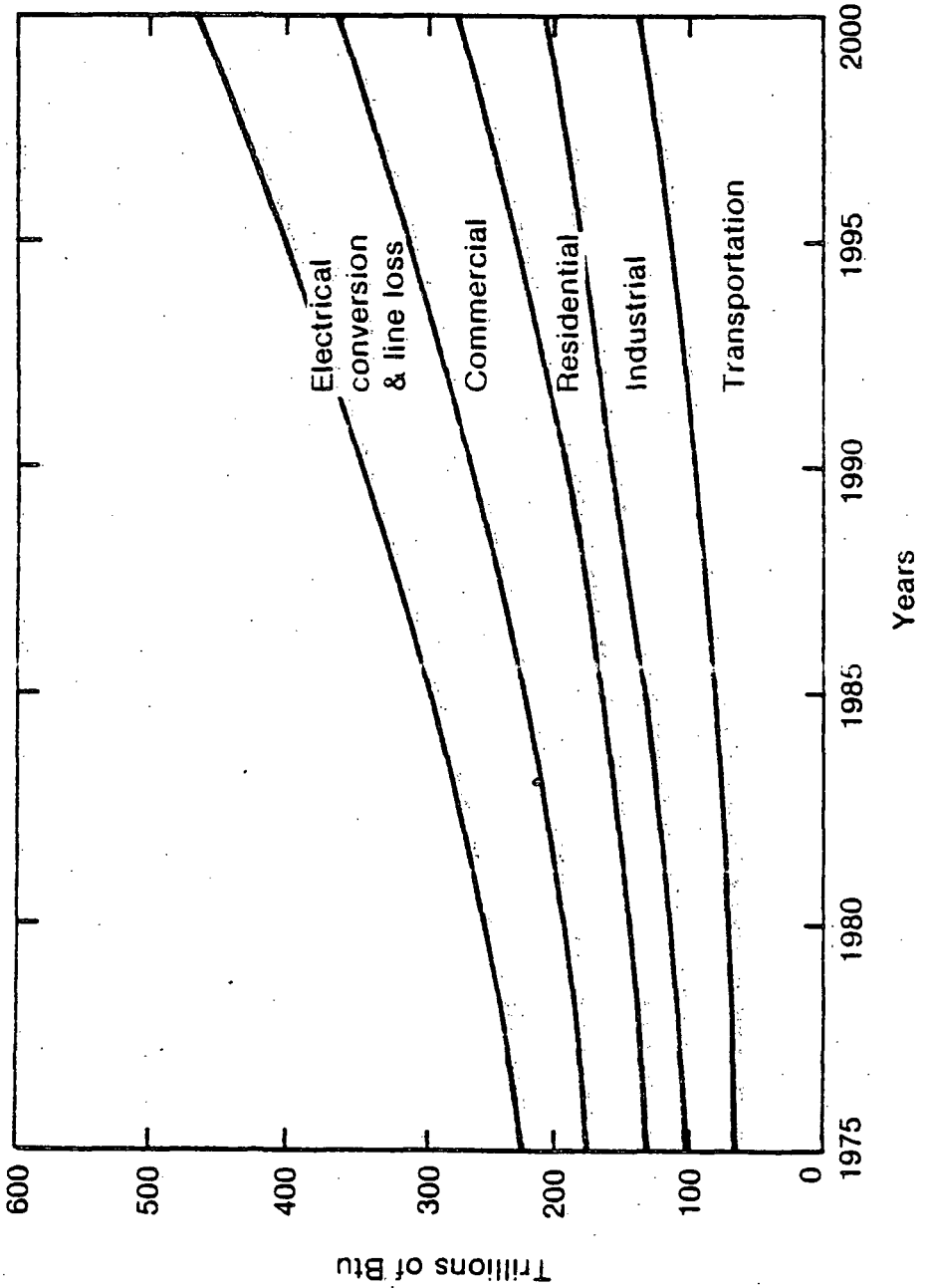

Fig. 7.3 North Dakota total energy use projection[1]

the available hydrothermal energy in their industrial processes. For these preliminary calculations, a single reservoir temperature has been assumed for each of these counties. Hydrothermal energy at this temperature is assumed to be recoverable without regard to economics. (As more detailed reservoir data becomes available, this assumed reservoir temperature may be refined or more than one temperature assumption may be used for different locations in the county. Such assumptions would then be used to recalculate potential hydrothermal energy usage.) A list of potential hydrothermal use industries is compiled from the manufacturer's directory for the state. The number of employees per manufacturer is taken to be the midpoint of the employee range listed for the manufacturer. Each Standard Industrial Classification (SIC) category is aggregated within the county. A Btu use value for each manufacturer was determined by employing energy intensity coefficients (Btu/employee). Industrial, as well as residential/commercial, data for each such county are given in Table 7.1. These data show the potential for conversion to hydrothermal energy based on 1975 usage in these counties.

Table 7.2 lists the industry, the SIC number, and the percent of the process heat used in various temperature ranges from 40 to 275°C. By use of this temperature breakdown, industries can be considered as candidates for hydrothermal energy applications, even if their total energy requirements cannot be met by hydrothermal energy.

B. References

[1] Regional Hydrothermal Commercialization Plan, Department of Energy Division of Geothermal Energy and Idaho Operations Office, EG&G Idaho, Inc., and Univeristy of Utah Reserach Institute Earth Science Laboratory, July 14, 1978.

Table 7.1

1975
Energy Use by County

County	Assumed Reservoir Temperature (°C)	Industrial		Residential/Commercial	
		Standard Industrial Code (SIC)	Energy Use (Btu/yr x 10^{12})	Total Energy Used Btu/yr x 10^{12})	Energy Used for Space Conditioning and Water Heating (Btu/yr x 10^{12})
ADAMS	90°	2011 2026 2086 3273	0.021 0.005 0.005 0.002		
		Subtotal	0.033	0.19	0.18
BILLINGS	No Significant, Concentrated Energy Use				
BOTTINEAU	90°	2011 2024	0.012 0.005		
		Subtotal	0.017	0.38	0.34
BOWMAN	90°	2011 2024 3037 3271	0.006 0.005 0.005 0.010		
		Subtotal	0.026	0.23	0.21
BURKE	90°	2011	0.003	0.16	0.14
DIVIDE	No Significant, Concentrated Energy Use				
DUNN	90°	2011	0.009	0.12	0.10
EMMONS	90°	2011 2022 3273	0.010 0.010 0.002		
		Subtotal	0.022	0.27	0.24

TABLE 7.1 (contd)

1975
Energy Use by County

County	Assumed Reservoir Temperature (°C)	Industrial		Residential/Commercial	
		Standard Industrial Code (SIC)	Energy Use (Btu/yr x 10^{12})	Total Energy Used Btu/yr x 10^{12})	Energy Used for Space Conditioning and Water Heating (Btu/yr x 10^{12})
GOLDEN VALLEY	90°	2011 2024 3273	0.006 0.005 0.002		
		Subtotal	0.013	0.16	0.14
GRANT	90°	2011	0.009	0.19	0.17
HETTINGER	90°	2011 2026	0.003 0.010		
		Subtotal	0.013	0.26	0.23
MCKENZIE	90°	2011 3271	0.006 0.010		
		Subtotal	0.016	0.23	0.21
MCLEAN	90°	2011 2048	0.006 0.010		
		Subtotal	0.016	0.43	0.38
MOUNTRAIL	90°	2011 2026 3273	0.015 0.010 0.002		
		Subtotal	0.027	0.48	0.43
RENVILLE	90°	No Significant, Concentrated Energy Use			
SLOPE	90°	No Significant, Concentrated Energy Use			

TABLE 7.1 (contd)

1975
Energy Use by County

County	Assumed Reservoir Temperature (°C)	Industrial		Residential/Commercial	
		Standard Industrial Code (SIC)	Energy Use (Btu/yr x 10^{12})	Total Energy Used Btu/yr x 10^{12})	Energy Used for Space Conditioning and Water Heating (Btu/yr x 10^{12})
STARK	90°	2011	0.015		
		2026	0.025		
		2037	0.010		
		3273	0.009		
		Subtotal	0.059	1.64	1.48
WARD	90°	2011	0.028		
		2026	0.040		
		2034	0.035		
		2086	0.005		
		3273	0.014		
		Subtotal	0.122	3.91	3.52
WILLIAMS	90°	2011	0.038		
		2034	0.010		
		2086	0.010		
		3271	0.010		
		3273	0.013		
		Subtotal	0.081	1.65	1.49
STATE TOTAL			0.466		9.26

TABLE 7.2

INDUSTRIAL PROCESS HEAT REQUIREMENTS - NORTH DAKOTA

INDUSTRY	SIC Number	40°C-60°C	60°C-80°C	80°C-100°C	100°C-120°C	120°C-140°C	140°C-160°C	160°C-180°C	180°C - 200°C	200°C	275°C
Meat packing	2011	NA	99%	100%							
Natural cheese	2022	23%	100%								
Fluid milk	2026	NA	NA	100%							
Dehydrated fruits and vegetables	2034	NA	100%								
Potato dehydration	2034										
granules		NA	19.9%		53%					100%	
flakes		NA	19.9%		53%				100%		
Frozen fruits and vegetables	2037	NA	NA	30%	100%						
Prepared feeds	2048										
pellet conditioning		NA	NA	100%							
alfalfa drying		NA	NA	NA	NA	NA	NA	NA	NA	100%	
Soft drinks	2086	60.9%	100%								
Concrete block	3271										
low pressure		NA	100%								
autoclaving		NA	NA	NA	NA	NA	NA	NA	100%		
Ready Mix	3273	100%									

[2] Draft Regional Hydrothermal Market Penetration Analysis, Appendix B, EG&G Idaho, Inc., and Utah University Research Institute Earth Science Laboratory, October 31, 1978.

8. LEASING AND PERMITTING POLICIES

A. General[1]

Because little geothermal development has occurred in the state of North Dakota, no state legislation has been aimed at defining geothermal resources and establishing a government policy for the development of geothermal. Currently there are no procedures for geothermal leasing in the state. Any leasing would probably follow procedures set forth for coal and oil and gas leasing. Additionally, geothermal has not been identified as a mineral, water or unique resource. Due to this situation, several state agencies may have jurisdiction over the geothermal resource, depending on where it is located.

Leasing of State Lands: The Board of University and School Lands is responsible for leasing state-owned lands, minerals, coal, oil and gas in North Dakota. This leasing activity is carried out by the State Land Department which has this authority given to them by the Board. The state owns approximately 708,000 acres of land and about 3.25 million acres of mineral rights.

The state has not established leasing policies specific to geothermal resources. However, the Land Department does have authority to promulgate geothermal leasing procedures without the necessity for legislative action. Once exploration activity has determined geothermal resources to be present, the prospector or other interested parties may apply for a lease. If the geothermal source is located on lands in which the state also is the surface owner, a surface lease may be required. If the state-owned geothermal source is located under lands not owned by the state, a lease may have to be obtained from the surface owner for access to the resource.

The Land Department issues leases on a short-term basis. Usually the lease requires that the resource must be extracted within 5 years, but the lease may be for a term of ten years. A lease is applied for through an application with the Land Department. The prospector for geothermal can negotiate to lease a discovered source before his exploration permit has expired. If a potential developer wishes to lease a particular tract, he applies to the Land Department. The department then reviews the application and posts a notice showing the time and place the leasing will take place. The notice states that the Land Department will negotiate with any interested parties concerning the provisions (royalty, daily rental, bonus) of the lease. The department then has the option to accept the highest bid for the tract or resource and sign an agreement with the successful bidder.

General Permitting Information: Prior to drilling any geothermal wells in North Dakota, permits must be obtained from a variety of state agencies depending on the depth of the well, the location and the use of the geothermal resource. Some agencies require permits regardless of where the wells are to be located, while some agencies require permits only if the well is located on lands under its authority or activities under its authority. Local permits may also be required from counties or municipalities.

State Permitting Procedures: Since geothermal resources are not specifically defined by the state, different agencies may have jurisdiction over the drilling of wells. The Water Commission and the State Engineer have control over water in the state while the North Dakota Geological Survey has control over minerals and deep drilling. Generally speaking, the Water Commission has jurisdiction over shallow water wells less than 2000 feet in depth and the NDGS has authority over drilling below this depth.

The Water Commission would probably have authority over geothermal drilling down to a depth of 2000 feet. This authority would include jurisdiction over waters found in the Fox Hill and Pierre formations. According to Title 61 of the 1977 North Dakota Water Laws, the Commission has authority over the quantity of water used but it does not have regulatory power over the quality of water.

Generally, the Commission does not require approval for domestic or stock wells. However, through the State Engineer, the Commission issues permits for multiple-user wells, irrigation wells, and wells which provide water for commercial, recreational and industrial uses. The potential user must submit an application for the water permit and provide all necessary information. The State Engineer then conducts a hearing on the application. Based upon criteria set by the Commission, the permit is acted upon. A key factor is the beneficial use of the water. All water must be put to a beneficial use which is consistent with the best interest of the people of the State of North Dakota. In some cases the Commission may put conditions on the use of the water relative to its beneficial use. For example, in competing applications, uses for domestic, municipal and agricultural uses would take precedence over geothermal applications. Also, the Commission might require secondary use of geothermal water to increase its beneficial use.

In cases where geothermal drilling is for depths greater than 2000 feet, the North Dakota Geological Survey (NDGS) maintains regulatory power. The State Geologist of the North Dakota Geological Survey has the authority to enforce rules and regulations of the Industrial Commission. The NDGS issues permits for exploration and extraction of minerals, coal, oil and gas. Although the NDGS does not have specific regulations for geothermal exploration and development, the process would probably be similar to the requirements for oil and gas exploration and development.

The procedures for control of oil and gas exploration and development (as set forth by Chapter 38-08 of the Rules and Regulations of the Industrial Commission) have several key requirements. The driller must provide a bond to assure that the well(s) will be properly plugged and the well site restored after exploration or development is completed. The driller must also apply with the State Geologist for a permit to drill. Once the permit is approved and issued, the driller may start. The driller must provide appropriate information on the location, depth, casing, etc. The drilling operation and well must also conform to specifications set by the Industrial Commission. The driller must provide notification of intent to plug the well to allow for inspection and approval by the State Geologist.

If exploration drilling is to take place on state lands or areas in which the state owns the mineral rights, a permit will be required from the State Land Department along with permits required from the NDGS or the Water Commission. Although the State Land Department has no established procedures for geothermal prospecting, the permits would probably be similar to those permits for other exploratory activity. These permits are good for one-year terms. The prospector has the option to apply for a lease of the resource, if a discovery is made. A royalty rate would be negotiated between the State Land Department and the prospector and a lease would be granted providing terms are accepted by the leasee. The exploration permits are requested through a letter application.

Permit for Fluid Discharge: If the geothermal developer wishes to discharge fluid into a stream or injection well he must obtain permits for such discharge. Where reinjection of geothermal fluids is desired, the developer must obtain approval and a permit from the Industrial Commission (NDGS) only after a notice has been issued and hearing has taken place (Rule 317 of Industrial Commission Rules and Regulations). The State

Department of Health would have regulatory power if geothermal water is injected into aquifers controlled by the Water Commission.

If geothermal fluids are to be discharged into streams, permits must be obtained from the State Department of Health, which controls water quality on all waters of the state. The State Department of Health would issue a permit after a notice and hearing have been completed on the application. The developer is also subject to penalties if the water quality does not meet the water-quality standards specified by the permit.

Geothermal Systems Development Permits: Permits are required when a developer wishes to construct a power plant or utility sytem. However, a municipality has authority to develop or buy a geothermal power plant or utility system without permits, providing the system will be funded from earnings derived from the operation of the plant.

Except for municipalities, utilities that own or operate, or plan within the next ten years to own, operate or start construction on a facility must follow regulations set by the Public Service Commission. These utilities are required to submit a ten-year plan (North Dakota County Code (NDCC) 49-22) on an annual basis on or before July 1 of each year. The plan must state where existing facilities are located and where future facilities are to be located. It must also state the efforts the utility is carrying out to coordinate activities with other utilites and state their efforts in involving environmental and local groups in the planning process.

The North Dakota Energy Conversion and Transmission Facility Siting Act (NDCC Chapter 49-22) also authorizes the Public Service Commission (PSC) to issue permits for water transmission pipelines for energy conversion facilities over 50 MWe. Also, permits are required for electric transmission lines in excess of 115 kilovolts.

Any utility which plans to construct an energy-conversion facility or transmission facility must follow these procedures set forth by PSC:

(1) Submit a ten-year plan;

(2) Provide a letter of intent prior to the siting process, which the Commission then acts upon by assessing a fee based upon the cost of the facility; and,

(3) Apply for a Certificate which is acted on by the PSC by issuing a Notice of Filing, scheduling a public hearing, and issuing a Certificate or permit if the application has been accepted.

Utilities may apply for a waiver of procedures providing the energy-conversion facility is less than 100 MWe or the transmission facilities are entirely within the state borders.

Other Permits Required: Local municipal or county permits may be required for some geothermal exploration and development. Although most local government articles may not desire to regulate geothermal, those who may choose to regulate will probably make provisions in their subdivision regulations.

The Public Service Commission also regulates reduction of surfaced mined lands (NDCC Chapter 38-14.1) which might affect geothermal development. The PSC requires plans to be submitted and issues permits for reclamation activities. Bonds may be required by the PSC to assure that reclamation is undertaken after the resource has been extracted. The reclamation activity is usually dictated by the preference of the surface owner.

B. Time Table of Institutional Procedures

A generic time table, showing minimum times for various institutional procedures related to any geothermal project in North Dakota, is shown in Table 8.1.

C. Reference

[1] R. T. Meyer: Please supply for final draft.

TABLE 8.1

TIME TABLE OF INSTITUTIONAL PROCEDURES FOR A GEOTHERMAL PROJECT - NORTH DAKOTA

To be prepared by State Team in second half of 1979.

9. BIBLIOGRAPHY (SELECTED REFERENCES)

This list of selected references is not yet a complete bibliography on geothermal energy in North Dakota. This objective will be sought in future updates of this baseline document.

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