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October 12, 1979

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DRAFT LOUISIANA BASELINE DOCUMENT REVIEW - BCL-85-79

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Commercialization Planning

sg

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Dick Pearl data not available
Just got Idaho
208|-529-2611

Comments read to
G. Fruend
11/16/79

DRAFT

LOUISIANA GEOTHERMAL COMMERCIALIZATION BASELINE

PREPARED FOR

DEPARTMENT OF ENERGY - IDAHO OPERATIONS OFFICE

DEPARTMENT OF ENERGY - RESOURCE APPLICATIONS,
GEOTHERMAL RESOURCE OFFICE

BY

EG&G IDAHO, INC.
IDAHO FALLS, IDAHO

EDITORS -

J. A. Hanny
B. C. Lunis

SEPTEMBER 1979

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ACKNOWLEDGEMENTS

A number of people from EG&G Idaho and the Earth Science Laboratory of the University of Utah Research Institute have contributed to this draft document. Input has also been provided by Western Energy Planners Ltd., Stafco Inc., and Science Applications, Inc. DeVan Daggett of the Legislative Council, Z. A. Bassiouni of Louisiana State University, C. G. Groat of the Louisiana Geological Survey and A. C. Chauviere of the Office of Conservation contributed on behalf of Louisiana.

1. INTRODUCTION

Louisiana appears to be blessed with both geopressured and hydrothermal resources for producing geothermal energy. Both the U.S. Geological Survey and the Department of Energy have conducted considerable assessment of the geopressured resources. DOE's work has been done by universities in the state. Five areas of high geopressured potential have been identified in southern Louisiana and several more are under detailed investigation.

Numerous oil and gas and mineral leases overlay prospective geothermal areas on private lands. An existing oil well has been successfully tested for the geothermal resource. Several test wells specifically drilled for geothermal energy are being proposed for DOE cost-sharing. The only operating geothermal system is a spa operated by the state near Alexandria.

This handbook (draft) provides a synopsis of various aspects of the geothermal program in Louisiana. The section on Basic State Data (Section 2) lists government personnel (both legislative and executive branches) who are most directly involved with geothermal development. Some basic demographic data are also included. The various hydrothermal geothermal resources and the pertinent geology are summarized in Section 3. Activities (ranging from leases to operational systems) that lead to commercialization are described in Section 4. Plans for various developments are summarized in Section 5, while government assistance to Louisiana projects is listed in Section 6. The section on energy use patterns (Section 7) summarizes existing energy use and identifies counties and industries likely to be impacted most by geothermal energy. The section on state government institutional procedures (Section 8) deals with both legal and institutional considerations and includes a time table of institutional procedures for a typical resource to show the interrelationships among various organizations involved in development and regulation of the resource.

2. BASIC STATE DATA - LOUISIANA

A. Government Contacts

Governor - Edwin W. Edwards (D)

Legislative

Senate President: Michael H. O'Keefe (D)

Senate Natural Resources Committee: Claude B. Duval (D), Chairman.

House Speaker: E. L. "Bubba" Henry (D).

House Natural Resources Committee: Wilbert J. "Billy" Tauzin (D), Chairman.

Legislative Council: DeVan Daggett, Director.

State Geothermal Team

Commercialization Planning: None established.

Resource Assessment: Zaki A. Bassiouni and William J. Bernard, Department of Petroleum Engineering, Louisiana State University.

State Agencies

Department of Natural Resources: William C. Huls, Secretary.

Louisiana Geological Survey: Charles G. Groat, Director and State Geologist.

Office of Conservation: R. T. Sutton, Asst. Secretary.

Research and Development Division; T. C. Landrum, Director, Geological and Engineering Division: R. D. Bates, Chief Engineer.

Office of Mineral Resource and State Minerals Board: Andrew A. Martin, Chairman; Edward H. Rhorer, Asst. Secretary and Chief Administrative Officer.

Division of State Lands:

Tax Commission: Gordon C. Johnson, Chairman; Russell Gaspard, Executive Director.

Revenue and Taxation Department: Shirley McNamara, Secretary.

Public Service Commission: Louis Lambert, Chairman; Louis S. Quinn, Secretary.

Department of Transportation Development: George A. Fischer, Secretary.

Office of Public Works: Roy Aguillard, Asst. Secretary.

Department of Wildlife and Fisheries: J. Burton Argelle, Secretary.

Stream Control Commission of Louisiana: Robert A. Lefleur, Executive Secretary.

B. Statistical Data

Demographic

Population (1977 estimate): 3,920,000

Area: 50,820 sq. mi.

Population Density: 77.2 persons/sq. mi.

Geothermal Resources

Confirmed Reservoirs > 150°C: None

Prospects > 150°C: Several geopressured geothermal systems.

Confirmed Reservoirs (20°C < T < 150°C): None

Prospects (20°C < T < 150°C): Several geopressured geothermal systems.

Identified Warm Springs and Wells > 40°C: None

Geothermal Leases

Federal: None

State: None

Private: Information not available.

Test Wells: No wells drilled specifically for geothermal; Several oil wells have been tested.

Operational Hydrothermal Systems

Spas: One

Space Heating: None

Others: None

Is this a hot spring? (i.e. a hydrothermal system?)

Major Active Developments

Direct Use: None

Electric: None

Government Assisted Activities

PON: None

PRDA: None

Loan Guarantees: None

Industry Coupled Program: None

Energy

Supply (1975): 11,500 x 10^{12} Btu; 73% exported.

Use (1975): 3,000 x 10^{12} Btu.

Potential Conversion to Geothermal (1975): Information not yet available.

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).

A confirmed reservoir is a geothermal system having demonstrated resources whose potential has been quantified by drilling and other geoscientific data.

Prospects are defined as those geothermal systems that have identified geothermal features or a geologic setting that is considered favorable for the discovery of geothermal resources. These areas have generally not been tested by exploratory drilling and the resources are presently unquantified.

A. Geologic Setting[2-5]

The Coastal geological province covers the entire state of Louisiana (see Figure 3.1). This is an area of low topographic relief and numerous deep basins containing thick accumulations of mesozoic to quaternary sediments. In some of these basins, the fluids contained in the pores of the rocks are under pressures greater than that attributable to the weight of the overlying rocks. This condition is known as a geopressured environment. Some geopressured zones contain hot saline water which dissolves natural gas and are hence called geopressured geothermal systems. There are numerous geopressured geothermal areas in Louisiana including:

(1) off shore and on shore portions of the northern gulf of the Mexico basin (also known as the Gulf Coast Salt Dome Basin);

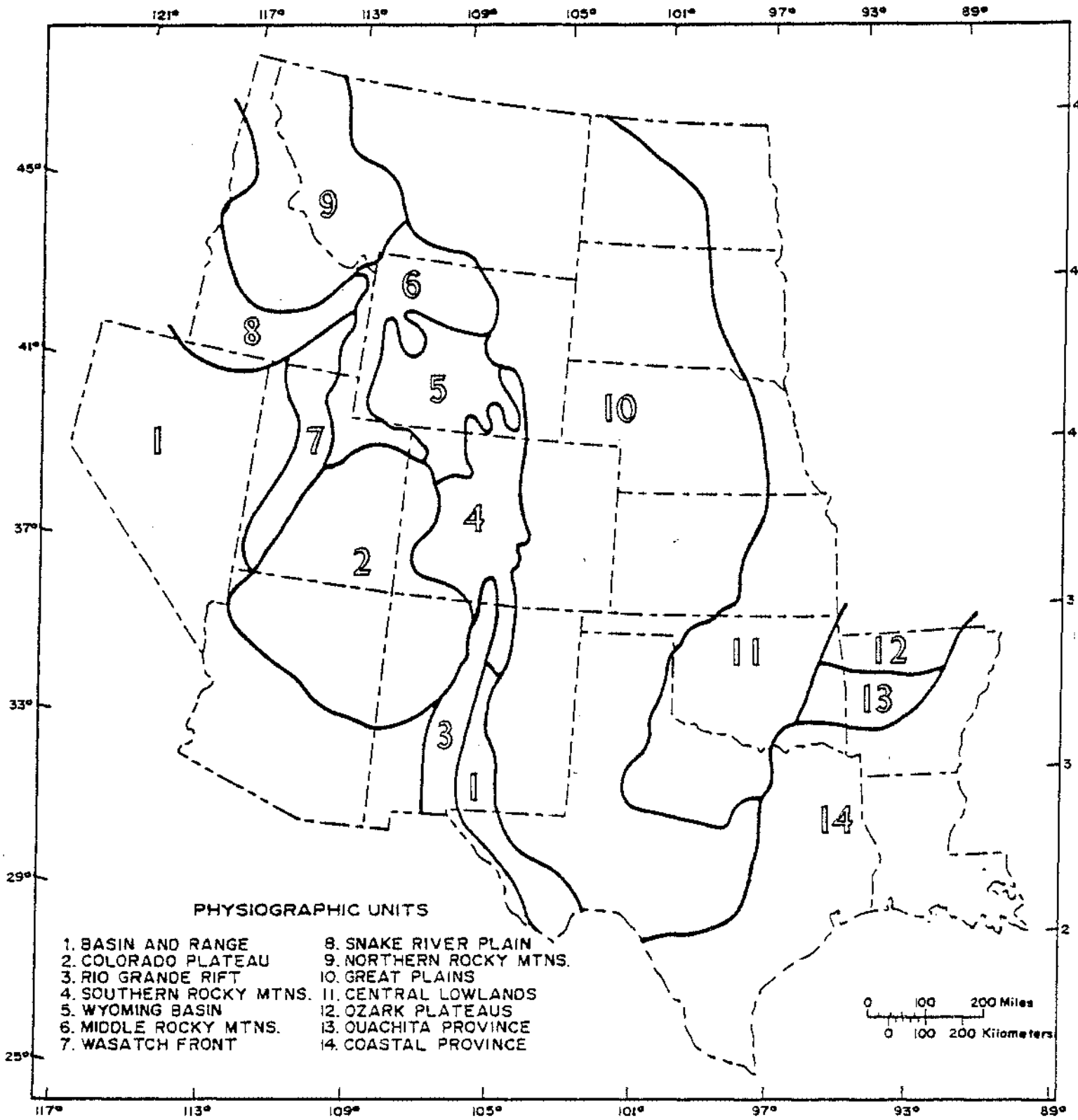


Fig. 3.1 Physiographic provinces.

(2) the northern half of the North Louisiana Salt Dome Basin; and

(3) portions of the Mississippi Salt Dome Basin in northeastern Louisiana.

Figure 3.2 shows the location of these areas.

Recent assessment by the U.S. Geological Survey of the geopressured geothermal zones in the Louisiana portions of the northern Gulf of Mexico basin estimates that 19,000 x 10^{18} joules (19,000 quads) of thermal energy and 10,000 x 10^{18} joules (10,000 quads) of methane energy may be present. The recoverability of this energy depends upon the amount of water produced from wells in the geopressured geothermal zones. An estimated 490 quads of thermal energy and 270 quads of methane energy might be recoverable assuming complete reservoir depletion and uncontrolled subsidence. Limited production and controlled subsidence lowers the estimate of recoverable energy to 47 quads of thermal energy and 26 quads of methane energy.

In both the North Louisiana Salt Dome Basin and the Mississippi Salt Dome Basin, the most extensive geopressured and geothermal zone occurs in carbonates and sandstones of the upper Jurassic Smackover Formation. Geopressured geothermal fluids produced from a depth of 10,900 ft (3,300 m) to 13,000 ft (4,000 m) range from 93 to 149°C. In the Mississippi Salt Dome Basins the geopressured geothermal zones in the Smackover formation generally occur below 10,000 ft (3,000 m) and contain water that is at least 150°C. Estimates of thermal and methane energy contained in the northern Louisiana and Mississippi Salt Dome Basins are not yet available. Although most of the potential geothermal resources in Louisiana are from geopressured systems, there may be an attractive hydrothermal system in northern Louisiana. Wells in adjacent areas of southwestern Arkansas produce thermal brines up to 140°C from depths of about 2,500 m. The thermal gradients in the area range from 33° to 40°C/km. Many wells and test holes in northern Louisiana have above normal thermal gradients.

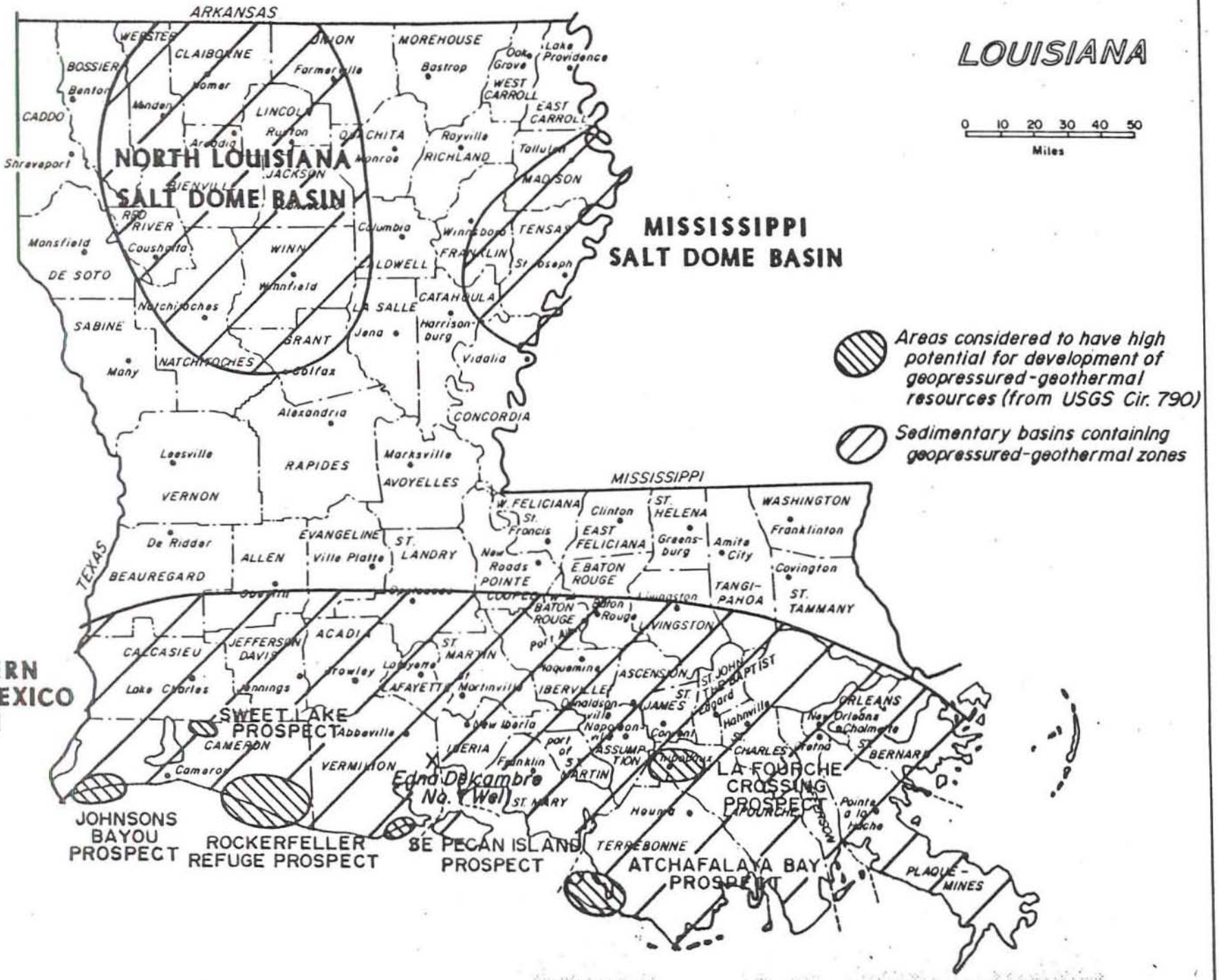


Fig. 3.2 Louisiana counties and geothermal resource areas.

Parishes

B. High Temperature Resources (> 150°C) (see Figure 3.2)

Confirmed Reservoirs: None.

Prospects: Some deep geopressured geothermal systems.

C. Low Temperature Resources (< 150°C) (see Figure 3.2)

Confirmed Reservoirs: None.

Prospects: Some geopressured geothermal systems; possible hydrothermal systems in northern Louisiana.

Spa in Rapides parish?

D. Comments

The development of geopressured geothermal is difficult. Numerous deep and expensive wells are needed for both exploration and development. The highly saline composition of most geopressured geothermal fluids may present engineering problems. Production of associated natural gas may add additional incentive to the future development of geopressured geothermal systems.

From a preliminary list of 63 geopressured prospects, five areas with high potential were subjected to more detailed study (see Figure 3.2). Results of these studies are summarized in Table 3.1. The five areas are: Atchafalaya Bay, Johnson's Bayou, Lafourche Crossing, Rockefeller Refuge, and SE Pecan Island.

E. Hydrothermal Springs and Wells

No hydrothermal springs and wells have been recorded for Louisiana in USGS File GEOTHERM[8]. Data on the most promising geopressured areas are summarized in Table 3.1.

TABLE 3.1

PROSPECT EVALUATION SUMMARY[7]
FOR GEOPRESSURED RESOURCES - LOUISIANA

	Atchafalaya Bay	Johnson's Bayou	Lafourche Crossing	Rockefeller Refuge	S.E. Pecan Island
Township-Range	18S, 12E	15S, 14W	15S, 17E	16S, 4W	17S, 1E
Parish	St. Mary; Terrebonne	Cameron	Lafourche; Terrebonne	Cameron	Vermilion
Physiography	Marsh;Bay	Marsh;Gulf	Dry Land	Marsh;Gulf	Marsh;Gulf
Top of Geopressure, feet	11,120	8,740	13,850	14,500	13,400
Bulk Rock Volume, $ft^3 \times 10^9$	1,051	1,600	332	946	1,342
In-Place Water bbl x 10^9	49	89	15	39	54
Avg. Pressure, psi	11,400	9,500	12,900	14,200	13,000
Avg. Temp.* °F	222	201	244	293	271
Water Salinity, ppm	107,000	95,000	45,000	56,000	70,000
Gas Solubility SCF/bbl	23	20	35	46	42
In-Place Dissolved Gas, SCF x 10^{12}	1.1	1.8	0.5	1.8	2.3
Permeability, md	95	300	70	80	98**
Porosity, fraction	0.26	0.31	0.25	0.23	0.23

* Temperatures are uncorrected for mud circulation.

** S.E. Pecan Island permeability could be considerably lower, in the 2-10 md. range, according to recently released Exxon information.

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

[3] H. P. Jones, Geopressured Geothermal Energy in Southcentral United States, Frontier Areas and Exploration Techniques in Geology of Alternate Energy Resources, 1977.

incomplete ref. →

[4] M. D. Campbell, at Houston Geological Society, pages 215 through 250.

[5] National Geothermal Report, March 16, 1979, Volume 1, No. 4.

[6] Z. A. Bassiouni and W. J. Bernard, Reservoir Study of Southeast Pecan Island Geopressured Water Sands, Paper No. SPE 7540 presented at 53rd annual Fall Technical Conference and Exhibition of the Society of Petroleum Engineers of AIME, Houston, Texas, October 1-3, 1978.

[7] W. J. Bernard, Evaluation of Five Potential Geopressure Geothermal Test Sites in Southern Louisiana, Final Report to DOE, Contract No. EY-76-S-05-4889, Louisiana State University, Department of Petroleum Engineering, June 1979.

[8] USGS File GEOTHERM (as of August 1979).

4. COMMERCIALIZATION ACTIVITIES

A. Overview

Considerable early-phase commercialization activity is underway in Louisiana, primarily in the resource assessment and well testing of the geopressured-geothermal resource that spans much of southern Louisiana. The Louisiana State University, Department of Petroleum Engineering, has conducted extensive evaluation of oil- and gas-well electric-log data for 63 prospective geopressured areas. More detailed geologic studies have been performed on five prospect areas (Atchafalaya Bay, Johnson's Bayou, Lafourche Crossing, Rockefeller Refuge, and S.E. Pecan Island, and similar work is underway on six other prospects[1-6].

The USGS has conducted resource assessments of the geopressured-geothermal potential of the coastal zones of Louisiana and Texas for several years. Results are published in USGS Circulars 726 and 790[4-5].

A well testing program has been conducted by McNeese State University on the Edna Delcambre et al No. 1 Well, Tigre Lagoon Field, in Vermilion Parish[7]. Several private and governmental parties are currently developing proposals to DOE for the drilling of "design test wells" in several state locations[8].

While no federal or state leases have been issued specifically for geothermal development, numerous oil and gas and mineral leases overlay prospective geothermal areas. Private land leasing is the major leasing activity in Louisiana[9].

The only operational geothermal system is a hot mineral water spa located at Hot Wells, 16 miles west of Alexandria in Rapids Parish. The spa is owned and operated by the State Tourist Development Commission[10].

B. Leases

No leasing activity has taken place in Louisiana on federal or state lands. Tables 4.1 to 4.5 and Figure 4.1 are provided as a framework for summarizing any 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 Louisiana, 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: (a) applications, (b) withdrawals, (c) rejections, (d) pending actions, (e) total leases, (f) terminations, (g) active leases, (h) production status, and (i) unitization. For competitive leases, the figure summarizes the lease offerings and the same items (e) through (i) of the noncompetitive leases. For Indian land leases, it shows the same items (e) through (i). 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 Louisiana. 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 their holdings, the effective date, and cost per acre of the lease.

Table 4.5 lists the holders of active state leases in Louisiana and the size of their holdings. The state of Louisiana owns the "navigable water bottoms" within the boundaries of the state, which is estimated to be approximately five million acres. The exact acreage has never been determined and is openly subject to negotiations and litigation, being dependent upon the interpretation of what is and is not "navigable". No geothermal leases have been issued by the state, but many of the existing oil and gas and mineral leases overlay the geopressured-geothermal prospect areas. Whether or not those existing leases would be applicable to the geothermal resources will probably have to be ascertained by either legislative or judicial actions[9].

C. Exploratory Activity[1-6]

Directed geopressured-geothermal exploration activity is fairly limited in Louisiana, but considerable resource assessment, based upon existing electric-log well data from thousands of deep oil and gas wells, has been conducted by DOE and USGS (see Table 4.6). DOE has contracted with the Louisiana State University, Department of Petroleum Engineering, for a major portion of the resource assessment. The USGS activity has covered the Gulf of Mexico in the coastal zones of Texas and Louisiana. The USGS results are published in USGS Circulars 726[4] and 790[5].

TABLE 4.1

TOTAL ACREAGES OF GEOTHERMAL LEASES - LOUISIANA

(as of August 1979)

Federal Leases:	
Total Acreages of Competitive Leases in KGRA's:	None
Total Acreages of Non-Competitive Leases:	None
State Leases:	
Total Acreages of State Leases:	None
TOTAL OF ALL ACREAGES LEASED	None

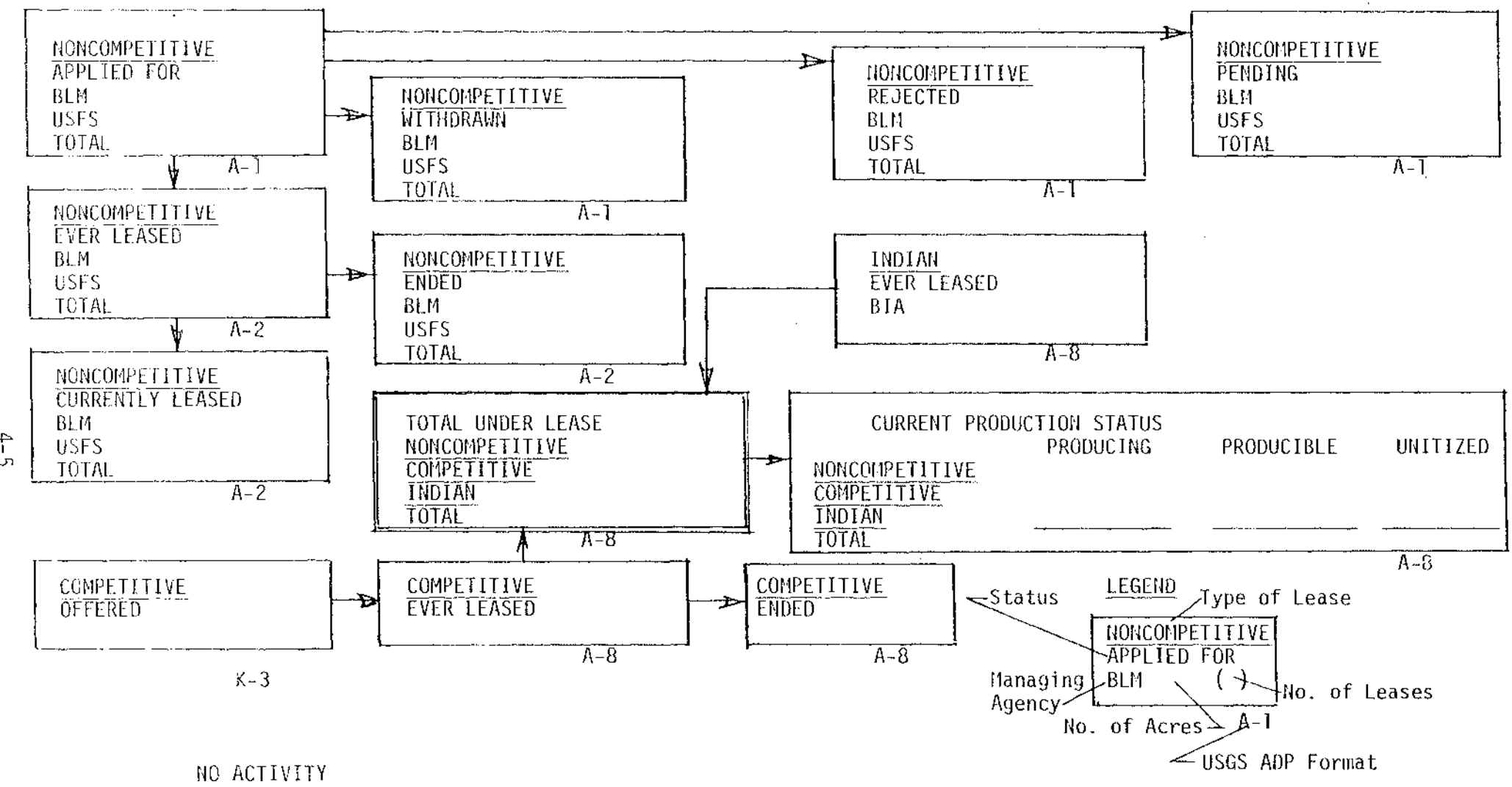


Figure 4.1 Summary of federal leasing activity - Texas

(Source - USGS ADP File)[1]

TABLE 4.2

FEDERAL ACTIVE NONCOMPETITIVE GEOTHERMAL LEASES - LOUISIANA

(as of August 1979)

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

TABLE 4.3[2]

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

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

TABLE 4.4

FEDERAL ACTIVE COMPETITIVE GEOTHERMAL LEASES - LOUISIANA

(as of August 1979)

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

TABLE 4.5

STATE LEASES - LOUISIANA[2]

(as of July 1979)

PARISH COUNTY & LESSEE	SIZE, ACRES & (NO. OF LEASES)	LOCATION
NO STATE LEASES HAVE BEEN ISSUED OR APPLIED FOR.		

TABLE 4.6

EXPLORATORY ACTIVITY - LOUISIANA

COUNTY & LOCATION	COMMENTS
South Third of State	The Louisiana State University Department of Petroleum Engineering [1,2] has evaluated electric well logs for 10,000 oil and gas wells to determine 63 prospective geopressured geothermal areas [1,2].
PARISHES St. Mary, Terrebonne, Cameron, Lafourche and Vermilion Prospect Areas Atchafalaya Bay Johnson's Bayou Lafourche Crossing Rockefeller Refuge S. E. Pecan Island	Follow-on data evaluations by the LSU Department of Petroleum Engineering has provided a ranking of the 63 prospects. Five selected prospects were subjected to more detailed geologic studies of existing well data for the following aquifer properties: areal extent, depth, thickness, temperature, pressure, porosity, salinity, permeability, and dissolved natural gas content. A summary of the data for the five prospects is given in Table 3.1 [2,3,6]. Proposals for test wells are now being formulated by both private and government parties [8].
PARISHES Unnamed Prospect Areas Bayou Herbert Lake Theriot South White Kaplan Grand Lake Tuscaloosa	Current geopressured geothermal prospect evaluations have been extended to six more of the original 63 areas by the LSU Department of Petroleum Engineering [6].
Southern Louisiana and Continental Shelf	The USGS has conducted an on-going resource assessment program, results of which have been published in USGS Circular 726 [4] and 790 [5]. The assessment techniques include evaluations of sandstone, shale, temperature, pressure, and salinity to obtain estimates of thermal and methane energies.

D. Test Wells

No wells have yet been drilled in Louisiana specifically for geopressured-geothermal energy production. However, the Edna Delcambre et al No. 1 Well, Tigre Lagoon Field, in Eastern Vermilion Parish (see Table 4.7) is an drilled oil and gas well which is being tested for geopressured-geothermal resource capability. In addition, several proposals for test well drilling are in preparation by private and governmental parties, which will seek funding from DOE[8].

The Edna Delcambre et al No. 1 well is located in the west half of the Southeast Quarter of Section 5, T14S, R5E in the Tigre Lagoon field. It is about 1 mile north of the Intracoastal Canal and about 1/4 mile west of the Iberia Parish boundary. The well is situated in the coastal marsh, requiring that all operations be conducted from barges. The well was completed in 1968 and produced gas from 1968 to 1975. The drilled total depth depth was 14,083 feet. The top of the geopressured zone occurs at 12,560 feet, and the transition zone is very thin, generally less than 300 feet[11].

The testing program for the Edna Delcambre et al No. 1 well has been conducted by the McNeese State University. The primary objectives were to: (a) produce geologic maps of the reservoir; (b) collect and analyze samples of water from each sand bed aquifer to be tested; (c) determine reservoir flow rates; (d) investigate sand stability problems; (e) determine Kh values of the sands; and (f) develop methods for additional dynamic tests on geopressured reservoirs. Results of the well testing program have been reported[7]. Two sandstone aquifers at approximately 12,600 ft and 12,900 ft were tested. Temperatures of 112°C and 114°C, pressures of 10,600 psi and 11,000 psi and salinities of 133,400 and 113,300 mg/l were measured in the upper and lower zones, respectively. Methane at approximate saturation levels was present in both aquifers.

transmissivity

TABLE 4.7

GEOTHERMAL TEST WELLS - LOUISIANA

PARISH & LOCATION	DEVELOPER	WELL NAME & FIELD	COMMENTS
POINTE COUPEE 20 miles west of Baton Rouge	Chevron Oil	Alma Plantation Well	An oil and gas well that has been designated a geopressured-geothermal discovery well. The well flowed methane-saturated super-heated water from a water sand at 20,600 feet; 5,000 barrels of water through a gas separator for two days. Water temperature of 425°F, salinity of 12,000 mg/l, closed-in formation pressure of 16,000 psi, dissolved gas content of 107 SCF per barrel [11,12].
VERMILION T14S, R5E, S5	McNeese State University (acquired from Coastal States Gas Producing Company)	Edna Delcambre et al No. 1 Well, Tigre Lagoon Field	Originally an oil and gas well, this well has been converted to a geothermal testing well; drilled depth was 14,083 feet; top of geo-pressured zone occurs at 12,560 feet; transition zone less than 300 feet thick [7,11].

Several proposals for design test wells are in preparation, according to information available from the Louisiana Geological Survey in August 1979[8]. The proposed test wells are as follows: (a) Lafourche Crossing prospect (Lafourche Parish) by the Louisiana Department of Natural Resources; (b) Sweet Lake (Cameron Parish) by Magma Gulf; (c) Parcperdue (Iberra Parish) by Dow Chemical; (d) Rockefeller Refuge (Cameron Parish) by Gruy Federal; (e) SE Pecan Island (Cameron Parish); and (f) another test well in the Lafourche Crossing prospect (Lafourche Parish) by .

E. Major Active Developments

Currently there are no industry-sponsored activities that can be considered specifically to be "development" activities for the production of geopressured-geothermal energy (see Table 4.8). However, several industry investigations are indicative of interest in development opportunities[11, 12].

Gulf Geothermal Corporation of Baton Rouge has been researching the geopressured-geothermal concept since 1971 and has begun to acquire an acreage position in Southwest Louisiana, preparatory to drilling a well. The well would be engineering as a water well to test the capability of the area under investigation.

Magma Gulf Company, a Texas corporation headquartered in Baton Rouge, was formed in October 1976 as an outgrowth of a joint venture in leasing between Magma Power Company, a Nevada Corporation, and Gulf Geothermal Corporation, a Louisiana corporation. Magma Gulf tried to obtain private funding, from October 1975 to February 1976, to drill three test wells in a $10 million program. However, increasing publicity in Texas newspapers regarding plans by ERDA to conduct a drilling program led to a "wait-and-see" attitude by private enterprise.

TABLE 4.8

MAJOR ACTIVE DEVELOPMENTS - LOUISIANA

~~COUNTY~~ Parish AND USE	GEOTHERMAL DEVELOPER	ENERGY USER	COMMENTS
NONE			

It is reported that Middle South Services, Inc., is studying the possibility of using the geothermal resource for electric power generation.

F. Operational Systems

Table 4.9 provides a summary of operational systems using geothermal energy in Louisiana[10].

G. References

[1] F. Murray Hawkins, Jr., Investigations on the Geopressure Energy Resource of Southern Louisiana, Final Report to ERDA, Contract No. EY-76-S-05-4889, Louisiana State University, April 15, 1977.

[2] Z. A. Bassiouni and W. J. Bernard, Reservoir Study of Southeast Pecan Island Geopressured Water Sands, Paper No. SPE 7540 presented at 53rd Annual Fall Technical Conference and Exhibition of the Society of Petroleum Engineers of AIME, Houston, Texas, October 1-3, 1978.

[3] W. J. Bernard, Evaluation of Five Potential Geopressure Geothermal Test Sites in Southern Louisiana, Final Report to DOE, Contract No. EY-76-S-05-4889, Louisiana State University, Department of Petroleum Engineering, June 1979.

[4] D. E. White and D. L. Williams (Eds.), Assessment of Geothermal Resources of the United States - 1975, U.S. Geological Survey Circular 726, 1975.

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

TABLE 4.9

OPERATIONAL HYDROTHERMAL SYSTEMS - LOUISIANA[10]

Parish

COUNTY & USE	LOCATION	COMMENTS
RAPIDES		
Spa	Hot Wells (16 miles west of Alexandria)	The state's only active hot mineral water spa, discovered in 1913; 116°F. Owned by State, operated by State Tourist Development Commission.

[6] Z. A. Bassiouni, Louisiana State University, Department of Petroleum Engineering, Personal Communication, August 1979.

[7] B. E. Hawkins and O. C. Karkalitis, Geopressured-Geothermal Test of the Edna Delcambre No. 1 Well, Tigre Lagoon Field, Vermilion Parish, Louisiana: Analysis of Water and Dissolved Gas, Final Report to DOE/DGE, Contract No. EY-76-S-05-4937, McNeese State University, 197?.

[8] C. W. Groat, Louisiana Geological Survey, Personal Communication, August 1979.

[9] Bobby Jones, Chief Geologist, Louisiana Office of Mineral Resources, Personal Communication, August 1979.

[10] J. H. Welsh, J. Adams and A. Chauvier, Louisiana Office of Conservation, Personal Communication, August 1979.

[11] R. T. Sutton, Louisiana Geothermal Geopressure Resources: Resume of Activity, Louisiana Department of Conservation, May 15, 1976.

[12] R. T. Sutton, Louisiana Geothermal/Geopressured Energy Resources: Resume of Activity, Louisiana Office of Conservation, June 1977.

5. DEVELOPMENT PLANS

A. Description

The present planning process for 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 Phased 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.

Current Status: No activity to date.

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 Louisiana.

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: Under a previous PRDA solicitation, deLaureal Engineers, Inc., was selected to conduct an "Inventory and Case Studies of Louisiana, Non-Electric Industrial Applications of Geopressured, Geothermal Resources"[1]. During the study nearly four hundred industries were inventoried and over sixty aquifers were reviewed for energy assessment. Based on geographic distribution, proximity to industrial food establishment densities, geothermal temperature capabilities, availability of geological and well log data, three aquifers were selected for detailed examination.

(1) The Houma aquifer, with temperatures approximating 262°F.
(2) The Lake Charles (East) aquifer, with temperatures of 240 to 250°F.
(3) The New Orleans aquifer, with indications of 230 to 240°F temperatures.

The Houma area offers higher temperatures (from well logs) than either Lake Charles or New Orleans. The area is however largely industrial (metals fabrication and related activities); it offers very limited present opportunities for using geothermal (heat) energy by food processors.

The Lake Charles aquifer (East) provides opportunities for future establishment of agriculturally associated energy users such as product drying.

The New Orleans area has provided the highest density of compatible food industry establishments. For this reason it was examined for geothermal potential of three typical food industry candidates:

(1) An established sugar refinery with a large demand for moderate-temperature heat energy.
(2) An established yeast-producer with a moderate demand of energy for both process cooling and heating.
(3) A new seafood processing plant (capacity 10 tons of seafood per day) with a small demand for heat energy but a large requirement to power absorption refrigeration equipment.

From a consensus of expressions, the use of disposal wells is the most environmentally acceptable method of disposing of thermally spent geothermal fluids (brines). To withstand the corrosive attack of hot geothermal fluids, isolation of these fluids from plant thermal systems is to be accomplished via liquid/liquid heat exchangers. This approach has a heavy cost impact, particularly in retrofitting applications.

In consensus because of the high risks involved, owners and managers of existing food processing establishments were found to be unwilling to venture the large capital sums necessary to develop geothermal resources to meet their plant energy requirements. The study recommends that consideration be given to the dedication of federal energy development funds, towards the drilling, testing, and qualification of a geopressured geothermal well. When proven energy-adequate, the title to this well could be transferred to the user on a pre-negotiated cost basis. The plant owners could then proceed to provide financing and hardware for the inplant portions of the geothermal energy system. In this manner, a geothermally energized food industry project for demonstration could be accelerated.

C. Demonstration Projects and Experiments

No projects so far in Louisiana.

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 Louisiana, 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. Louisiana is not one of these states. Therefore there has been no activity on this project in Louisiana.

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 (UURI). 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: No State Coupled Program has been formally established in Louisiana.

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 only a limited commitment to the development of high-temperature resources.

The Industry-Coupled Program addresses some of the above problems through: (a) cost sharing with industry for exploration, reservoir assessment and reservoir confirmation, (b) release to the public of geoscience data which will improve our understanding of the geothermal resource. Improved understanding will decrease reservoir uncertainty and lower exploration and assessment costs.

The Program is a cooperative effort between DOE and an industrial organization engaged in geothermal exploration. Industry responds with proposals to DOE procurement initiatives. Successful proposers then negotiate contracts with DOE. The contracts specify: (a) an exploration and/or reservoir confirmation program which industry will manage and perform, (b)

a data package which industry agrees to make public, and (c) a certain percentage of total costs (generally in the range of 20% to 50%) which DOE will contribute toward funding the work.

The Earth Science Laboratory of the University of Utah Research Institute provides assistance to DOE on the Industry-Coupled Program by: (a) assisting in management of the Program, (b) releasing geoscience data generated by the program to public open file, and (c) interpreting and supplementing the above data for the purpose of developing and publishing reservoir case studies.

Current Status: There has been no Industry-Coupled Program so far in Louisiana.

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 program established for Louisiana by EG&G Idaho and UURI.

I. State-Assisted Activities

None.

J. References

[1] T. W. Schnadelbach, Jr., (Project Mgr.), Inventory and Case Studies of Louisiana, Non-Electric Industrial Applications of Geopressured Geothermal Resources, Final DOE Report IDO-1629-4, deLaureal Engineers, Inc., February 1978.

7. ENERGY USE PATTERNS

A. Energy Use Summary - Louisiana

Presently, oil and natural gas produced in Louisiana provide virtually all of the state energy usage and are major contributors of energy in the United States. Eighty-three percent of the state's electricity is generated from natural gas, with oil and peak shaving providing the remaining state requirements. However, it is anticipated that by 1985 coal and nuclear will both be significant contributors of electrical power in Louisiana.

Figure 7.1 divides the total energy consumption into five sectors: industrial, transportation, electrical energy conversion and line loss, residential, and commercial. The largest energy user is the industrial sector, consuming 64%. The transportation sector uses 17%, and the residential and commercial sectors combined use 10%. The electric power generation loss accounts for 9%. Of the industrial energy demand, chemical and allied products use about 50%; petroleum and coal products, 20%; and paper and allied products, 10%.

Total energy used in each county is given in Figure 7.2. It is based on total county population and per capita energy use.

A continued growth scenario of Louisiana's energy demand forecasts energy consumption to increase at about 1.0% per year to the year 2000 (Figure 7.3).

In other states, counties overlying geothermal resources have been assessed to determine how many manufacturers could use the available hydrothermal energy in their industrial processes. For these preliminary calculations, a single reservoir temperature has been assumed for each of these counties. Geothermal energy at this temperature is assumed to be recoverable without regards 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 geothermal energy usage.) Each Standard Industrial Classification (SIC) category is aggregated within the county. A Btu use value for each manufacturer is determined by employing energy intensity coefficients (Btu/employee). Industrial, as well as residential/commercial, data for each such county are compiled. These data show the potential for conversion to geothermal energy based on 1975 usage in these counties.

Table 7.1 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 geothermal energy applications, even if their total energy requirements cannot be met by geothermal energy.

B. References

[1] Frank Drysdale and Charles E. Calef, The Energetics of the United States of America: An Atlas, Brookhaven National Laboratory (Revised October 1977).

[2] R. B. Kidman, et al, Energy Flow Patterns for 1975, LASL-LA-6770 (June 1977).

[3] State-by-State Profile of Electricity Use in Southern U.S., Energy User News, May 1, 1978.

[4] T. C. Landrum, Director of the Louisiana Department of Natural Resources, Personal Communication, March 23, 1979.

[5] Preliminary Forecast of Likely U.S. Energy/Consumption/Production Balances for 1985 and 2000 by States, U.S. Department of Commerce. Washington D.C., November 1, 1978.

[6] Jeffrey Price and Janet Farr, Ozarks Region Energy Alternatives Study, Working Paper XVI, Energy Demand Projections, March 1977.

[7] Patricia Rice, Energy Conditions in the South, Oak Ridge National Laboratory, December 1976.

[8] U.S. Department of Commerce, Bureau of Census, Annual Survey of Manufacturers 1976: Fuels and Energy Consumed, States, by Industry Group, M76 (AS)-4.2, May 1978.

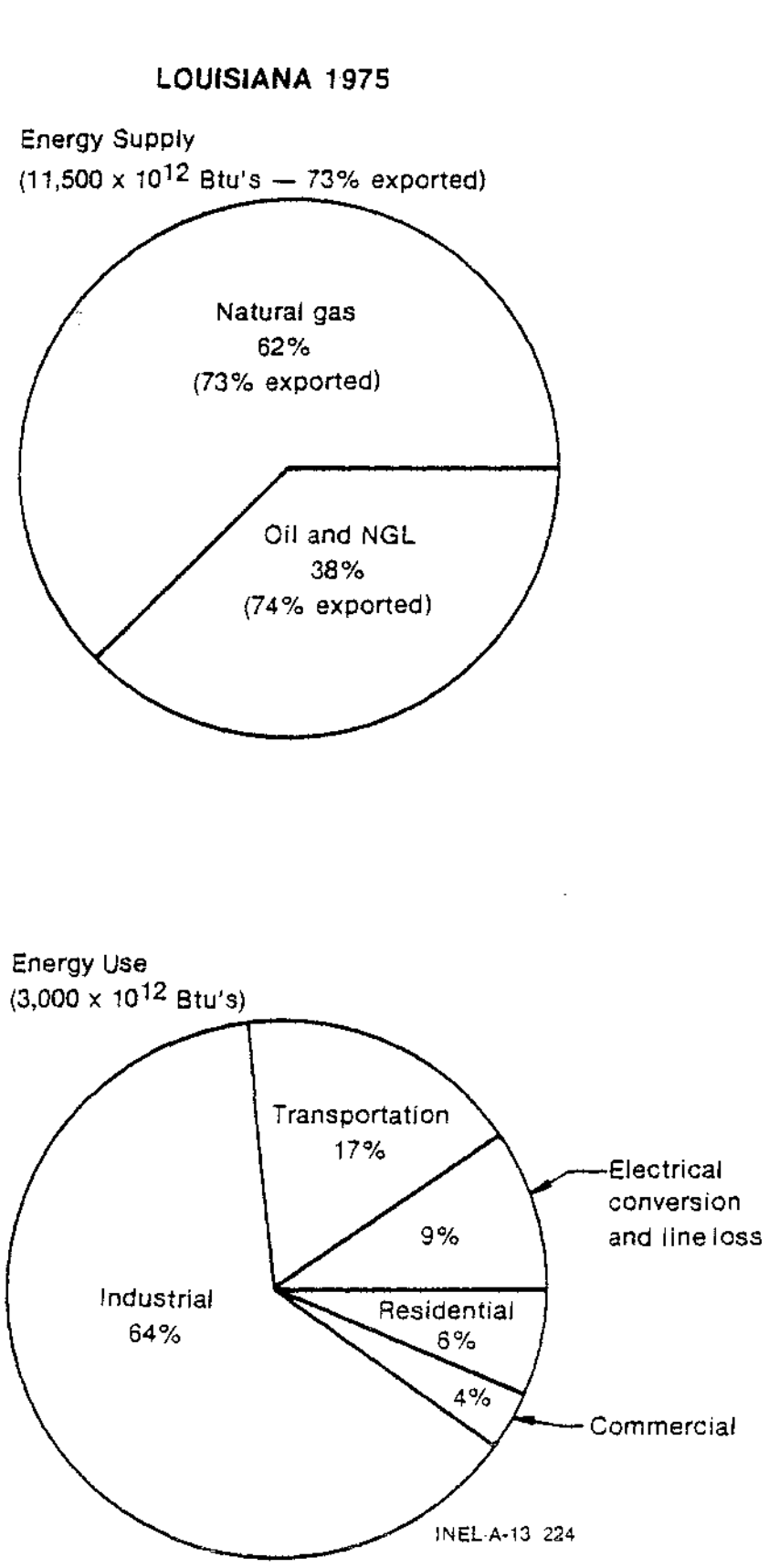
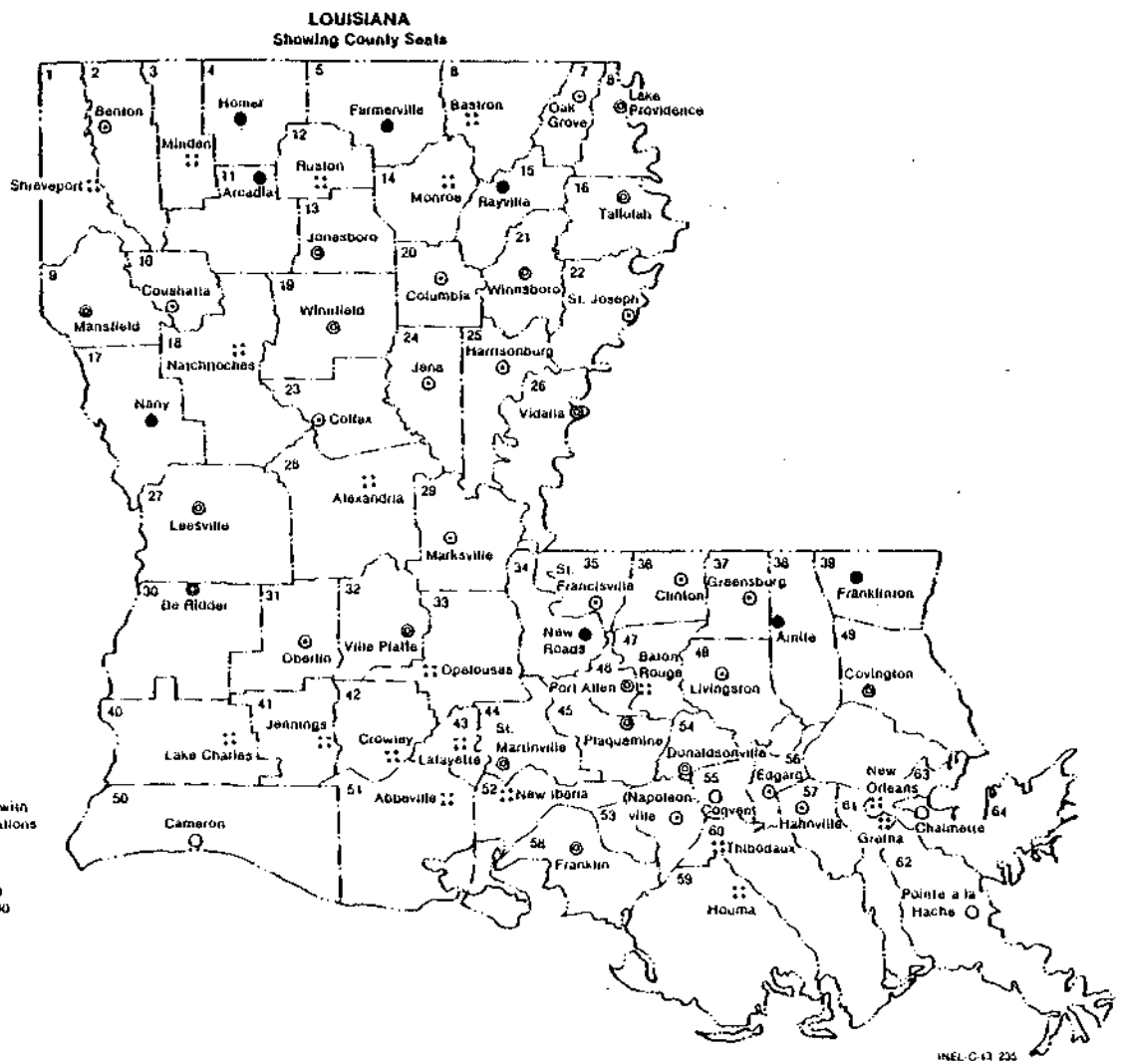


Fig. 7.1 Louisiana energy supply and use.

1975 Louisiana Energy Use By County

No.	County	Energy Use (Btu x 10^{12}/yr)	No.	County	Energy Use (Btu x 10^{12}/yr)
1	CADDO	200	33	ST. LANDRY	43
2	BOSSIER	38	34	POINTE COUPEE	10
3	WEBSTER	43	35	WEST FELICIANA	3.6
4	CLAIBORNE	8.7	36	EAST FELICIANA	8.8
5	UNION	9.8	37	ST. HELENA	3.3
6	MOREHOUSE	18	38	TANGIPAHOA	40
7	WEST CARROLL	7.0	39	WASHINGTON	31
8	EAST CARROLL	70	40	CALCASIEU	160
9	DE SOTO	13	41	JEFFERSON DAVIS	22
10	RED RIVER	4.4	42	ACADIA	30
11	BIENVILLE	7.3	43	LAFAYETTE	60
12	LINCOLN	20	44	ST. MARTIN	13
13	JACKSON	8.6	45	IBERVILLE	75
14	OUACHITA	110	46	WEST BATON ROUGE	8.4
15	RICHLAND	13	47	EAST BATON ROUGE	340
16	MADISON	9.2	48	LIVINGSTON	19
17	SABINE	10	49	ST. TAMMANY	41
18	NATCHITOCHES	19	50	CAMERON	4.9
19	WINN	1.0	51	VERMILION	28
20	CALDWELL	4.2	52	IBERIA	35
21	FRANKLIN	13	53	ASSUMPTION	94
22	TENSAS	5.3	54	ASCENSION	23
23	GRANT	5.5	55	ST. JAMES	14
24	LASALLE	7.2	56	ST. JOHN BAPTIST	16
25	CATAHOULA	6.5	57	ST. CHARLES	110
26	CONCORDIA	12	58	ST. MARY	56
27	VERNON	26	59	TERREBONNE	48
28	RAPIDES	78	60	LAFOURCHE	43
29	AVOYELLES	17	61	JEFFERSON	290
30	BEAUREGARD	14	62	PLAQUEMINES	17
31	ALLEN	14	63	ORLEANS	560
32	EVANGELINE	40	64	ST. BERNARD	47



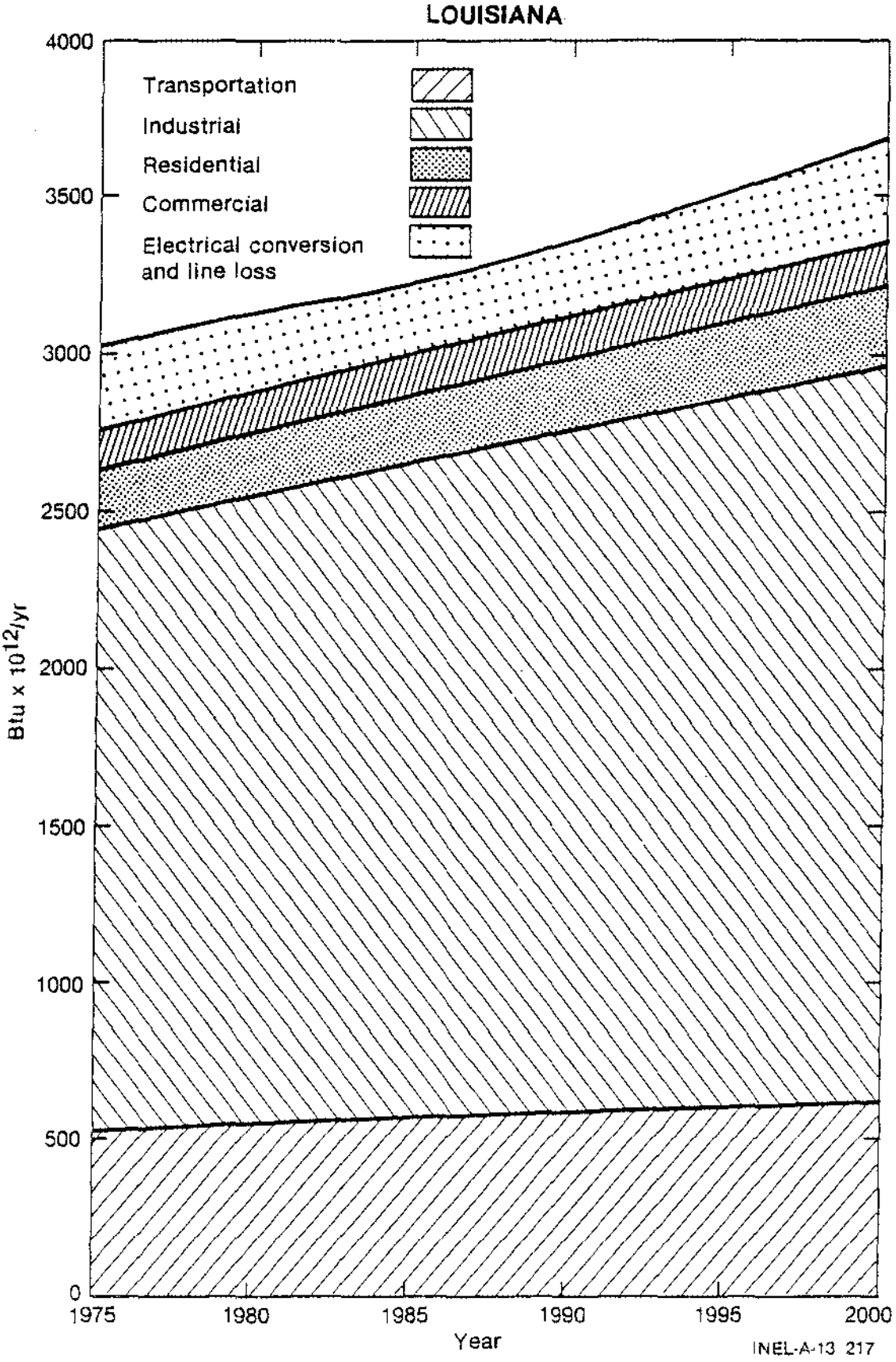


Fig. 7.3 Louisiana total energy use projection.

TABLE 7.1

PERCENT PROCESS HEAT IN TEMPERATURE RANGES

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
Copper concentrate	1021	NA	NA	NA	100%						
Potash	1474	NA	NA	NA	100%						
Sulfur	1477	NA	NA	NA	NA	NA	NA	100%			
Meat packing	2011	NA	99%	100%							
Prepared meats	2013	NA	46.2%	61.5%	100%						
Poultry dressing	2016	100%									
Natural Cheese	2022	23%	100%								
Condensed milk	2023	NA	63%		93%	100%					
Dried Milk	2023	NA	NA	42.4%	66.4%	70.8%			100%		
Fluid milk	2026	NA	NA	100%							
Canned specialities	2032	NA	NA	16.4%	68.9%	100%					
Canned fruits and vegetables	2033	NA	NA	22.7%	67.6%	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%						
Wet corn milling	2046	21.5%			36.4%	46.6%		84.1%		100%	
Prepared feeds	2048										
pellet conditioning		NA	NA	100%							
alfalfa drying		NA	NA	NA	NA	NA	NA	NA	NA	100%	

TABLE 7.1 (continued)

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
Bread & baked goods	2051	11.6%								100%	
Beet sugar	2063	NA	7.4%	22.4%		95.4%					100%
Soybean oil mills	2075	NA	24.7%	26.5%	73.4%			100%			
Animal and marine fats	2077	NA	NA	NA	NA	NA	NA	NA	100%		
Shortening and cooking oils	2079	NA	33.9%	46.8%		71.0%	85.9%			100%	
Malt beverages	2082	NA	3.8%	7.1%	42.0%					100%	
Soft Drinks	2086	60.9%	100%								
Finishing plants											
Cotton	2261	NA	NA	47.3%		100%					
Synthetics	2262	NA	NA	68.8%		100%					
Sawmills and planing mills	2421	NA	NA	NA	NA	NA	100%				
Plywood drying	2435	NA	NA	NA	NA	100%					
Veneer drying	2436	NA	NA	NA	100%						
Wooden furniture	2511	60%	100%								
Upholstered furniture	2512	60.9%	100%								
Pulp mills	2611	NA	16.3%			31.7%	67.4%		91.0%		100%
Paper mills	2621	NA	16.3%			31.7%	67.4%		91.0%		100%
Paperboard mills	2631	NA	16.3%			31.7%	67.4%		91.0%		100%
Building paper	2661	NA	16.3%			31.7%	67.4%		91.0%		100%

TABLE 7.1 (continued)

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
Fiber boxes	2653	NA	NA	NA	NA	NA	NA	100%			
Alumina	2819	NA	NA	NA	NA	76.2%					100%
Plastic materials	2821	NA	NA	51.0%	100%						
Synthetic rubber	2822	3.6%	50.4%	100%							
Cellulosic fibers	2823	NA	NA	NA	NA	NA	NA	NA	NA	100%	
Noncellulosic fibers	2824	NA	NA	NA	100%						
Pharmaceutical	2834	NA	.3%			100%					
Soaps	2841	NA	NA	.6%						100%	
Detergents	2841	NA	NA	52.2%				99.9%		100%	
Organic chemicals-	2869	NA	NA	NA	NA	100%					
Ethanol											
Isopropanol		NA	NA	NA	NA	NA	NA	100%			
Cumene		NA	NA	NA	NA	100%					
Vinyl Chloride Monomer		NA	NA	NA	NA	NA	NA	100%			
Urea	2873	NA	NA	NA	NA	NA	85.1%		100%		
Explosives	2892	NA	NA	83.5%		98.7%	100%				
Petroleum	2911	NA	NA	NA	NA	NA	NA	5%			100%
Paving	2951	NA	NA	NA	NA	NA	NA	100%			
Asphalt Felts	2952	NA	NA	NA	NA	NA	77.1%			100%	
Tires	3011	NA	NA	NA	NA	NA	NA	100%			

TABLE 7.1 (continued)

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-
Plastic products	3079									100%	
Leather Tanning	3111	100%									
Concrete block	3271										
low pressure		NA	100%								
autoclaving		NA	NA	NA	NA	NA	NA	NA	100%		
Ready Mix	3273	100%									
Gypsum	3275	NA	NA	NA	NA	NA	52.8%	100%			
Treated minerals	3295										
clay & shale		NA	NA	NA	NA	NA	NA	NA	NA	NA	100%
fuller's earth		NA	NA	NA	NA	NA	NA	NA	NA	NA	100%
kaolin		NA	NA	NA	90%						100%
perlite		NA	11.15%								100%
barium		NA	NA	NA	100%						
Galvanizing	3479	NA	NA	NA	NA	44%					100%
Motors & Generators	3621	NA	2.7%					11.2%			100%

8. STATE GOVERNMENT INSTITUTIONAL PROCEDURES - LOUISIANA[1-12]

The information in this section was in part obtained from an ERDA/DOE funded study on the legal problems inherent in the development of geopressured and geothermal resources in Louisiana[3].

A. General

The 1975 Louisiana State Legislature enacted the Louisiana Geothermal and Geopressured Energy Research and Development Act No. 735 of 1975 L.R.S.30:(81). This act defined the resource and gave the State Department of Conservation the responsibility for management and coordination of a state geothermal and geopressure energy research and development program. The Geothermal Energy Resource Act No. 78 of 1975 (L.R.S. 30:800) provides rules and regulations governing geothermal energy development, production and distribution. In 1976, Act No. 134 amended Act No. 784 to be more specific. These two acts set forth as policy that "the primary purpose is to provide a dependable supply of electrical energy and process heat at reasonable rates for the people of the state of Louisiana". They also give the following definition of geothermal resources as:

(1) All products of geothermal processes, embracing indigenous steam, hot water, hot brines and geopressured waters excepting, however, water produced incidental to oil or gas exploration or production.

(2) Steam and other gas, hot water and hot brines resulting from water, gas or other fluids artificially introduced into geothermal and/or geopressured water formations.

(3) Heat, natural gas dissolved in formation water of which was dissolved in formation water and is produced at the geothermal and/or well bore, or other associated energy found in geothermal and/or geopressured water formations.

(4) Any byproduct derived therefrom." (RS 30:801)

Byproducts means any mineral excluding oil and natural gas.

As part of these same acts the following are included:

(1) Full regulatory authority over all geothermal activities was vested in the State Department of Conservation.

(2) Disposal into water is under the supervision of the Stream Control Commission.

(3) The State Mineral Board has authority to lease state lands.

These acts also included procedures for leasing, rental, royalties, and records which are described in Section 8.C below.

The 1978 Legislative adopted Resolution No. 237 to "create an Energy Development Study Commission composed of public figures and private citizens to determine the dependence of the Louisiana economy on natural gas,... to explore all other avenues for bringing energy into Louisiana... and to find the solution to making available sufficient energy to support the Louisiana economy". In 1979 the Legislative passed Resolution No. 67 which continued the Energy Development Study Commission through July 10, 1980, to explore energies whether it be coal, or nuclear or any other energy source, and to find the solution to include the growing rate of using energy.

B. Principal State Agencies

The Department of Natural Resources is directly under the Governor and the Secretary is appointed by the Governor. The Department administers the Office of Conservation, Energy Development and Research, Forestry, Mineral Resources, and State Lands.

The State Mineral Board is under the Department of Natural Resources, but the chairman is appointed by the Governor. It has the powers to either develop or lease state owned lands for development and production.

The Department of Conservation is under the Department of Natural Resources, but the Commissioner is appointed by the Governor. It has full regulatory authority over all geothermal exploration, drilling, development and production including waste. It issues prospecting and drilling permits.

The Stream Control Commission is under the Department of Wildlife and Fisheries and has supervision of disposal of geothermal energy into navigable or non-navigable streams or water.

The Department of Public Works is under the Department of Transportation and Development and deals with the utilization, administration, and conservation of underground waters.

The Public Service Commission regulates public electric power utilities and transmission systems.

C. Leasing Surface Land and Resources

Most geothermal energy developers will procure rights to exploit the resource by means of a lease from the landowner or the owner of a mineral servitude covering the geothermal right.

The leasing of state land is regulated and granted by the State Mineral Board as provided by L.R.S.30:804-806. A written application with $200 is made to the Board. The Board may then cause an inspection of the land. No lease can be more than 5,000 acres. The Board will then advertise in official journals three times not more than 60 days prior to the date

for the opening of bids, and not less than 5 days between each ad. The ad must contain a description of the land, the time and place the sealed bids will be received, the royalty to be demanded, and any other information the Board considers necessary. The Board can also send this information to those whom it thinks would be interested. The opening of the bids is at any state-owned building in the Capitol city. The Board may reject any or all bids or accept the bid most advantageous to the state. If all written bids are rejected, the Board may reoffer a competitive bidding for the lease. Again, the Board can reject any or all bids.

The lease has a primary term of ten years. The annual rent is not less than $1.00/acre or one-half the cash bonus, whichever is greater. The royalties are not less than 10% of the price received for all geothermal resources produced and not less than 5% of the value of any byproduct produced.

The lease can not be assigned or transferred unless approved by the State Mineral Board. The Board has full supervision of all geothermal leases granted by the State. It can cause actions to annul, enter into agreements, or amend a lease. The Board cannot extend the primary term of any lease and cannot reduce the amount of bonus, rental, royalty, or other consideration stipulated in the lease. The Board may also contract under terms for storage, transportation, refining, processing, distribution, sale, and/or use of royalties.

D. Exploration and Drilling

No well or test well may be drilled without first obtaining a permit from the Commissioner of Conservation. The permit has a drilling fee of $100 and is valid for 90 days. It can be renewed once for an additional fee of $25. For each drilling permit that must be altered, amended, or changed, an additional fee of $25 is due for each such alteration, amendment or

change (amended by Acts 1959, No. 66§1.). Applications are to be mailed or delivered to the District Office and accompanied by three copies of the location plat. No well can commence before permit has been issued by the Office of Conservation. The District Office must receive field maps and logs of all test wells 10 days after completion. A form entitled, "Well History and Work Resume Report" must be filed 20 days after completion in the District Office. There are also rules and regulations on how and when the drilling can be conducted under the Office of Conservation (Statewide Order No. 29-P).

Disposal of all geothermal/geopressured waste materials into the surface waters is under the control of the Stream Control Commission. Produced salt water and related waste may be sorted in pits that have been approved by the Commissioner of Conservation. Prior to disposing of salt water by injecting the same into any subsurface formation, a permit must be obtained from the Commissioner of Conservation (Statewide Order No. 29-P).

The State Mineral Board has the exclusive authority to grant permits to conduct geophysical and geological surveys on state-owned lands and water bottoms. For geophysical exploration on state-owned water bottoms, there must be compliance with the Department of Wildlife and Fisheries Regulations before a permit will be issued. Application for a permit for such exploration must be filed in quadruplicate with the Secretary of the State Mineral Board at least 10 days before the requested effective date of permit. A detailed map has to be included as well as a statement of type of work planned. Permits are for 6 months from date issued with two additional periods of 3 months allowed.

E. Development and Commercialization

To be provided in next edition.

F. Municipal and County Authorities

Under L.R.S. 33:4162 of the Louisiana Statutes, "any municipal corporation or any parish or any other political subdivision or taxing district...may construct, acquire, extend, or improve any revenue producing public utility ... and may operate and maintain the utility". No municipal corporation may lease or purchase gas fields, wells, lands, or holding for the purpose of drilling and operating gas wells, but a parish is able to lease or purchase gas plants, distributing system wells, lands and holdings.

Any municipal corporation, except New Orleans, or any district created for the purpose of supplying the public with a public utility may issue bonds for the purpose of constructing, acquiring, extending, or improving any revenue producing public utility. The bonds issued shall be payable solely from the income and revenues from the operation of the utility and do not constitute an indebtedness or pledge of the general credit of the municipal corporation (L.R.S. 33:4252 and 33:4221).

G. State and Local Taxation

There is no state property tax in Louisiana, but the Louisiana Constitution does allow such a tax. Property taxes are assessed at the parish and city level and no additional value may be assessed on land due to oil, gas or mineral deposits being on the land (La. Const. Act 7, 1849). Louisiana does have a Royalty Gas Excise Tax; the tax rate is the difference between the price received by the producer for the royalty owner's interest in dry gas or gas products and the prices the royalty owner is paid (La. Rev. Stat. Ann. 47:641). Severance taxes are applied to oil, distillate (condensate), natural gasoline, casing head gasoline, other natural gas liquids, gas, sulphur, and coal. The corporate income tax is based on net income from instate sources, ranging from 4% to 8%.

H. Other Information

None

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[4] Statewide Order No. 29-P, State of Louisiana Office of Conservation, Baton Rouge, Louisiana.

[5] Related Statutes Relative to Oil and Gas Development of State Owned Lands and Water Bottoms and State Agency Lands, Compiled by Office of State Mineral Board, Baton Rouge, Louisiana, December 1975 (Revised, February 1977).

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9. BIBLIOGRAPHY (SELECTED REFERENCES)

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