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REGIONAL OPERATIONS RESEARCH PROGRAM
FOR COMMERCIALIZATION OF GEOTHERMAL ENERGY IN THE
ROCKY MOUNTAIN BASIN AND RANGE

FINAL TECHNICAL REPORT
NMEI 61-25
JANUARY 1980 TO MARCH 1981
JULY 1981

WORK PERFORMED UNDER DOE CONTRACT NO. DE-AS07-78IDO-1756

PREPARED FOR THE
DEPARTMENT OF ENERGY
DIVISION OF GEOTHERMAL ENERGY

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Final Technical Report
NMEI 61-25
January 1980 to March 1981

July 1981

New Mexico Energy Institute
New Mexico State University
Las Cruces, New Mexico

Prepared for the
Department of Energy Division of Geothermal Energy
Under Contract No. DE-AS07-78-IDO-1756

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Abstract

This report describes the work accomplished from January 1980 to March 1981 in the Regional Operations Research efforts for the Rocky Mountain Basin and Range Geothermal Commercialization Program. The scope of work is as described in New Mexico State University Proposal 80-20-207. The work included continued data acquisition and extension of the data base, enhancement and refinement of the economic models for electric and direct use applications, site-specific and aggregated analyses in support of the state teams, special analyses in support of several federal agencies, and marketing assistance to the state commercialization teams.

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August 7, 1981

Mr. John Crawford
U.S. Department of Energy
333 Market Street
San Francisco, CA 94105

Dear Mr. Crawford:

Please find enclosed a copy of our final report on DOE Contract DE-AS07-78-IDO-1756. Mod 6 of the contract was in support of your region.

The state-specific results have been furnished to the appropriate state personnel.

Sincerely,

A handwritten signature in cursive script, appearing to read 'J. Marlin'.

Joe Marlin, Director
Geothermal O/R Project

rgy

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INTRODUCTION

The work performed by New Mexico Energy Institute under contract to the U.S. Department of Energy (Contract No. DE-AS07-78ID01756) during the calendar year 1980 consisted of four parts - 1) continued building of the supporting data base, 2) computer model construction and development, 3) application of the previous two parts to produce relevant planning information for the Geothermal Energy community as a whole, and 4) marketing assistance to the state teams (reported separately as NMEI Report No. 61-26).

The New Mexico Energy Institute (NMEI) initiated its Geothermal Energy Operations Research efforts in June, 1977 and has continued to build its capabilities since then. The equity acquired over that period is reaching a degree of maturity in which the tools and information can be gainfully disseminated to the Geothermal Energy community.

THE DATA BASE

Purpose

The objectives in compiling a Geothermal Energy data base are twofold: First, to provide supporting information to project investigators for economic and marketing modelling, and second, to provide a depository for Geothermal Energy information accessible by the community as a whole.

Structure of the Files

The Data Base is divided into three general electronic files; 1) Geothermal resource, 2) Population centers, and 3) Industrial firms.

The Resource File

A sample of the resource file is exhibited in Table 1. The basic information was gathered from the state teams, the USGS "Geotherm" data base, geologists and USGS circulars. A listing of sources appears in Table 2. Most of the column headings in Table 1 are self-explanatory. The ID number is assigned by NMEI. The Source columns (SO) aid in determining where the data came from. The subsurface temperature is generally the reservoir temperature, and the E or M column indicates whether the temperature was estimated or measured. The P/I column identifies sites as potential, inferred, or both potential and inferred depending upon well depth. The last two fields on the right are commercialization depth and temperature. These are the values that were used to analyze the economic feasibility of each site. To determine the commercialization depth and temperature all available information about a site is assembled including surface temperature, well temperature and depth, and estimated reservoir temperature. Regional and local temperature gradients are also checked when available. The commercialization state team member and the resource person at NMEI chose the most likely commercialization depth and temperature for the site after evaluating the available data. If possible, a temperature of at least 60°C. is chosen with the appropriate depth to provide an adequate fluid temperature for district heating.

SITE ID	SITE NAME	COUNTY	LAT DEG	LONG DEG	T S P	R N G	S E C	RSVR VOL CU KM	S O	SUBS TEMP C	S O	SURF TEMP C	S O / M	CO CO DE I	P /	COML DEPTH FT	COML TMP C	
230102	BAINVILLE	ROOSEV	48.140	104.220	28N	58E	27	1.00	21	60	21		E	43	I	5000	60	
230103	BROCKTON	ROOSEV	48.150	104.918	28N	53E	29	1.00	21	60	21		E	43	I	5000	60	
230104	CULBERTSON	ROOSEV	48.150	104.517	28N	56E	29	1.00	21	60	21		E	43	I	5000	60	
230105	FROID	ROOSEV	48.335	104.493	30N	56E	19	1.00	21	60	21		E	43	I	5000	60	
230106	POPLAR	ROOSEV	48.133	105.200	27N	50E	12	1.00	21	60	21		E	43	I	5000	60	
230107	WOLF POINT	ROOSEV	48.083	105.667	27N	47E	15	1.00	21	60	21		E	43	I	5000	60	
230108	ASHLAND	ROSEBU	45.592	106.268	3S	44E	11	1.00	21	70	21		E	44	I	5000	70	
230109	CARTERSVILLE	ROSEBU	46.283	106.450	6N	42E	14	1.00	21	70	21		E	44	I	5000	70	
230110	COLSTRIP	ROSEBU	45.883	106.627	2N	41E	27	1.00	21	70	21		E	44	I	5000	70	
230111	FORSYTH	ROSEBU	46.250	106.667	6N	40E	23	1.00	21	70	21		E	44	I	5000	70	
230112	INGOMAR	ROSEBU	46.578	107.377	10N	35E	31	1.00	21	70	21		E	44	I	5000	70	
230113	LAME DEER	ROSEBU	45.623	106.667	2S	41E	33	1.00	21	70	21		E	44	I	5000	70	
230114	ROSEBUD	ROSEBU	46.273	106.445	6N	42E	14	1.00	21	70	21		E	44	I	5000	70	
230115	CAMAS HOT SPRINGS	SANDER	47.616	114.666	21N	24W	3	3.00	14	81	21	45	12	E	45	P	750	65
230116	GREEN SPRINGS	SANDER	47.451	114.648	20N	24W	33	3.00	14			19	12		45			
230117	QUINNS PARADISE HS	SANDER	47.329	114.789	18N	25W	9	3.00	14			43	12		45	P	750	50
230118	SYMES WELL	SANDER	47.616	114.676	21N	24W	4	3.00	14	81	21	40	21	E	45			
230119	ANTELOPE	SHERID	48.692	104.455	34N	55E	13	1.00	21	60	21		E	46	I	5000	60	
230120	HOMESTEAD	SHERID	48.420	104.540	31N	55E	26	1.00	21	60	21		E	46	I	5000	60	
230121	MEDICINE LAKE	SHERID	48.502	104.507	32N	55E	24	1.00	21	60	21		E	46	I	5000	60	
230122	OUTLOOK	SHERID	48.888	104.778	36N	53E	10	1.00	21	60	21		E	46	I	5000	60	

Table 1. Sample of Site File

SC	SOURCE
1	U.S. Geological Survey, Circular 726
2	Dr. C. Swanberg, or NMSU Department of Earth Sciences
4	Arizona State Team
5	Colorado State Team
6	Nevada State Team
7	New Mexico State Team
8	Utah State Team
9	U.S. Department of Energy
10	National Oceanic and Atmospheric Administration (NOAA)
11	New Mexico Energy Institute
12	Geotherm Database
13	W.K. Summers, or N.M. Bureau of Mines and Mineral Resources
14	U.S. Geological Survey, Circular 790
15	University of Utah Research Institute (UURI)
17	U.S. Geological Survey - Waring
18	Stone and Mizell, or N.M. Bureau of Mines and Mineral Resources
20	Idaho State Team
21	Montana State Team
22	North Dakota State Team
23	South Dakota State Team
24	Wyoming State Team
29	University of New Mexico
30	Dr. L.N. Chaturvedi, or Dept. of Civil Engineering, NMSU
34	DOE Region 9 (San Francisco)
35	Geothermal Energy in Alaska. OIT, Klamath Falls, OR.
36	Geothermal Resources in Oregon. OIT, Klamath Falls, OR.
37	Geothermal Energy in Washington. OIT, Klamath Falls, OR.
40	Low to Inter. Temp SPR + Wells in Oregon. GMS-10.
41	National Climatic Center, Essa, U.S. Dept. of Commerce
42	Alaska State Team
43	Oregon State Team
44	Washington State Team

Table 2. List of Sources for Resource.

The Population Center File

The file on cities and towns contains positions, populations, heating degree days, mean low temperature, and urban development status for many large and small towns in states that have geothermal potential. Table 3 shows a sample of the population file. There is no minimum population requirement for a town to be listed in this file. Positions are given by latitude and longitude.

ID	CITY NAME	COUNTY	LAT DEG	LONG DEG	POPULATION	HEAT DEG DAYS	LOW TMP F	U D G	CO CO DE
355001	ABBOTT	HILL	31.885	97.072	326	2253	36		109
355002	ABILENE	JOHNSO	32.597	97.157	96573	2498	35		126
355003	ACKERLY	DALLAS	32.997	96.679	310	2599	37		57
355004	ADDISON	DALLAS	32.958	96.830	4105	2587	36		57
355005	ALAMO HEIGHTS	BEXAR	29.473	98.463	6979	1627	38		15
355006	ALBA	WOOD	32.793	95.630	640	2509	39		250
355007	ALEDO	PARKER	32.695	97.602	792	2564	33		184
355008	ALLEN	COLLIN	33.103	96.672	4571	2644	36		43
355009	ALMA	ELLIS	32.288	96.548	113	2386	38		70
355010	ALTOGA	COLLIN	33.123	96.623	416	2652	36		43
355011	ALVARADO	JOHNSO	32.400	97.213	2514	2458	35		126
355012	ALVORD	WISE	33.360	97.697	890	2700	30		249
355013	ANGUS	NAVARR	32.080	96.478	111	2324	38		175
355014	ANNA	COLLIN	33.348	96.550	737	2744	35		43
355015	ANNONA	RED RI	33.580	94.917	353	2709	36		194

Table 3. Sample of City and Town File

Industrial File

Files containing industrial information have been compiled for most states with Geothermal Energy potential. A sample of an industrial file is shown in Table 4. Each firm (or record) receives a unique identification number that includes in code the town in which the firm is located. When available, the processing temperature (°C.) for the standard industrial code (SIC) is listed. The Energy76 field is an estimate of the energy used by each firm in 1976, expressed in tens of billions of BTU's.

Current Status

The following states are presently represented in NMEI data base. The addition of states outside the Rocky Mountain Basin and Range was the direct result of NMEI's participation in the National Market Estimates Task Force.

Arkansas	Maryland	Pennsylvania
Alaska	Montana	South Carolina
Arizona	North Carolina	South Dakota
California	North Dakota	Texas
Colorado	New Jersey	Utah
Georgia	New Mexico	Virginia
Hawaii	Nevada	Washington
Idaho	New York	West Virginia
Kansas	Oregon	Wyoming

Table 5 indicates the number of records in each of the three data files as of the end of 1980. This represents the most extensive data base of this type.

ID	FIRM NAME	CO CO	SIC CODE	TEMP C	NR EMPL	BTU/ EMPL	ENERGY76
5754120120	U S COCOA CORP	4	2066	121	34	0.0362	1.231
5754120121	UTILITY INDUSTRIES INC	4	3643	149	6	0.0044	0.026
5754120122	WALTON STAMP + SEAL MFG C	4	3555	1371	30	0.0041	0.123
5754120123	WALTON STAMP + SEAL MFG C	4	3953	93	0	0.0016	0.000
5754120124	WEST BANK OIL CO INC	4	2952	260	0	0.1069	0.000
5754120125	WETLER CORP	4	3444	93	55	0.0097	0.534
5754120126	WETLER CORP	4	3643	149	0	0.0044	0.000
5754120127	WEYERHAUSER CO	4	2653	149	200	0.0238	4.760
5754120128	WISE TAG + LABEL CO	4	2649	149	50	0.0121	0.605
5754310001	DUAL MACHINE TOOL INC	4	3544	1371	25	0.0039	0.097
5754330001	DELAWARE VALLEY INDUSTRIA	4	2813	149	40	0.6199	24,796
5754340001	STANDARD ELECTRIC MFG CO	4	3564	1371	28	0.0071	0.199
5754340002	STANDARD ELECTRIC MFG CO	4	3561	1371	0	0.0065	0.000
5754340003	WORNE BIOCHEMICALS INC	4	2899	149	12	0.1050	1.260
5754350001	GARDEN MACHINE CO., INC	4	3494	93	26	0.0115	0.299
5754350002	KRAFLOW MFG. CO.	4	3499	93	11	0.0099	0.109

Table 4. Sample of Industrial File

STATE	NUMBER OF SITES	NUMBER OF TOWNS	NUMBER OF FIRMS
ALASKA	98	175	0
ARIZONA	72	197	3186
ARKANSAS	1	488	0
CALIFORNIA	650	685	16323
COLORADO	56	333	5373
DELAWARE	0	63	341
FLORIDA	0	384	0
GEORGIA	0	546	1364
IDAHO	311	278	1824
KANSAS	0	664	416
MARYLAND	1	353	2954
MASSACHUSETTS	1	356	0
MONTANA	136	339	1138
NEBRASKA	0	542	2864
NEVADA	307	98	274
NEW JERSEY	0	441	2466
NEW MEXICO	116	214	1150
NEW YORK	1	678	1311
NORTH CAROLINA	1	657	6330
NORTH DAKOTA	161	301	588
OREGON	278	247	2632
PENNSYLVANIA	1	1015	0
SOUTH CAROLINA	0	321	2417
SOUTH DAKOTA	67	298	1181
TEXAS	358	1115	10540
UTAH	223	248	1819
VIRGINIA	3	539	3420
WASHINGTON	51	282	300
WEST VIRGINIA	1	240	17
WYOMING	64	138	745
TOTALS	2958	12235	70863

Table 5. Number of Records in Files

MODELING

BTHERM

BTHERM is the basic analysis program that evaluates the economics of a particular geothermal energy project. Much developmental work continued on BTHERM through the contract year. Using the model BTHERM and the NMEI Data Base, that was extended from the 10-state Rocky Mountain Basin and Range to the national level, projections of geothermal supply potential were developed during the year.

The variable inputs to the simulation model BTHERM include over two hundred geophysical, demographic, and economic parameters. The resulting model product includes the price competitiveness of geothermal energy and the heat supply potential for geothermal energy for a given resource-co-located user. The task of aggregating the national geothermal supply potential through time, therefore, could be accomplished by summing the results of individual BTHERM runs for each resource-co-located user in the country. With over 2,000 resource-co-located users developed in the data base completion process, an alternative methodology was thought necessary to minimize the cost and increase the timeliness of the analysis.

The model BTHERM was designed to calculate a levelized price per million BTU which would be charged to consumers in a direct use geothermal application. The model solves the following engineering/economic identity.

$$\sum_{t=1}^T (\text{Costs}_t) (1+R)^{-t} = \sum_{t=1}^T (\text{Revenues}_t) (1+R)^{-t} \quad (1)$$

This can be broken down into its significant components.

$$\sum_{t=1}^T (\text{Investments}_t + \text{TVC}_t + \text{TVC}_t) (1 + R)^{-t} = \sum_{t=1}^T \text{Rev}_t (1 + R)^{-t} \quad (2)$$

$$= \sum_{t=1}^T (P \times Q_t) (1 + R)^{-t}$$

Further solving for a constant price which equates costs and revenues through time, we have

$$\sum_{t=1}^T (\text{Investments}_t + \text{TVC}_t + \text{TX}_t) (1 + R)^{-t} = P \quad (3)$$

$$\frac{\sum_{t=1}^T Q_t (1 + R)^{-t}}{\sum_{t=1}^T Q_t (1 + R)^{-t}}$$

where,

- Investments_t = annual amortization expenditure of capital investments
- TVC_t = total variable costs_t (operating royalties, profits and maintenance),
- TX_t = taxes in year_t,
- Q_t = annual sales of heat in MMBTU, and
- R = weighted average cost of capital.

CASH

CASH is the computer program that aggregates individual B THERM results into geographical (regional, state, national) totals for planning and projection purposes. Changes incorporated into CASH were:

1. Added software to make CASH less user-dependent and more machine-compatible.
2. Modified existing code to reflect changes in database structure, particularly new IDs.
3. Modified existing code to accept inputs for any of the 50 states, rather than the original RMB&R region.

National Potential

NMEI's participation in the National Market Estimates Task Force, organized by DGE/Washington, evidenced a need for a quick, efficient method to estimate the nation's Geothermal Energy potential and market penetration for the next twenty years. Two models were developed by NMEI to meet this need, one each for potential and penetration.

The model developed for the estimation of Geothermal potential is described in detail in the technical report NMEI 61-4. Basically, the model aggregates site-specific analyses of the most relevant economic determinants of Geothermal Energy market price and compares them to the price of each locality's conventional fuel price. With a sample of 496 observations on the levelized geothermal price and readily available independent price determinants from the B THERM model, a geothermal price model was developed for this analysis. The model had the following form:

$$PGEO_i = (Temp_i)^{-B_1} (Depth_i)^{B_2} (Dist_i)^{B_3} (Lt_i)^{B_4} (Pop_i)^{-B_5}$$

where i refers to the i th city-site pair and,

PGEO = levelized price (cost) per million BTU geothermal delivered,

Temp = temperature of the resource °C,

Depth = depth to the resource, in feet,

Dist = transmission distance from the resource to the central distribution system,

Lt = community annual lowest temperature (°F + 460), and

Pop = population. This is a proxy for the economies of scale which result from serving larger markets.

The estimated coefficients for PGEO along with Standard Errors (SE) are given below. R^2 is correlation coefficient.

	TEMP B_1	DEPTH B_2	DIST B_3	Lt B_4	POP B_5	R^2
\hat{B} (SE)	-1.0327 (.047)	.1048 (.014)	.3376 (.015)	.8683 (.033)	-.0830 (.009)	.96

Table 6. Preliminary Price Coefficients.

With the estimation of the B_1 the price competitiveness of geothermal energy is determined by loading the independent values of all i user-site pairs and comparing the resulting vector of PGEO with a vector of forecasted prices of the cheapest alternative fuel.

Thus far, only price competitiveness of all i users has been determined. The potential supply of geothermal energy, in aggregate, is defined as the summation of the heat requirements for all cities for which geothermal energy is price competitive.

The heat demand for a given user is expressed as a function of population and weather factors and are given below with standard errors in parentheses.

$RCS_{i,t}$	=	.5879	.9183	$\frac{R^2}{.999}$
(SE)		(.005)	(.007)	
$ANNHD_{i,t}$	=	.5693	.9467	.999
(SE)		(.006)	(.007)	

Where i refers to the i -th city-site, t to the t -th year and

RCS = residential/commercial demand for space and hot water heating per year (MMBTU),

ANNHD = RCS + per capita industrial process heat requirements per year (MMBTU),

Degd = heating degree-days, and

Pop = population.

The critical estimate in the projection of geothermal heat supply is the determination of heat on line for a given city. As shown above, the calculated PGEO is a levelized price which does not change through time. The price of the cheapest conventional fuel in a co-located city, however, increases at some real rate through time. The point in time at which the price of the conventional fuel becomes greater than the levelized PGEO is the point at which geothermal development is assumed. The heat supply to that city then increases through time as a function of population growth rates. The geothermal supply potential for a given city may be represented as follows:

$$RCS_{i,t} = (Degd_i)^{.5879} \times (Pop_{i,0} (1+PopG)^t)^{.9183} D$$

Where D is, in a sense, a dummy variable which is either 1 or 0 and is calculated as follows.

where,

- D = 1 when $Palt_t / PGEO > 1$,
 D = 0 when $Palt_t / PGEO < 1$,
 $Palt_0$ = Price of cheapest alternative fuel, i th city,
 $Palt_t$ = $Palt_0 (1+RG)^t$,
 RG = Real price growth rate of $Palt$, and
 PopG = annual population growth rate.

In aggregate the results take the form:

$$\sum_{i=1, t=1}^{N, T} RCS_{i,t} = \sum_{i=1, t=1}^{N, T} \{ (Degd_i)^{.5879} \times [Pop_{1,0} (1 + PopG)^t]^{.9183} \times D \}.$$

Penetration Estimation

The model developed for the estimation of Geothermal penetration is described in the technical report NMEI 61-5. This model depends on the logistic estimation methodology originally developed by the International Institute for Applied Systems Analysis in Austria and modified by the NMEI technical staff to fit the peculiarities of the Geothermal market and the data available.

To estimate the national role of geothermal energy, it was not realistic simply to aggregate all potentially matched resources and users. The total must be discounted to reflect the resistance to change of the market.

One way of doing this is to consider geothermal as a competitor in the market against more conventional energy sources, and to apply some of the results from analyses performed on the adoption of new alternatives among competing technologies. The particular derivation used is that of Peterka (1). It is based on the observation by earlier researchers that the fractional takeover of a market by a new technology from a previous one appears to follow a similar course in a wide variety of cases. Specifically, the graphs of market fractions as functions of time follow so-called 'logistic' curves, curves resembling a hyperbolic tangent function, or an 'S' shape.

The work by Peterka is a generalization of this finding to several competitors at once. It leads to an algorithm for computing the market fraction of each competitor at any time, given the fractions at a reference time. The algorithm is especially attractive since it requires as input only two parameters for any competitor: the specific investment necessary to increase the production by one unit, and the price to the buyer of one unit of that competing product.

The first parameter is the less critical of the two. Since variation by as much as a factor of two in the value chosen for it produces negligible variations in the results, an average value can be used for each of the competitors being considered, in this case 15 \$/MMBTU-YR.

The answers are far more sensitive to changes in the second of the two parameters, the consumer prices of the alternatives. To overcome

¹"Macrodynamics of Technological Change: Market Penetration by New Technologies"; V. Peterka; I.I.A.S.A., Laxenburg, Austria; 1977.

the great variability of the economic selling price of geothermal heat from one resource to the next, the resources were broken down into different brackets. A mean selling price was assigned to all resources in a given bracket; for instance, \$5.50 was assigned to resources between \$5 and \$6.

A computer run was made for each of the sub-markets, defined as the collection of energy consumers in geothermal resource co-located areas with an economic selling price in a certain range. Finally to obtain the total fraction of the geothermal market potential that could be expected to be penetrated, the year-by-year submarket fractions penetrated in each price range were added, weighted by the relative amount of heat-on-line in that range and year.

Groundwater Heat Pump

With interest in the Geothermal Energy community regarding groundwater heat pumps, NMEI constructed a model specially tailored to the economic analysis of groundwater heat pumps. The BTHERM model was versatile enough to model heat pumps, but the operation proved to be awkward.

The model was designed to simulate a central system, district heating unit operating on near-surface groundwater. The result is a market price (dollars/ btu) that includes capital and operating costs for comparison with alternate conventional fuels. A schematic appears in Figure 1. This model is operable and awaiting utilization on site-specific analyses. A detailed description appears in the report NMEI 61-22.

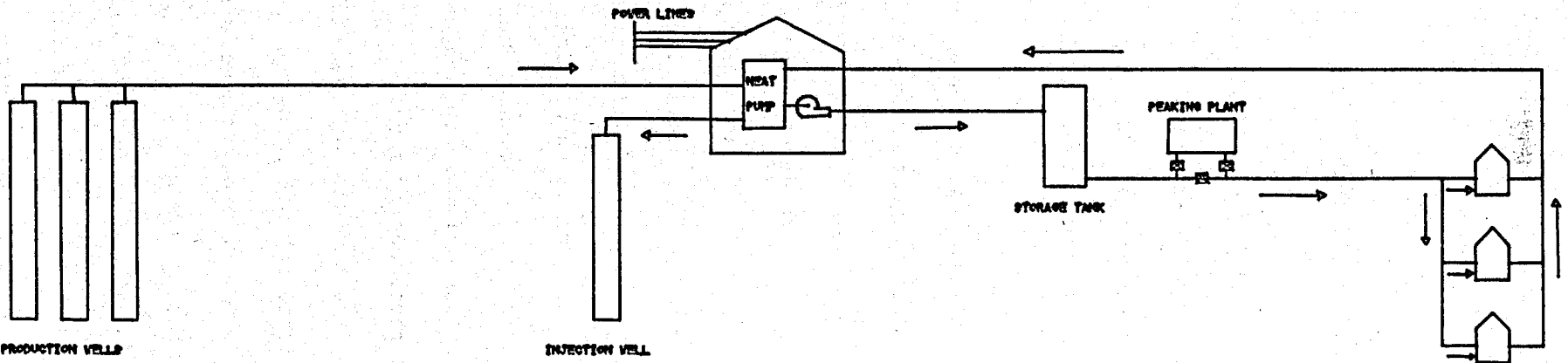


Figure 1. Heat Pump District Heating Model

APPLICATIONS

National Estimate

NMEI prepared its own estimate of the future (1980-2000) of Geothermal Energy in the United States. Much of the work and data was an outgrowth of NMEI's participation in the National Market Estimates Task Force organized by the Division of Geothermal Energy in Washington, D.C.

The purpose of the study was to present the first national estimate of direct geothermal energy use based upon an aggregation of site-specific analyses of all known geothermal resources. The Task Force estimate depended on regional estimates rather than site-specific.

Because of the lack of portability of geothermal energy, a precondition for utilization is that users be co-located with resources. The economic feasibility of geothermal energy depends on a wide range of economic and technological parameters that vary considerably from location to location. Each of these must be individually examined in order to evaluate the financial viability of geothermal energy as an alternate energy form.

The results of the study were published in a document, "National Estimate for Direct Use", which is available from NMEI. Figures 2 and 3 and Table 6 provide a summary of the results. The basic conclusions were:

1. Geothermal Energy can make a significant contribution to the nation's low temperature energy needs and can lessen dependence on foreign energy sources.

2. Federal tax incentives and regulatory easement will enhance the development of geothermal energy in the U.S.
3. District heating applications will constitute the major proportion of geothermal market penetration.
4. Most development will occur in the western U.S. due to the prevalence of resource in the West.

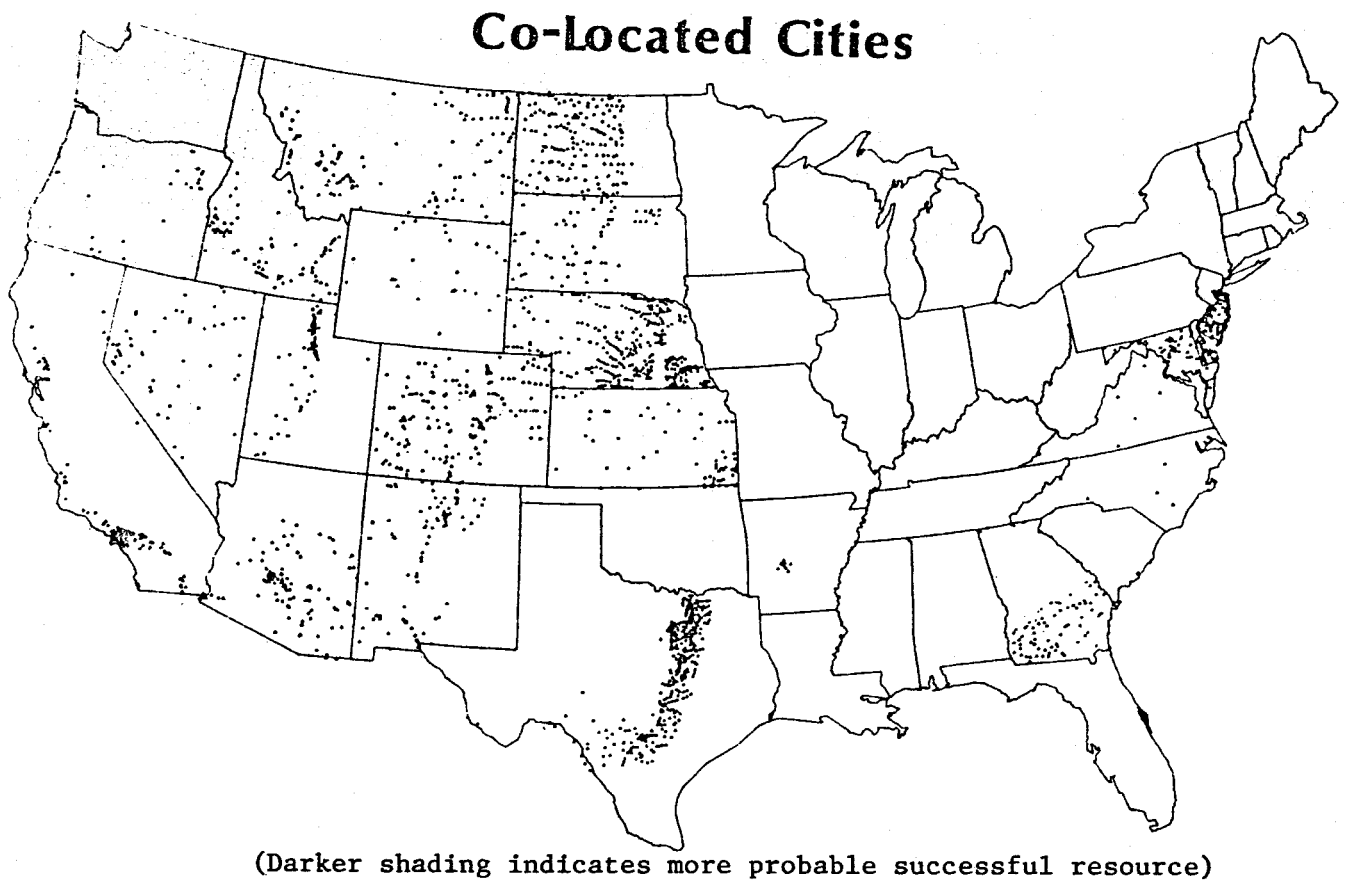


Figure 2. Colocated Cities

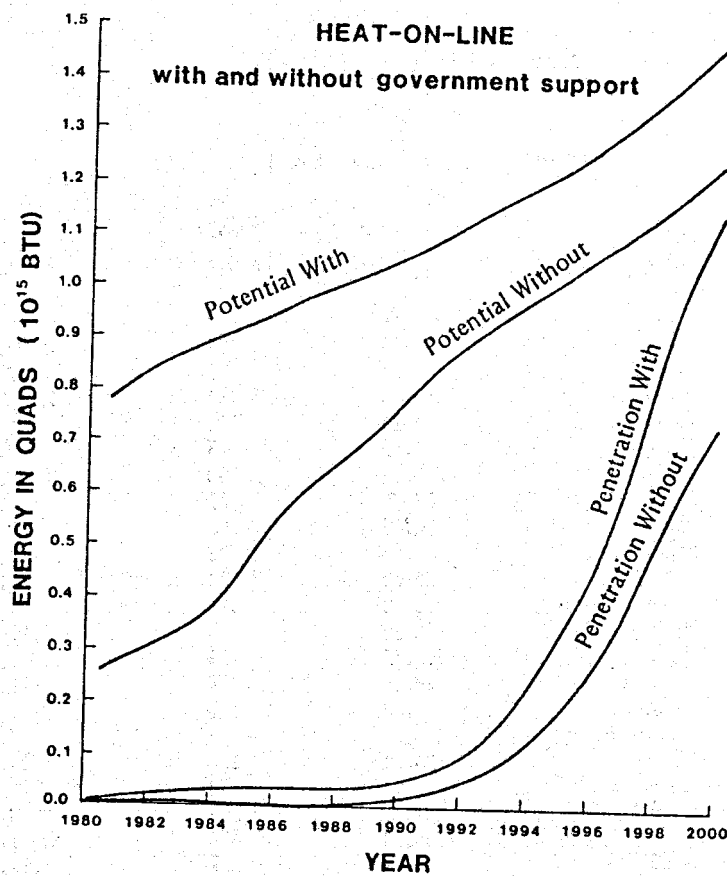


Figure 3. Heat-On-Line by Year

PENETRATION by STATE

DIRECT USE

YEAR 2000 WITH GOVERNMENT SUPPORT

STATE	POTENTIAL x 10 ¹² BTU	PENETRATION x 10 ¹² BTU	NUMBER OF CITIES	CO-LOCATED POPULATION
ALASKA	.63	.37	8	2,400
ARIZONA	74.97	48.18	103	1,844,872
ARKANSAS	3.07	2.18	9	42,301
CALIFORNIA	404.50	265.30	154	8,868,754
COLORADO	120.84	99.24	164	374,503
DELAWARE	1.87	1.80	45	69,010
GEORGIA	12.78	12.29	190	588,684
IDAHO	61.47	58.75	71	405,825
KANSAS	1.16	1.06	62	161,409
MARYLAND	57.78	55.56	42	153,423
MONTANA	29.69	25.79	120	225,974
NEBRASKA	4.44	3.90	301	486,726
NEVADA	39.29	36.90	53	191,562
NEW JERSEY	125.52	103.77	189	1,438,625
NEW MEXICO	38.93	28.28	97	645,655
NEW YORK	.02	.00	1	1,024
NORTH CAROLINA	.38	.08	6	7,869
NORTH DAKOTA	30.00	28.78	157	214,525
OREGON	.8.84	6.52	30	74,457
SOUTH DAKOTA	13.08	12.13	68	99,768
TEXAS	255.57	245.74	357	4,441,064
UTAH	91.15	64.33	77	777,463
VIRGINIA	.74	.06	8	34,650
WEST VIRGINIA	.19	.01	3	2,244
WYOMING	25.07	21.74	29	166,861
TOTAL	1,454.63	1,170.83	2,344	21,819,657

Table 7. Penetration by State

WORKSHOP

At the request of Mr. John Griffith, DOE/Idaho Falls, NMEI sponsored a workshop on the BTHERM model and its applications May 19th and 20th, 1980. The purpose of the workshop was to provide an in-depth background for the State Commercialization Planning Teams and other interested contractors of the Geothermal Energy Program.

A special notebook on the BTHERM model was compiled for easy reference by a casual user of the model. The workshop provided lecture sessions followed by "Hands-on" experience with a CRT terminal manipulating the model to solve actual problems.

Site-Specific Studies

The following is a partial listing of site-specific studies performed in support of state teams or DOE/Washington that culminated in a report, letter or phone conversation with the results.

Alaska

Kotzebue

Arizona

Engineering and Economic factors of Low-Temperature Chillers
City of Safford

California

Rohr Industries Project

Colorado

Poncha Hot Springs

Buena Vista

Idaho

Lewiston Schools

Preston

Salmon

Challis

Ketchem/Sun Valley

Industrial Data Summary

Montana

Baker

White Sulphur Springs

MTONN (Generic)

Home Ground Water Heat Pump Analysis

Ennis Schools Heat Pump

Remote Terminal Support

Nevada

Gabbs

Commercial Greenhouse

New Mexico

Candelight Homes

White Sands Missile Range

NMSU Campus Project

Las Cruces Industrial Park

New Mexico Handbook

Hanes

Sandyland Nursery

North Dakota

Paterson Hotel

Heat Pump and Conventional Fuel Economics Comparison

South Dakota

Heat Pump Economics in South Dakota

State Capitol Complex

Lemmon

Philip

Edgemont

Utah

Berg/Escalante Desert

Becks Hot Springs

Salt Lake City Business District

Wyoming

Compilation of Specialized Industry

Colocated Industry List

City of Cody

Midwest

Edgerton

Thermopolis

CASH Results

The following pages contain the results of a comprehensive aggregation of individual cities' geothermal energy space heating and industrial applications for each state in the western U.S. A summary of the market potential heat-on-line for the west is presented in Table 8. The results are for the more optimistic case - high case for city developers. City development was chosen over private development for the summary (both would not occur in the same location) because of the more optimistic results. The PCT column indicates the percentage of the state's energy demand Geothermal Energy could provide economically in the year 2000. Some states have no PCT figure due to lack of reliable energy demand data for a calculation. The CASH result of 1.283 quads by the year 2000 compares closely with the NMEI National Plan estimation and represents a significant portion of the West's energy consumption.

CASH is a computer process for aggregating geothermal potential from many sites. The process begins with co-locating cities to the nearest resource. Each city/site pair is evaluated using the BTHERM computer model for economic viability. The results of this analysis predict the year in which geothermal energy is economic for a site and the amount of heating potential which could be supplied by year, after construction. Each city/site pair is then summed according to which year it comes on line to arrive at a total aggregation on a regional and then state level.

The CASH process is updated each year as new resource data becomes available. Financial parameters such as tax credits and bond rates are also updated to reflect present conditions.

It should be noted that this aggregation is an estimate of total possible or potential geothermal heat for the state, as opposed to the expected market penetration or actual heat-on-line which will be realized. Preliminary estimates of market potential for all fifty states were prepared and published in the NMEI publication "National Estimates for Direct Use", December, 1980.

Discussion of Input Assumptions

The policy case is constructed by varying important economic parameters which are uncertain for future years. By using pessimistic values a low case was constructed. The following specifications were used for low-case.

<u>State</u>	<u>City/Site Pairs</u>		<u>Yr 2000 Potential</u>	<u>Pct</u>
	<u>Potential</u>	<u>Inferred</u>		
Alaska	11	1	7.33x10 ¹¹	-
Arizona	77	21	10.83x10 ¹³	13
California	30	1	2.38x10 ^{14*}	-
Colorado	61	31	8.28x10 ¹³	27
Idaho	21	60	10.08x10 ¹³	55
Montana	39	91	3.33x10 ¹³	34
Nevada	48	1	3.75x10 ¹³	67
New Mexico	48	34	6.29x10 ¹³	68
North Dakota	146	1	2.95x10 ¹³	48
Oregon	30	1	9.64x10 ¹³	-
South Dakota	51	11	8.45x10 ¹²	17
Utah	55	80	2.74x10 ¹⁴	47
Washington	25	30	1.63x10 ¹⁴	-
Wyoming	<u>9</u>	<u>19</u>	<u>4.74x10¹³</u>	65
Total	651	382	128.3083x10 ¹³	

(*Does not include industrial results)

Table 8. Heat-on-Line Summary.

LOW CASE

Bond Rate - a value equivalent to 2% above the annual inflation rate was selected for this cost of borrowed money.

Geothermal Tax Credit - none assumed (less than present).

Production Well Success Ratio - 50% or $\frac{1}{2}$ those drilled are successful.

Conventional Fuel Price Increase - annual increase of 4% above inflation (much less than present rate).

Investors Rate of Return - 25% above inflation rate.

Surface Exploration - \$500,000 assumed for each city-site pair.

Depletion Allowance - 15% per year.

City Share of Money - 100%, No grants.

Government Share of Research Money - 0 (none).

The high case used more optimistic values of unknown quantities in the drilling part of geothermal energy. Hopefully we could expect the actual values to fall somewhere in between the low and high cases.

The following specifications were used for the high case.

HIGH CASE

Bond Rate - same 2% above annual inflation rate.

Geothermal Tax Credit - 15% assumed for capital investments.

Production Well Success Ratio - 80% of those drilled are successful.

Conventional Fuel Price Increase - annual increase of 4% above inflation.

Investors Rate of Return - 10% above inflation rate.

Surface Exploration - No cost.

Depletion Allowance - 15% per year.

City Share of Money - 75% of total project costs.

Government Share of Research Investment - 10% of total needed.

State of Alaska

Summary of Results for State Aggregation

The state geothermal aggregation for Alaska uses 17 Potential and 1 Inferred City/Site pairs as a basis. This is the total number of resource-user matches which are considered for economic evaluation.

A. Low Case - Modified Capital (300%)

While the total city/site pairs are shown above, only a few show up to be economic by the year 2000 in the low case. It should be noted that on the average, construction costs are set at 300% of normal "stateside" cost but conventional fuel costs are only doubled. If the district heating is developed by private business, no sites are economic within the year 2000 time frame.

With the city as the developer, significant growth in heat-on-line in the year 1983. This low level of growth continues through the year 2000. The economic direct use market potential for the year 2000 is 6.6×10^{10} Btu/yr. For the city developer 2 potential and 1 inferred site become economic by the year 2000. A graph of the city developed geothermal energy market potential by year for the residential/commercial sector is presented in Figure 1.

The industrial energy supply market potential with a city as developer begin to grow in 1986. It increases to 2.32×10^{10} by the year 2000.

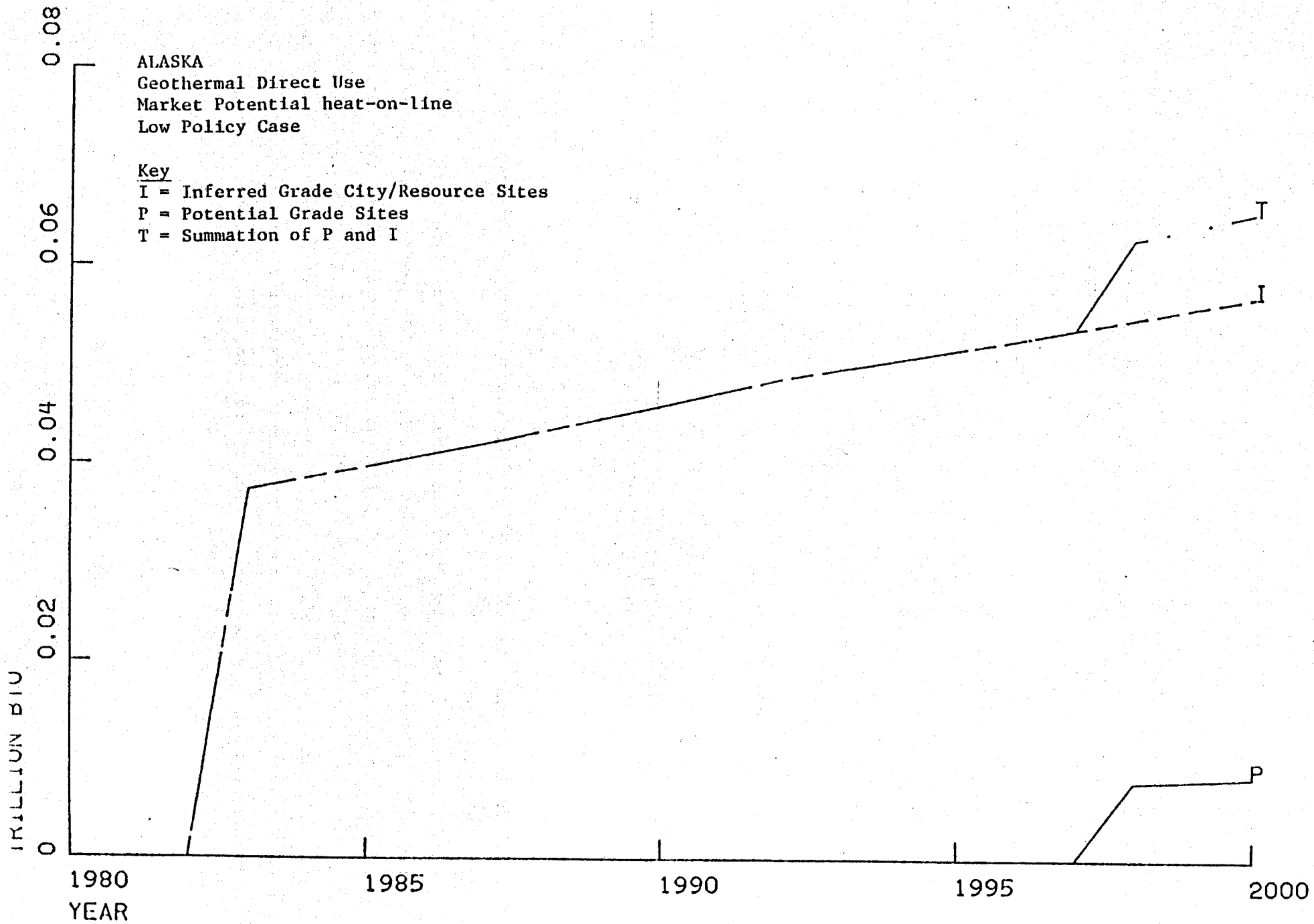


Figure 1

B. High Case - Modified Capital (300%)

The high case, a more optimistic case for geothermal development, shows much more development potential than low case. These results are presented below in tabular form along with the results for low case for comparison. A graph of city developed geothermal energy market potential in the high case, for residential/commercial sectors is presented in Figure 2.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential City/Site	0	11
	Inferred City/Site	0	1
City Developer	Potential City/Site	2	11
	Inferred City/Site	1	1
Year major growth in market potential begins			
	Private Developer	-	1995
	City Developer	1983	1994
Economic heat market potential in 2000			
	Private Developer	0	6.94×10^{11}
	City Developer	0	7.09×10^{11}
Industrial heat potential in 2000			
	City Developer	2.32×10^{10}	2.39×10^{10}

Summary

On previous aggregations which were done for Alaska using the same city/site pairs but "conventional" system costs. Many of the possible pairs came on line.

The data presented in the table above shows minor development for the state of Alaska using the 300% cost. It is possible that the true potential for economic geothermal development lies somewhere between these two extremes.

The very large load factor present for Alaskan cities makes the use of district heating system efficient. If the present trend for very high capital and demonstration costs is abated or changes drastically, geothermal district heating would become a prime contender for economic energy supplies.

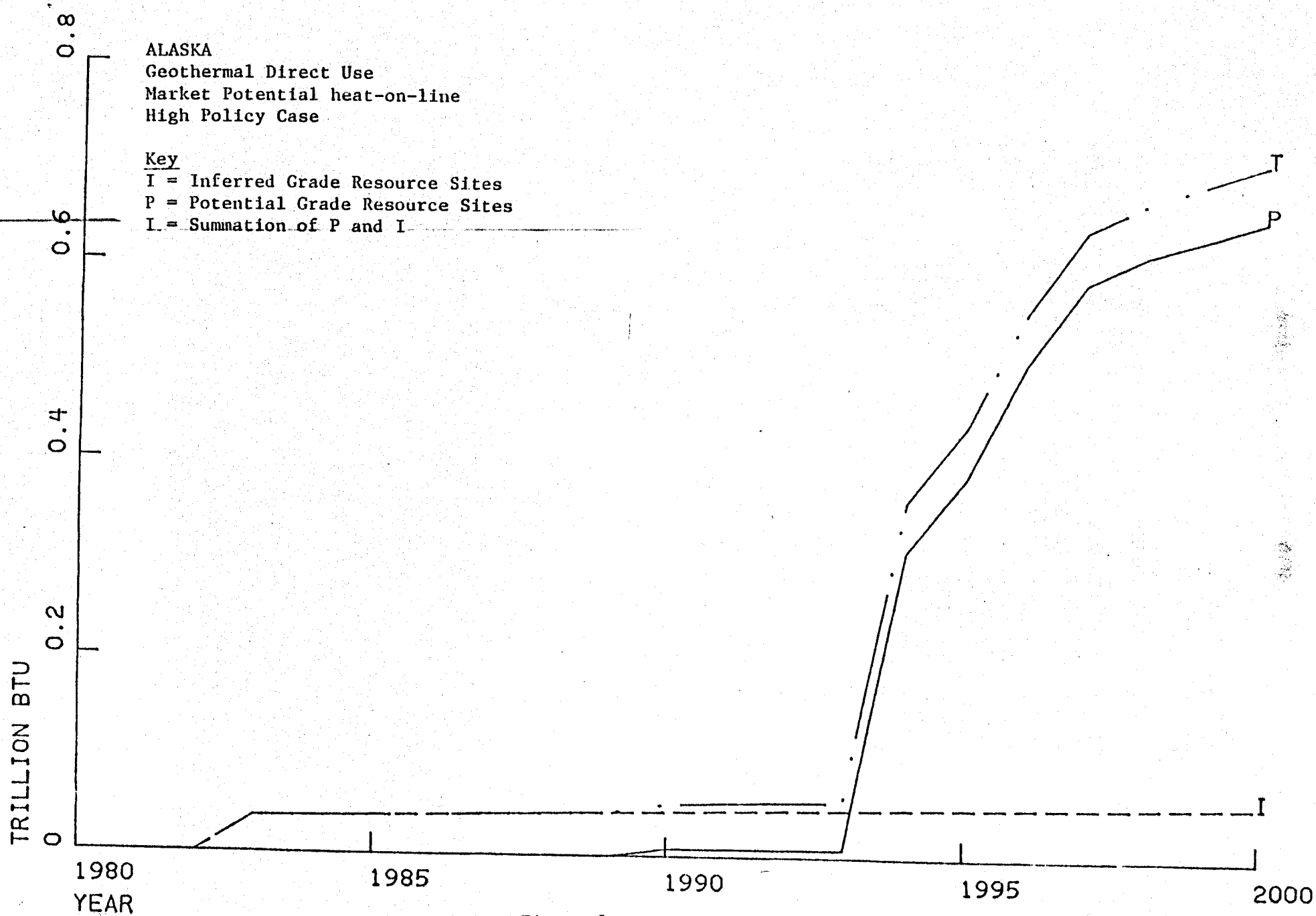


Figure 2

STATE: ALASKA
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
325126 PORT HEIDEN	\$ 6.43	1983
325155 TENAKEE SPRINGS	9.90	1990
325092 MANLEY HOT SPRINGS	10.24	1992
325033 COPPER CENTER	12.33	1994
325084 KOTZEBUE	13.39	1995
325065 HOUSTON	13.87	1996
325055 GLENNALLEN	14.36	1996
325169 WASILLA	14.37	1996
325136 SELAWIK	24.82	1997
325004 AKUTAN	14.84	1999
325047 ELIM	25.57	2000

STATE: ALASKA
INFERRED SITES
FOR PRIVATE DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
325075 KIANA	\$ 10.84	1983

STATE: ALASKA
INFERRED SITES
FOR CITY DEVELOPER

CITY ID AND NAME
325075 KIANA

PRICE
OF GEO
\$ 10.51

YEAR
ON-LINE
1983

State of Arizona

Summary of Results for State Aggregation

<u>87</u>	Potential City/Site Pairs
<u>30</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 2 potential and 1 inferred pair are economic within the year 2000 time frame. Existing on line capacity for the state is 3.00×10^9 Btu/Yr.

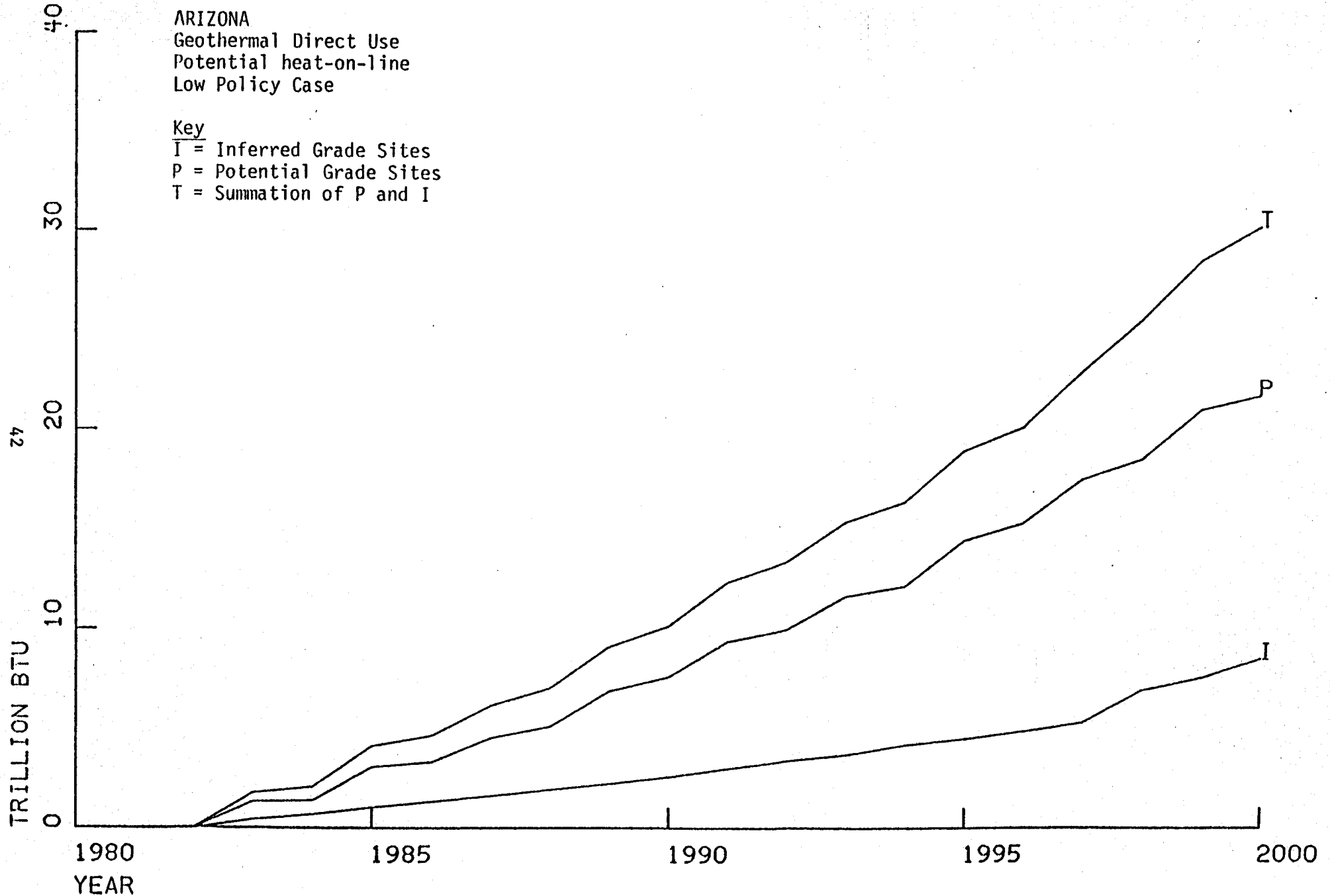
Significant growth in quantity of geothermal heat which is economic begins in 1994. This increases through the year 2000. The economic heat potential for the year 2000 is 1.12×10^{12} Btu/Yr.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 3.02×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 14.4×10^{13} Btu/Yr of which geothermal could supply 21%. For the city developer 45 potential and 8 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1995. It increases to 2.39×10^{13} Btu/Yr by the year 2000.

ARIZONA
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



High Case

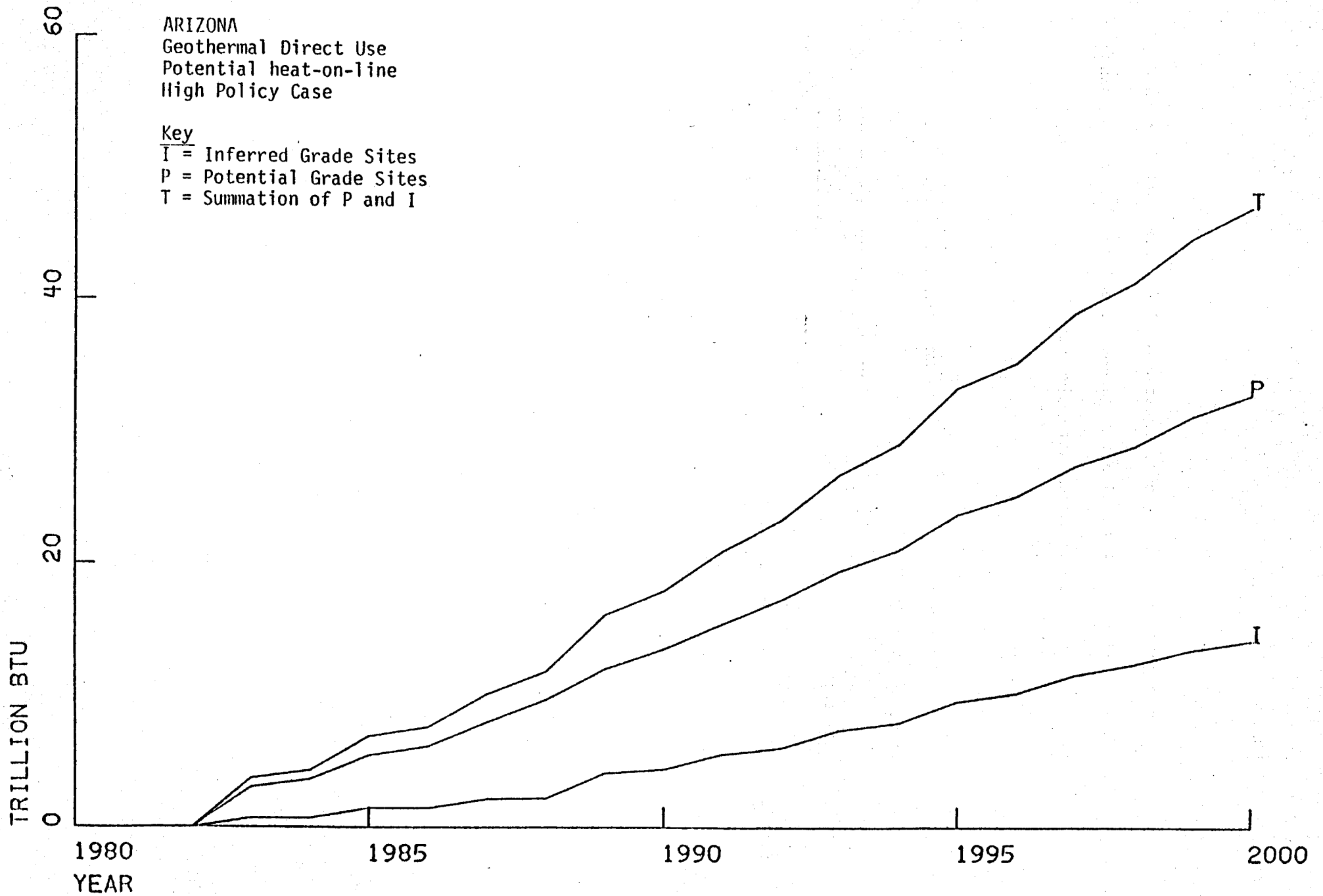
The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	2	66
	Inferred	1	17
City Developer	Potential	48	77
	Inferred	8	21
Year major growth in potential begins			
	Private Developer	1994	1984
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	1.12×10^{12}	3.81×10^{13}
	City Developer	3.02×10^{13}	4.70×10^{13}
Industrial heat potential in 2000			
	Private Developer	2.39×10^{13}	6.13×10^{13}
Percentage of state space heat demand*		21%	33%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

ARIZONA
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: ARIZONA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
205046 DOUGLAS	\$ 2.99	1983	14,580,585
205069 GOODYEAR	3.26	1983	2,803,014
205030 CHANDLER HEIGHTS	3.59	1983	615,263
205041 COOLIDGE	3.89	1983	3,399,849
205015 BOWIE	4.95	1983	0
205182 WILLCOX	5.09	1983	4,824
205092 LITCHFIELD PARK	4.12	1984	1,422,624
205067 GLENDALE	4.23	1984	1,857,725
205102 MESA	3.95	1985	4,170,067
205124 PHOENIX	4.37	1985	858,480
205130 PLANTSITE	4.24	1986	0
205126 PIMA	5.16	1986	0
205029 CHANDLER	4.93	1987	615,285
205139 SAFFORD	5.46	1987	18,450
205170 THATCHER	5.49	1987	0
205121 PAYSON	7.50	1987	1,843
205023 CASA GRANDE	4.81	1988	1,932,768
205011 BENSON	7.32	1988	1,050,074
205105 MORENCI	5.26	1989	0
205163 STARGO	5.32	1989	0
205094 LUKE AFB	5.44	1989	444,570
205066 GILBERT	5.66	1989	108,253
205038 CLIFTON	5.48	1990	0
205123 PEORIA	5.79	1990	19,028
205134 QUEEN CREEK	5.87	1990	46,680
205004 ALPINE	9.18	1990	0
205171 TOLLESON	6.27	1991	24,674
205051 EL MIRAGE	6.28	1991	0
205049 EAGAR	5.82	1992	16,983
205054 FLAGSTAFF	6.06	1992	283,622
205166 SURPRISE	6.54	1992	2,223
205016 BUCKEYE	6.54	1992	289
205008 AVONDALE	6.65	1992	9,336
205184 WILLIAMS AFB	6.75	1992	55,571
205160 SPRINGVILLE	6.18	1993	0
205097 MARICOPA	6.49	1993	0
205152 SELLS	6.51	1993	0
205065 GILA BEND	6.84	1993	1,334
205164 SUN CITY	6.98	1993	5,779
205190 YOUNGTOWN	6.99	1993	2,890

STATE: ARIZONA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
205018 BYLAS	\$ 7.43	1993	0
205024 CASHION	7.21	1994	14,449
205192 YUMA	7.22	1994	292,483
205005 APACHE JUNCTION	7.28	1994	533
205053 ELOY	7.20	1995	30,231
205183 WILLIAMS	7.24	1996	10,892
205150 SEDONA	7.47	1996	5,357
205177 WELTON	8.40	1996	0
205127 PINE	12.47	1996	0
205179 WEST YUMA	8.57	1997	0
205020 CAMP VERDE	8.33	1998	765
205143 SAN CARLOS	8.60	1998	0
205162 STANFIELD	8.80	1998	0
205013 BISBEE	9.08	1998	1,934
205057 FOUNTAIN HILLS	9.11	1998	0
205188 WITTMANN	9.13	1998	0
205181 WICKENBURG	9.32	1998	12,893
205068 GLOBE	9.48	1998	21,362
205193 YUMA PROVING GROUND	9.53	1998	222,285
205125 PICACHO	9.03	1999	0
205158 SOMERTON	9.66	1999	29,831
205194 YUMA STATION	9.78	1999	22,228
205055 FLORENCE	9.79	1999	0
205091 LAVEEN	9.87	1999	45,346
205100 MAYER	14.87	1999	0
205048 DUNCAN	9.69	2000	0

STATE: ARIZONA
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
205144 SAN MANUEL	\$ 3.13	1983	2,381,784
205140 SAHUARITA	3.82	1984	420,874
205095 MAMMOTH	5.77	1990	0
205009 BAGDAD	9.20	1990	0
205112 ORACLE	6.41	1993	0
205175 TUCSON	6.53	1993	363,014
205071 GREEN VALLEY	6.79	1994	2,779
205142 SALOME	8.49	1996	0
205076 HOLBROOK	7.71	1997	3,690
205161 ST JOHNS	7.73	1997	1,356
205132 PRESCOTT	7.77	1997	322,591
205159 SOUTH TUCSON	8.61	1998	0
205156 SNOWFLAKE	8.98	1999	15,115
205187 WINSLOW	9.29	2000	13,915
205096 MARANA	9.83	2000	100,828
205155 SILVER BELL	9.90	2000	0
205114 ORO VALLEY	10.08	2000	0

State of California

Summary of Results for State Aggregation

The state geothermal aggregation for California uses 126 Potential and 1 Inferred City/Site pairs as a basis. This is the total number of resource-user matches which are considered for economic evaluation.

Low Case

The number of possible users which could be developed are listed above. Upon analysis using BTHERM, some will never prove to be economic within the aggregation time frame.

If the district heating system development is done by private business, 8 potential and 0 inferred city/site pairs are economic within the year 2000 time frame. The low number of economic pairs is due to few degree days heating demand coupled with a very low conventional fuel price.

Significant growth in quantity of geothermal heat which is economic begins in 2004. This increases steadily through the year 2020. The economic direct use market potential for the year 2000 is 2.33×10^{12} Btu/yr. under the private development scenario.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1986 and rise steadily through the year 2020. The economic heat market potential for the year 2000 is 1.91×10^{14} Btu/yr. For the city developer 15 potential and 0 inferred sites become economic by the year 2000. A graph of the city developed, geothermal energy market potential by year for the residential/commercial sectors is presented in Figure 1.

The industrial energy supply market potential with a private developer does not begin until after 2004. It increases to 1.01×10^{13} Btu/yr by the year 2000.

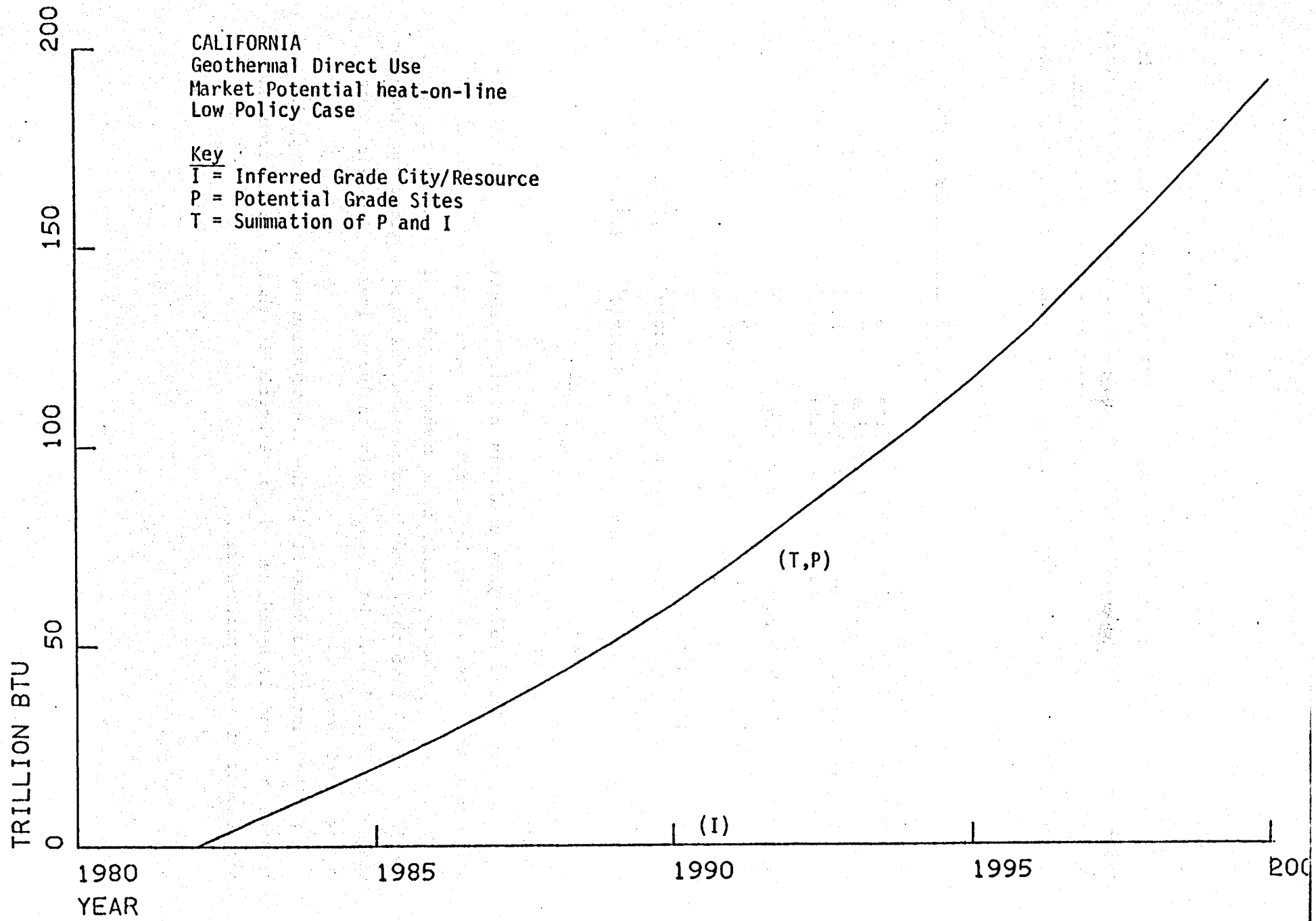


Figure 1

High Case

The high case, a more optimistic case for geothermal development, is quite similar. These results are presented below in tabular form along with the results for low case for comparison. A graph of city developed geothermal energy market potential in the high case, for residential/commercial sectors is presented in Figure 2.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential City/Site	8	23
	Inferred City/Site	0	1
City Developer	Potential City/Site	15	30
	Inferred City/Site	0	1
Year major growth in market potential begins			
	Private Developer	2004	1987
	City Developer	1986	1985
Economic heat market potential in 2000			
	Private Developer	2.33×10^{12}	2.17×10^{14}
	City Developer	1.91×10^{14}	2.38×10^{14}

Summary

The resource information used was heavily weighted toward southern California with its low heating demand. A more detailed study of the resources would probably result in a greater number of economic sites. It should be noted that the economic comparison was made against the cheapest conventional fuel in the area. This includes inexpensive Northwest hydroelectricity.

Another important benefit is the conservation of present supplies of natural gas and lessened demand for electricity that results from the development of geothermal energy.

CALIFORNIA
Geothermal Direct Use
Market Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Resource Sites
P = Potential Grade Resource Sites
T = Summation of P and I

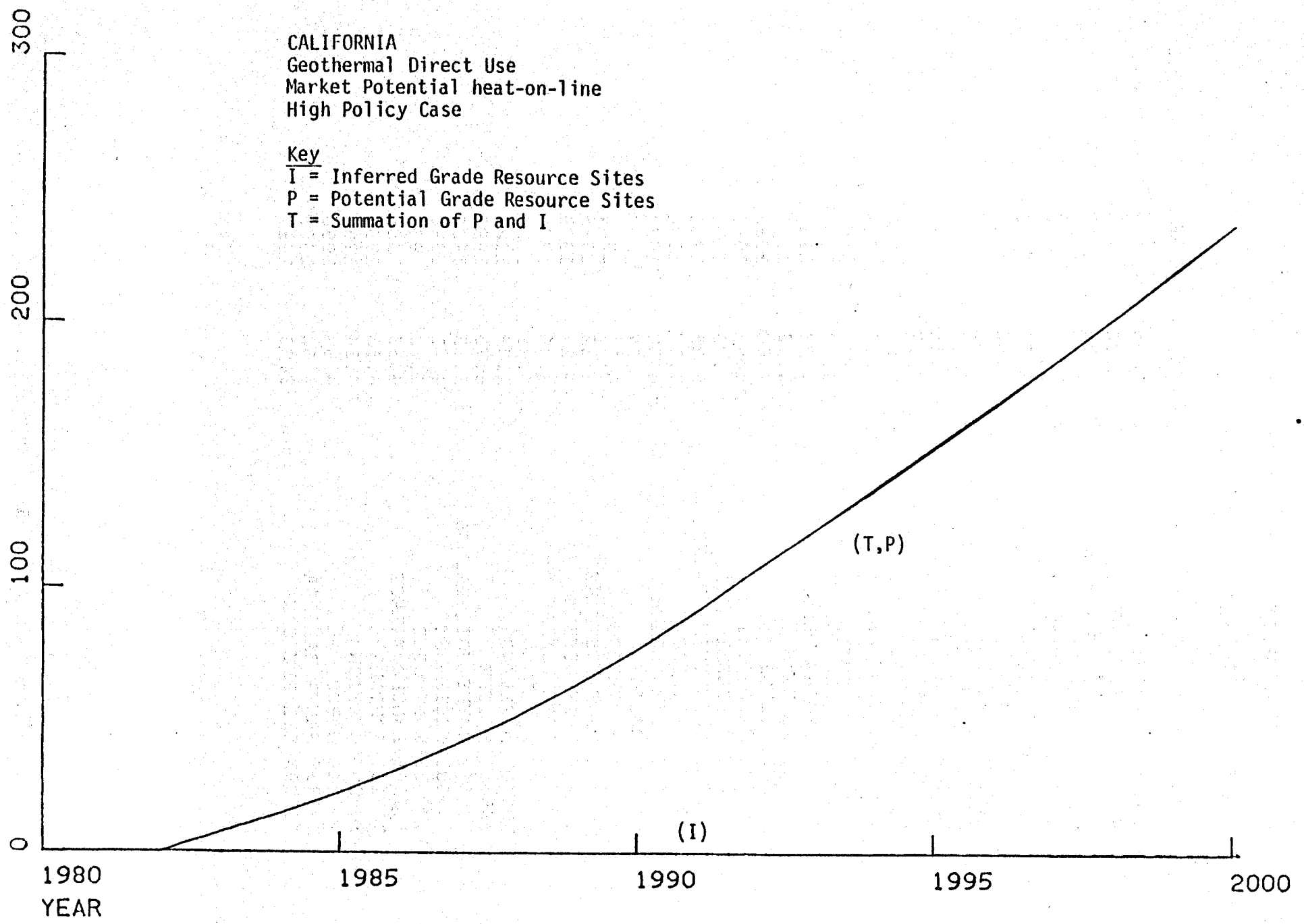


Figure 2

STATE: CALIFORNIA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
305039 BRAWLEY	\$ 2.07	1983
305368 SUSANVILLE	2.30	1983
305503 MAMMOUTH LAKES	2.55	1983
305456 ELSINORE	2.70	1983
305130 FULLERTON	2.77	1983
305204 LOS ANGELES	2.78	1983
305207 LOYALTON	2.82	1983
305285 PORTOLA	2.99	1983
305007 ANAHEIM	3.07	1983
305013 ARROYO GRANDE	3.14	1983
305677 WILMINGTON	3.37	1983
305126 FOUNTAIN VALLEY	3.57	1983
305474 GREENVILLE	3.65	1983
305135 GLENDALE	3.71	1983
305132 GARDEN GROVE	3.73	1983
305163 INDIAN WELLS	3.83	1983
305005 ALTURAS	3.93	1983
305035 BISHOP	4.00	1983
305333 SAND CITY	4.51	1983
305446 CRESCENT MILLS	5.03	1983
305569 TWENTYNINE PALMS	5.25	1983
305049 CALISTOGA	3.17	1984
305274 PISMO BEACH	4.02	1984
305072 COLTON	4.07	1984
305301 RIVERSIDE	4.11	1984
305183 LAKE ELSINORE	4.22	1985
305259 PALM DESERT	4.27	1985
305197 LOMA LINDA	4.36	1985
305609 HOLLYWOOD	4.38	1985
305607 HIGHLAND	4.39	1985
305037 BLYTHE	6.75	1985
305687 BOYES HOT SPRINGS	3.73	1986
305401 WESTMINSTER	4.41	1986
305689 MONTECITO	4.43	1986
305287 RANCHO MIRAGE	4.53	1986
305121 FONTANA	4.53	1986
305364 STANTON	4.54	1986
305244 NORCO	4.59	1986
305336 SANTA BARBARA	4.60	1986
305093 DEL REY OAKS	3.83	1987

STATE: CALIFORNIA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
305348 SEASIDE	\$ 3.86	1987
305243 NEWPORT BEACH	4.77	1987
305290 REDLANDS	4.79	1987
305305 ROLLING HILLS	4.84	1987
305606 HARBOR CITY	4.85	1987
305095 DESERT HOT SPRINGS	4.87	1987
305532 PLASTER CITY	7.72	1987
305578 YUCCA VALLEY	7.81	1987
305412 YORBA LINDA	5.02	1988
305198 LOMITA	5.08	1988
305347 SEAL BEACH	5.15	1988
305046 CALEXICO	5.21	1988
305444 CLEARLAKE OAKS	4.25	1989
305230 MONTEREY	4.30	1989
305054 CARMEL BY THE SEA	4.45	1989
305213 MARINA	4.45	1989
305257 PACIFIC GROVE	4.46	1989
305356 SONOMA	4.46	1989
305312 SAN BERNARDINO	5.28	1989
305507 MENTONE	5.31	1989
305296 RIDGECREST	5.34	1989
305304 ROLLING HILLS ESTATE	5.42	1989
305422 ATASCADERO	5.47	1989
305159 HUNTINGTON PARK	5.48	1989
305201 LOS ALAMITOS	5.53	1989
305055 CARPINTERIA	5.54	1989
305471 GOLETA	5.54	1989
305239 NEEDLES	8.34	1989
305327 SAN LUIS OBISPO	4.57	1990
305574 WINDSOR	4.71	1990
305082 COSTA MESA	5.58	1990
305543 ROMOLAND	5.63	1990
305276 PLACENTIA	5.65	1990
305402 WESTMORLAND	5.70	1990
305150 HEMET	5.75	1990
305048 CALIPATRIA	5.80	1990
305023 BANNING	5.80	1990
305491 LEE VINING	4.78	1991
305593 CARMEL	4.80	1991
305443 CLEARLAKE HIGHLANDS	4.86	1991

STATE: CALIFORNIA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
305270 PETALUMA	\$ 4.97	1991
305260 PALM SPRINGS	5.89	1991
305294 RIALTO	5.91	1991
305688 DIAMOND BAR	5.92	1991
305158 HUNTINGTON BEACH	5.97	1991
305156 HOLTVILLE	6.05	1991
305269 PERRIS	6.18	1991
305267 PASO ROBLES	5.05	1992
305470 GLEN ELLEN	5.15	1992
305669 UNIVERSAL CITY	6.29	1992
305165 INDUSTRY	6.30	1992
305599 CRESTMORE	6.40	1992
305676 WESTLAKE VILLAGE	6.44	1992
305282 POMONA	6.45	1992
305425 BLOOMINGTON	6.45	1992
305083 COTATI	5.35	1993
305303 ROHNERT PARK	5.43	1993
305033 BEVERLY HILLS	6.61	1993
305554 SOLVANG	6.78	1993
305374 THOUSAND OAKS	6.81	1993
305559 SUNNYMEAD	6.82	1993
305315 SAN CLEMENTE	6.86	1993
305340 SANTA MARIA	6.94	1993
305436 CAPISTRANO BEACH	6.96	1993
305661 STUDIO CITY	6.97	1993
305237 NAPA	5.80	1994
305545 RUBIDOUX	7.06	1994
305142 GUADALUPE	7.06	1994
305479 HESPERIA	7.17	1994
305390 VICTORVILLE	7.18	1994
305598 CORONA DEL MAR	7.30	1994
305646 PUENTE	7.30	1994
305139 GREENFIELD	6.10	1995
305069 COALINGA	6.21	1995
305603 ENCINO	7.52	1995
305583 APPLE VALLEY	7.59	1995
305648 RANCHO CUCAMONGA	7.84	1995
305517 MURRIETA	8.07	1996
305653 ROWLAND HEIGHTS	8.58	1997
305394 WALNUT	8.70	1997

STATE: CALIFORNIA
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
305040 BREA	\$ 8.78	1997
305179 LA PUENTE	9.03	1998
305104 EL CENTRO	9.13	1998
305175 LA HABRA	9.22	1998
305161 IMPERIAL	9.25	1998
305430 CABAZON	10.02	2000

STATE: CALIFORNIA
INFERRED SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
305173 KING CITY	\$ 5.57	1993

State of Colorado

Summary of Results for State Aggregation

<u>69</u>	Potential City/Site Pairs
<u>40</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 15 potential and 3 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 6.31×10^{11} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1994. This increases through the year 2000. The economic heat potential for the year 2000 is 10.7×10^{13} Btu/Yr.

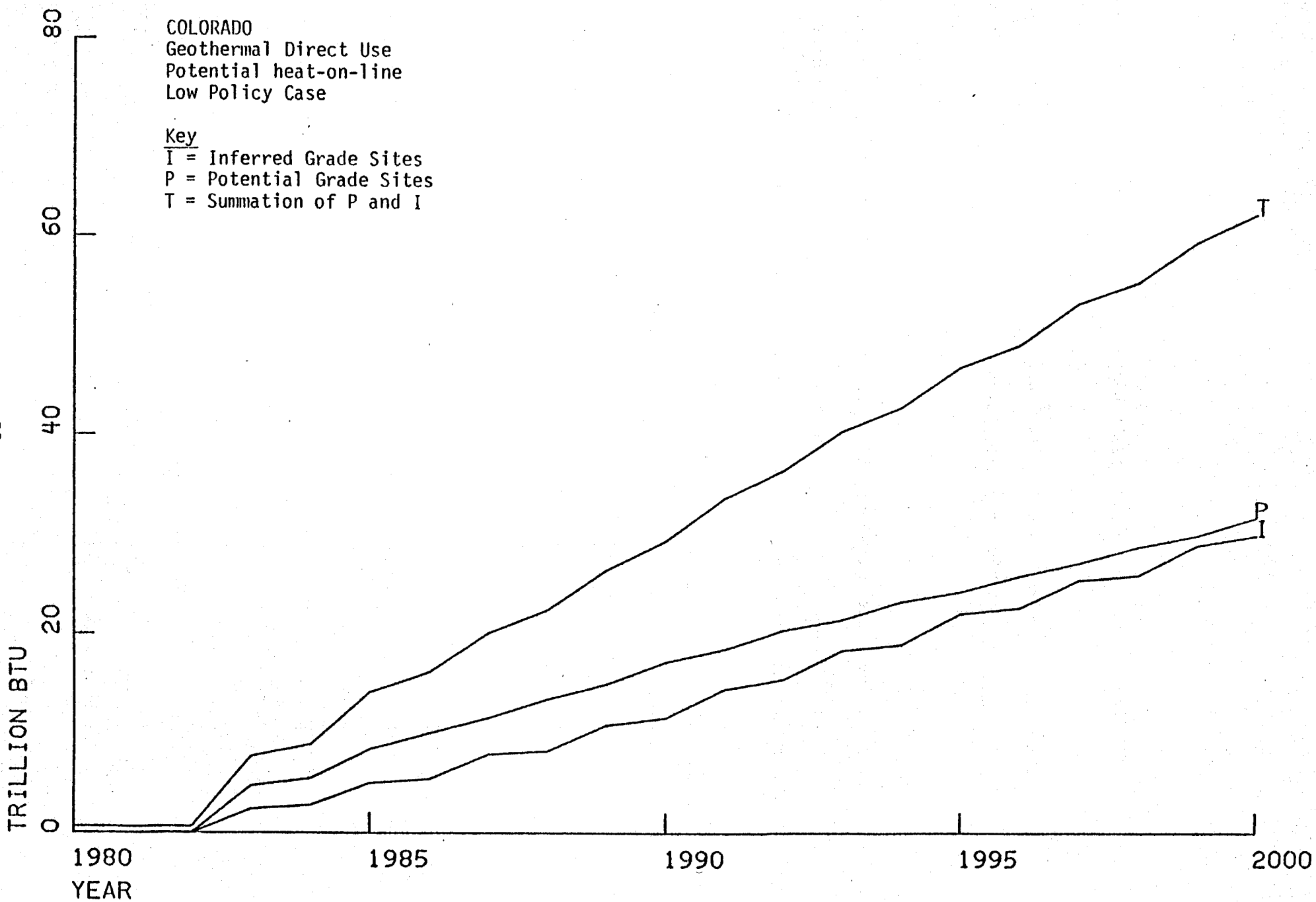
With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 6.22×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 24.7×10^{13} Btu/Yr of which geothermal could supply 25%. For the city developer 48 potential and 29 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1990. It increases to 8.33×10^{12} Btu/Yr by the year 2000.

COLORADO
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key

I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I

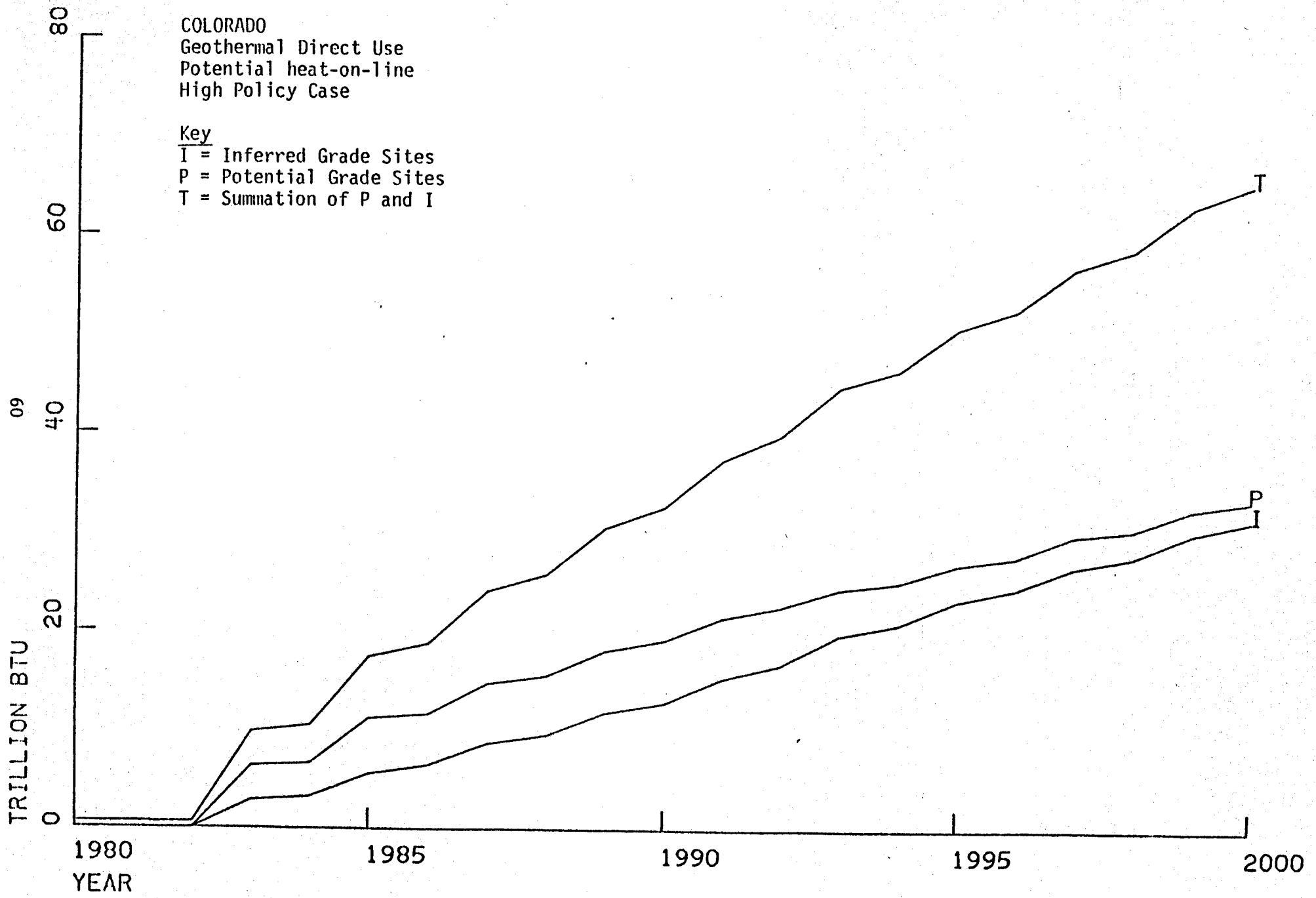


High Case

The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	15	57
	Inferred	3	30
City Developer	Potential	48	61
	Inferred	29	31
Year major growth in potential begins			
Private Developer	1994		1989
	City Developer	1983	1983
Economic heat potential in 2000			
Private Developer		1.07×10^{13}	5.48×10^{13}
	City Developer	6.22×10^{13}	6.54×10^{13}
Industrial heat potential in 2000			
Private Developer		8.33×10^{12}	1.74×10^{13}
Percentage of state space heat demand*		25%	27%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.



STATE: COLORADO
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MYBTU)
215160 INDUSTRIAL PARK	\$ 2.68	1983	1,778,502
215229 PAGOSA SPRINGS	2.77	1983	0
215288 STEAMBOAT SPRINGS	2.80	1983	24,554
215065 CRAIG	3.19	1983	3,950
215127 GOLDEN	3.21	1983	2,911,524
215039 BUENA VISTA	3.24	1983	2,769
215157 IDAHO SPRINGS	3.47	1983	1,100
215151 HOT SULPHUR SPRINGS	3.58	1983	0
215126 GLENWOOD SPRINGS	3.64	1983	43,559
215227 OURAY	3.64	1983	0
215253 RICO	3.64	1983	0
215244 PONCHA SPRINGS	3.85	1983	0
215264 SALIDA	4.05	1983	31,851
215254 RIDGWAY	4.41	1983	0
215005 ALAMOSA	4.42	1983	37,297
215139 GUNNISON	4.47	1983	22,606
215067 CREEDE	4.54	1983	165,826
215129 GRANBY	4.68	1983	2,117
215297 TELLURIDE	4.69	1983	768
215045 CARBONDALE	4.71	1983	0
215282 SILVERTON	5.91	1983	2,112
215318 WHEAT RIDGE	4.29	1984	940,942
215048 CENTER	4.68	1984	66
215180 LEADVILLE	4.69	1984	768
215169 KREMMLING	5.50	1985	0
215044 CANON CITY	4.71	1986	221,190
215099 EVERGREEN	4.72	1986	39,781
215175 LAKEWOOD	4.88	1986	1,327,140
215144 HAYDEN	5.86	1986	3,318
215122 GEORGETOWN	5.90	1986	724
215213 NEW CASTLE	6.58	1986	564
215220 OAK CREEK	6.96	1986	86
215182 LINCOLN PARK	5.25	1988	0
215009 APPLEWOOD	5.28	1988	44,238
215207 MONTROSE	5.94	1988	550,199
215150 HOOPER	7.89	1989	0
215106 FLORENCE	6.18	1990	22,119
215170 LA JARA	8.18	1990	3,720
215020 BASALT	8.60	1990	20
215255 RIFLE	7.34	1991	11,988

STATE: COLORADO
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
215278 SILT	\$ 9.12	1991	0
215212 NEDERLAND	8.63	1992	442
215266 SANFORD	8.99	1992	11,148
215263 SAGUACHE	9.10	1992	726
215285 SOUTH FORK	9.38	1992	686
215193 MANASSA	9.44	1992	10,153
215087 EAGLE	9.88	1992	1,106
215209 MORRISON	9.84	1994	442
215097 ESTES PARK	7.87	1995	19,058
215111 FRASER	9.87	1995	1,441
215140 GYPSUM	11.39	1995	1,106
215083 DOLORES	12.04	1996	0
215008 ANTONITO	10.13	1997	1,971
215204 MINTURN	11.28	1997	34,008
215018 BACA GRANDE	12.36	1997	0
215260 ROMEO	14.10	1999	0
215303 VAIL	13.75	2000	2,199

STATE: COLORADO
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
215101 FALCON	\$ 4.34	1983	1,029
215012 ASPEN	5.60	1983	33,968
215233 PAONIA	4.80	1984	664
215211 NATURITA	5.11	1984	0
215218 NUCLA	5.26	1984	0
215068 CRESTED BUTTE	6.42	1985	0
215060 COLORADO SPRINGS	4.83	1986	3,317,850
215108 FOUNTAIN	5.00	1986	553
215070 CRIPPLE CREEK	6.50	1987	0
215292 STRATTON MEADOWS	5.40	1988	221,190
215152 HOTCHKISS	7.61	1988	0
215200 MEEKER	5.62	1989	110,595
215195 MANITOU SPRINGS	5.67	1989	110,595
215217 NORWOOD	6.96	1989	0
215307 WALDEN	7.06	1989	4,169
215248 PUEBLO	6.28	1991	2,654,280
215269 SECURITY WIDFIELD	6.32	1991	221,190
215115 FT CARSON	6.35	1991	22,119
215026 BEULAH	8.26	1991	0
215130 GRAND JUNCTION	6.49	1992	1,105,950
215250 RANGELY	6.62	1992	110,595
215076 DEL NORTE	10.28	1994	557
215047 CEDAREGE	11.43	1995	0
215134 GREEN MOUNTAIN FALLS	10.86	1996	0
215059 COLORADO CITY	11.50	1997	0
215016 AUSTIN	11.35	1999	1,106
215224 ORCHARD CITY	11.55	1999	221
215077 DELTA	11.79	1999	1,327
215206 MONTE VISTA	11.85	2000	209,520
215221 OLATHE	15.35	2000	0

State of Idaho

Summary of Results for State Aggregation

<u>22</u>	Potential City/Site Pairs
<u>61</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 11 potential and 20 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 1.27×10^{12} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1983. This increases through the year 2000. The economic heat potential for the year 2000 is 2.66×10^{13} Btu/Yr.

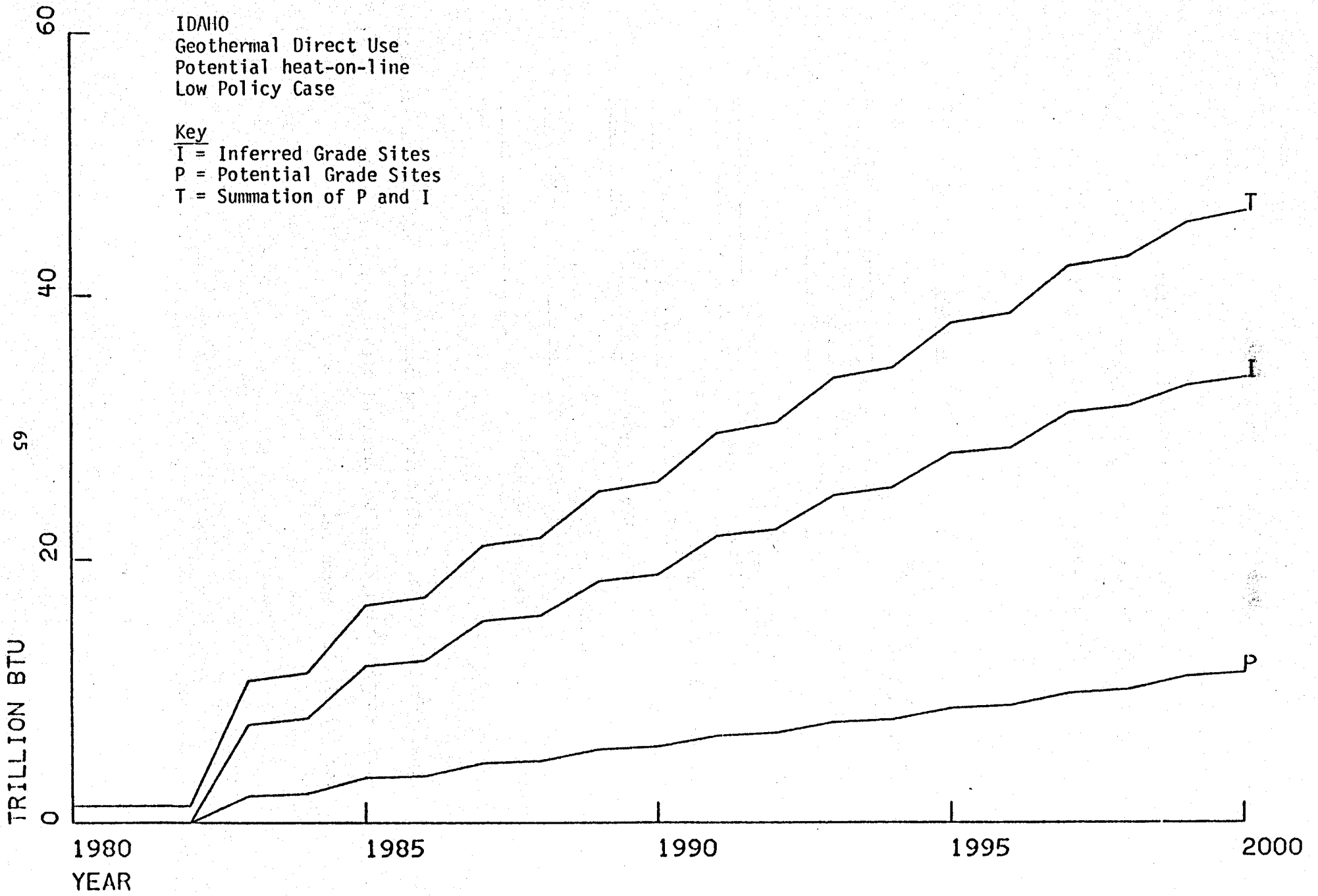
With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 4.64×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 8.5×10^{13} Btu/Yr of which geothermal could supply 55%. For the city developer 21 potential and 60 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1983. It increases to 4.42×10^{13} Btu/Yr by the year 2000.

IDAHO
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key

I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



High Case

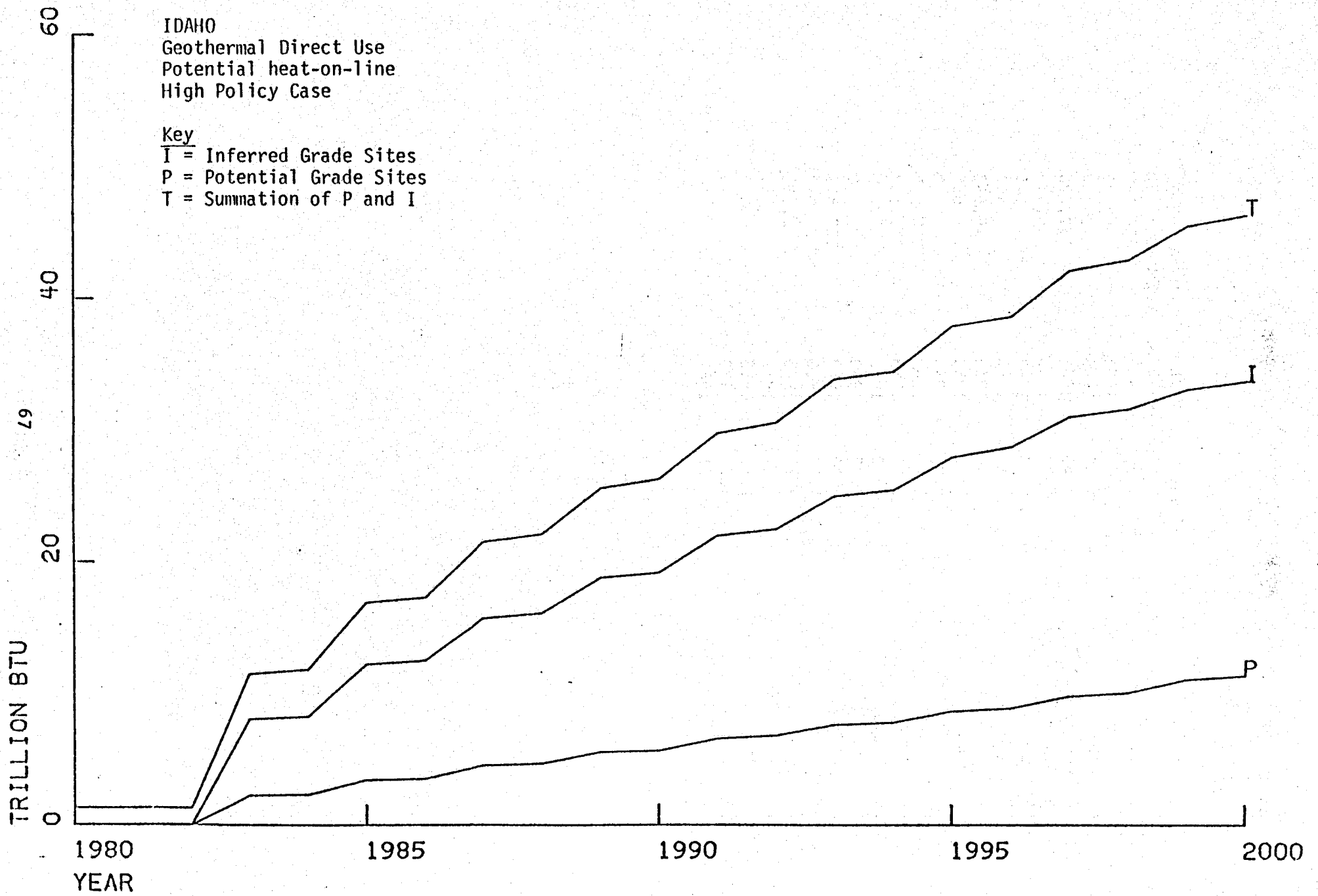
The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	11	21
	Inferred	20	60
City Developer	Potential	21	21
	Inferred	60	60
Year major growth in potential begins			
	Private Developer	1983	1984
	City Developer	1983	1984
Economic heat potential in 2000			
	Private Developer	2.66×10^{13}	4.64×10^{13}
	City Developer	4.64×10^{13}	4.64×10^{13}
Industrial heat potential in 2000			
	Private Developer	4.42×10^{13}	5.44×10^{13}
Percentage of state space heat demand*		55%	55%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

IDAHO
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: IDAHO
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
225025 BOISE	\$ 1.89	1983	3,806,169
225132 KETCHUM	2.28	1983	6,136
225101 HAILEY	2.43	1983	2,714
225218 ROGER'S FOODS	2.45	1983	252,895
225142 LAVA HOT SPRINGS	2.72	1983	6,455
225009 ARCO	2.87	1983	945
225149 MALAD CITY	3.12	1983	490
225211 REXBURG	3.21	1983	79,668
225042 CHALLIS	3.26	1983	669
225175 NEW MEADOWS	3.26	1983	0
225243 SUN VALLEY	3.27	1983	110,595
225261 WEISER	3.62	1983	201,588
225019 BELLEVUE	3.68	1983	0
225051 COLLISTER	3.73	1983	0
225157 MERIDIAN	3.75	1983	272,617
225057 CROUCH	4.00	1983	0
225072 EAGLE	4.17	1983	2,062
225153 MC CAMMON	4.21	1983	384
225114 HOMEDALE	4.95	1983	0
225005 ALBION	5.35	1983	0
225116 HORSESHOE BEND	7.71	1987	0

STATE: IDAHO
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
225038 CARNATION FOODS	\$ 1.30	1983	384,466
225253 TWIN FALLS	1.49	1983	6,045,276
225125 JR SIMPLOT CALDWELL	1.67	1983	2,021,538
225031 BURLEY	1.70	1983	4,196,935
225119 IDAHO FALLS	1.79	1983	1,279,398
225126 JR SIMPLOT HEYBURN	1.79	1983	1,378,322
225140 LAMB-WESTON	1.82	1983	1,088,874
225006 AMALGAMATED SUGAR	1.96	1983	1,825,000
225007 AMERICAN FALLS	2.28	1983	200,447
225220 RUPERT	2.28	1983	845,939
225145 LEWISVILLE	2.33	1983	1,031,340
225254 U AND I SUGAR	2.46	1983	2,748,929
225173 NAMPA	2.56	1983	2,678,254
225039 CASCADE	2.57	1983	1,356
225201 POCATELLO	2.57	1983	2,767,099
225080 FAIRFIELD	2.58	1983	0
225185 ORE-IDA	2.67	1983	1,314,000
225034 CALDWELL	2.76	1983	3,967,951
225194 PAYETTE	2.83	1983	655,379
225021 BLACKFOOT	3.14	1983	3,609,716
225083 FILER	3.16	1983	28,129
225134 KIMBERLY	3.21	1983	21,971
225161 MONTPELIER	3.31	1983	659
225215 RIRIE	3.35	1983	354,803
225192 PARMA	3.36	1983	314,595
225094 GLENNS FERRY	3.37	1983	331,875
225151 MARSING	3.49	1983	0
225225 SHELLEY	3.49	1983	60,000
225228 SODA SPRINGS	3.50	1983	22,430
225096 GRACE	3.53	1983	0
225045 CHUBBOCK	3.66	1983	0
225222 SALMON	3.70	1983	86,355
225127 JR SIMPLOT ABERDEEN	3.94	1983	547,500
225165 MOUNTAIN HOME	3.96	1983	45,889
225206 PRESTON	4.01	1983	0
225112 HEYBURN	4.26	1983	0
225124 JEROME	4.43	1983	24,006
225029 BUHL	4.44	1983	225,570
225095 GOODING	4.45	1983	56,328
225213 RIGBY	4.59	1983	51,710

STATE: IDAHO
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
225079 EMMETT	\$ 4.67	1983	218,659
225182 OAKLEY	4.85	1983	935
225104 HANSEN	4.93	1983	6,384
225262 WENDELL	4.94	1983	3,219
225255 UCON	4.95	1983	0
225193 PAUL	5.05	1983	0
225011 ASHTON	5.12	1983	1,115
225232 ST ANTHONY	5.14	1983	125,696
225100 HAGERMAN	5.18	1983	0
225001 ABERDEEN	5.30	1983	0
225176 NEW PLYMOUTH	5.33	1983	0
225055 COUNCIL	5.48	1983	9,699
225242 SUGAR CITY	5.80	1984	0
225120 INKOM	5.80	1984	0
225138 KUNA	6.63	1987	0
225085 FORT HALL	6.86	1987	1,570
225226 SHOSHONE	7.33	1988	721
225087 FRUITLAND	7.48	1989	155,526
225166 MOUNTAIN H AFB	8.11	1991	0
225214 RIGGINS	9.77	1991	1,336

State of Montana

Summary of Results for State Aggregation

<u>41</u>	Potential City/Site Pairs
<u>94</u>	Inferred City/Site Pairs

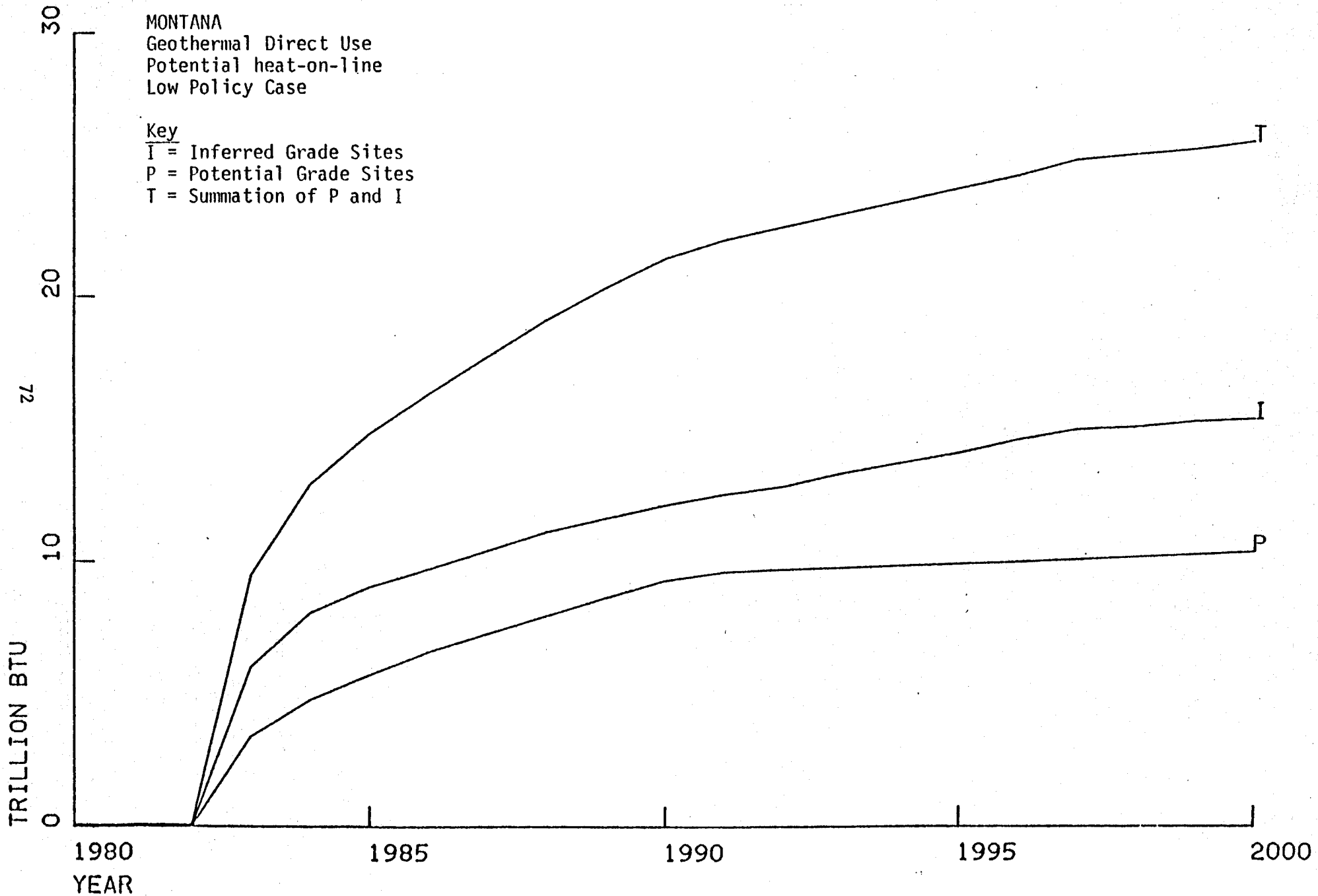
Low Case

If the system development is done by private business, 20 potential and 11 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 5.7×10^{10} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1983. This increases through the year 2000. The economic heat potential for the year 2000 is 1.7×10^{13} Btu/Yr.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 2.59×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 7.6×10^{13} Btu/Yr of which geothermal could supply 34%. For the city developer 37 potential and 80 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1984. It increases to 3.88×10^{12} Btu/Yr by the year 2000.

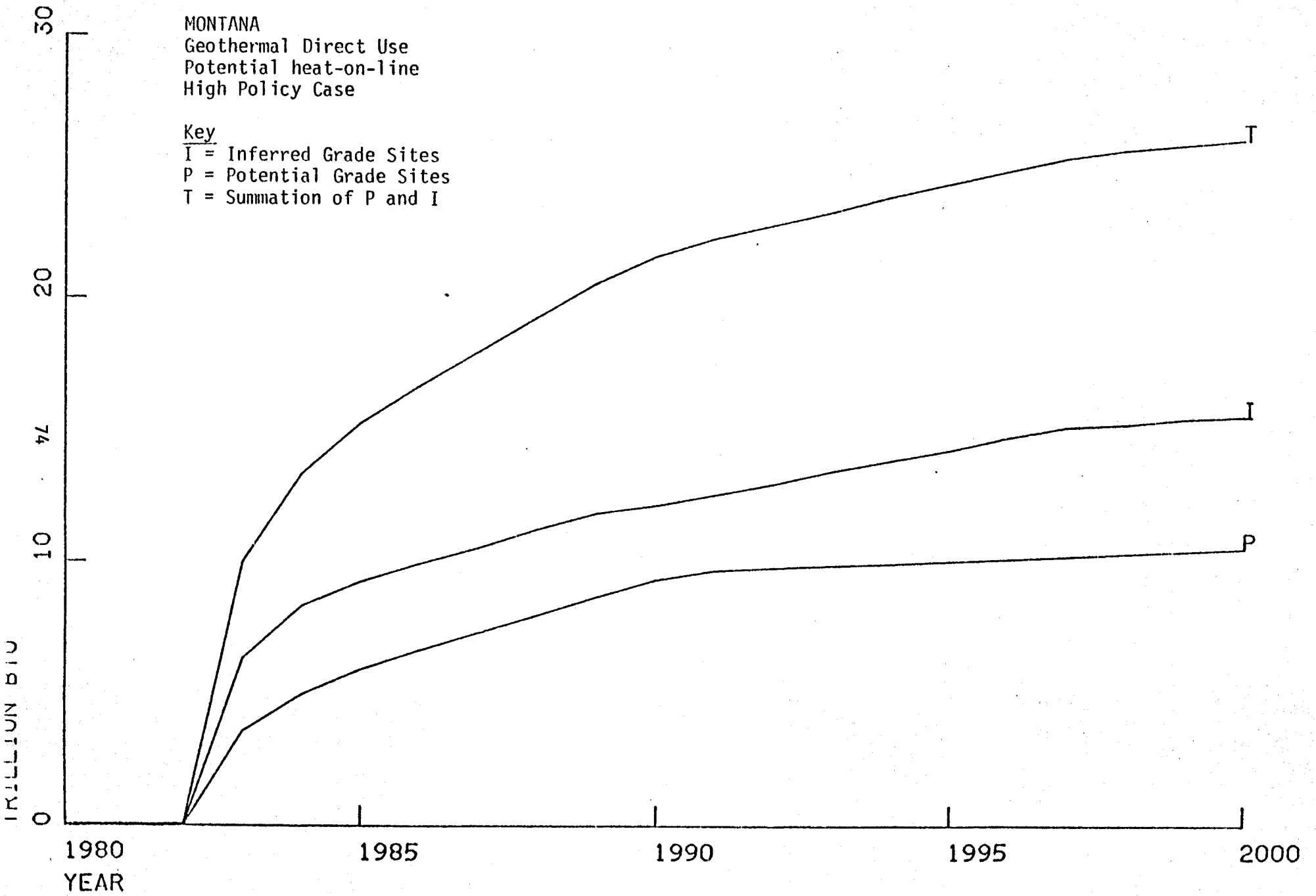


High Case

The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	20	39
	Inferred	11	82
City Developer	Potential	37	39
	Inferred	80	91
Year major growth in potential begins			
	Private Developer	1983	1983
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	1.7×10^{13}	2.59×10^{13}
	City Developer	2.59×10^{13}	2.6×10^{13}
Industrial heat potential in 2000			
	Private Developer	3.88×10^{12}	7.33×10^{12}
Percentage of state space heat demand*		34%	34%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.



STATE: MONTANA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
235314 WARM SPRINGS	\$ 2.55	1983	33,178
235144 HELENA	2.77	1983	158,483
235154 HOT SPRINGS	2.93	1983	0
235008 ANACONDA	2.99	1983	111,391
235320 WHITE SULPHUR SPRIN	3.04	1983	13,714
235034 BOULDER	3.09	1983	0
235059 CLANCY	3.14	1983	0
235162 JACKSON	3.15	1983	0
235322 WHITEHALL	3.18	1983	36,607
235037 BOZEMAN HOT SPR	3.20	1983	0
235303 TWIN BRIDGES	3.36	1983	0
235123 GARDINER	3.46	1983	0
235223 OPPORTUNITY	3.52	1983	0
235227 PARADISE	3.52	1983	0
235098 ENNIS	3.60	1983	0
235092 EAST HELENA	3.66	1983	5,773
235046 BUTTE	3.66	1983	14,775
235107 FLORAL PARK	3.69	1983	0
235277 SILVER BOW PARK	3.69	1983	0
235278 SILVERSTAR	3.79	1983	0
235053 CENTERVILLE DUBLIN	3.82	1983	0
235253 RINGLING	4.14	1983	0
235200 MCGLONE HEIGHTS	4.37	1983	0
235202 MCQUEEN EAST BUTTE	4.40	1983	0
235313 WALKERVILLE	4.72	1983	0
235005 ALHAMBRA	4.77	1983	0
235201 MCQUEEN	4.83	1983	0
235232 PLAINS	4.85	1983	13,271
235028 BIG TIMBER	5.09	1983	16,434
235121 GALEN	6.10	1983	11,059
235237 PONY	6.99	1983	0
235295 THREE FORKS	6.39	1984	7,144
235163 JEFFERSON CITY	6.83	1985	0
235311 VIRGINIA CITY	7.75	1985	376
235141 HARRISON	7.90	1985	0
235019 BASIN	9.48	1988	0
235188 LOLO	10.98	1993	0
235326 WILLOW CREEK	13.35	1994	0
235004 ALDER	17.51	1999	0

STAT.: MONTANA
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
235151 HOERNER WALDORF	\$ 1.80	1983	2,875,470
235087 DTA FEED PLANT	1.88	1983	1,327,140
235285 STAUFFER CHEMICAL	1.93	1983	619,332
235312 VITA RICH DAIRY	1.93	1983	526,432
235008 ANACONDA	2.02	1983	884,760
235299 TRIDENT	2.46	1983	265,428
235076 CYPRESS INDUSTRIAL	2.46	1983	265,428
235168 KAISER CEMENT	2.57	1983	398,142
235011 ASARCO	2.68	1983	376,023
235100 EVANS PRODUCTS	2.81	1983	221,190
235190 LOUISIANA PACIFIC	2.81	1983	221,190
235306 U.S. PLYWOOD	2.81	1983	221,190
235036 BOZEMAN	3.42	1983	67,574
235021 BELGRADE	3.49	1983	60,584
235133 GLENDIVE	3.54	1983	65,536
235080 DEER LODGE	3.86	1983	1,135
235275 SIDNEY	3.99	1983	59,056
235137 HAMILTON	4.17	1983	44,267
235208 MISSOULA	4.18	1983	256,403
235131 GLASGOW	4.25	1983	17,540
235069 CORVALLIS	4.26	1983	0
235017 BAKER	4.37	1983	7,379
235138 HARDIN	4.44	1983	451
235072 CROW AGENCY	4.49	1983	1,327
235206 MILES CITY	4.61	1983	18,666
235186 LODGE GRASS	4.67	1983	0
235094 EKALAKA	4.73	1983	487
235058 CIRCLE	4.83	1983	1,113
235110 FORSYTH	4.83	1983	376
235333 WOLF POINT	4.84	1983	22,119
235233 PLENTYWOOD	4.89	1983	383
235175 LAME DEER	4.91	1983	0
235040 BROADUS	4.92	1983	553
235103 FAIRVIEW	4.97	1983	553
235073 CULBERTSON	5.05	1983	553
235238 POPLAR	5.15	1983	2,654
235269 SCOBAY	5.16	1983	7
235192 MALTA	5.28	1983	18,476
235122 GALLATIN GATEWAY	5.33	1983	9,666
235166 JORDAN	5.33	1983	553

STATE: MONTANA
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
235012 ASHLAND	\$ 5.45	1983	708
235293 TERRY	5.46	1983	376
235082 DILLON	5.48	1983	18,343
235193 MANHATTAN	5.57	1983	0
235203 MEDICINE LAKE	5.78	1983	0
235149 HINSDALE	5.98	1983	0
235157 HUSON	6.02	1983	553
235042 BROCKTON	6.07	1983	0
235252 RICHEY	6.19	1983	0
235126 GARRYOWEN	6.38	1983	0
235117 FROID	6.58	1983	0
235077 DARBY	6.62	1983	13,271
235222 OPHEIM	6.69	1983	0
235045 BUSBY	6.81	1983	0
235319 WESTBY	7.02	1983	0
235152 HOLLY SUGAR	2.46	1984	3,074,541
235264 SACO	6.30	1984	0
235230 PFIZER INC.	3.12	1985	185,800
235115 FRAZER	6.64	1985	0
235216 NASHUA	6.77	1985	0
235310 VICTOR	6.80	1985	752
235120 FT PECK	6.96	1985	0
235022 BELL CREEK	7.98	1985	0
235132 GLASGOW AFB	7.15	1986	0
235174 LAMBERT	8.64	1986	0
235134 GRANTS DALE	8.94	1987	0
235016 BAINVILLE	9.02	1987	0
235268 SAVAGE	8.05	1988	0
235095 ELK RIVER CONCRETE	4.29	1990	125,415
235106 FLAXVILLE	10.34	1990	0
235234 PLEVNA	10.61	1990	0
235063 COLSTRIP	10.65	1990	0
235259 ROSEBUD	9.52	1991	0
235104 FALLON	10.43	1992	0
235224 OUTLOOK	11.59	1992	0
235007 AMSTERDAM	11.66	1994	0
235323 WHITETAIL	13.13	1994	0
235125 GARRISON	11.90	1995	0
235335 WYOLA	14.48	1995	0
235113 FORT SMITH	14.77	1996	0

STATE: MONTANA
INFERRED SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
235229 PEERLESS	\$ 16.12	1997	0
235281 ST XAVIER	17.93	1999	0

State of Nevada

Summary of Results for State Aggregation

<u>51</u>	Potential City/Site Pairs
<u>4</u>	Inferred City/Site Pairs

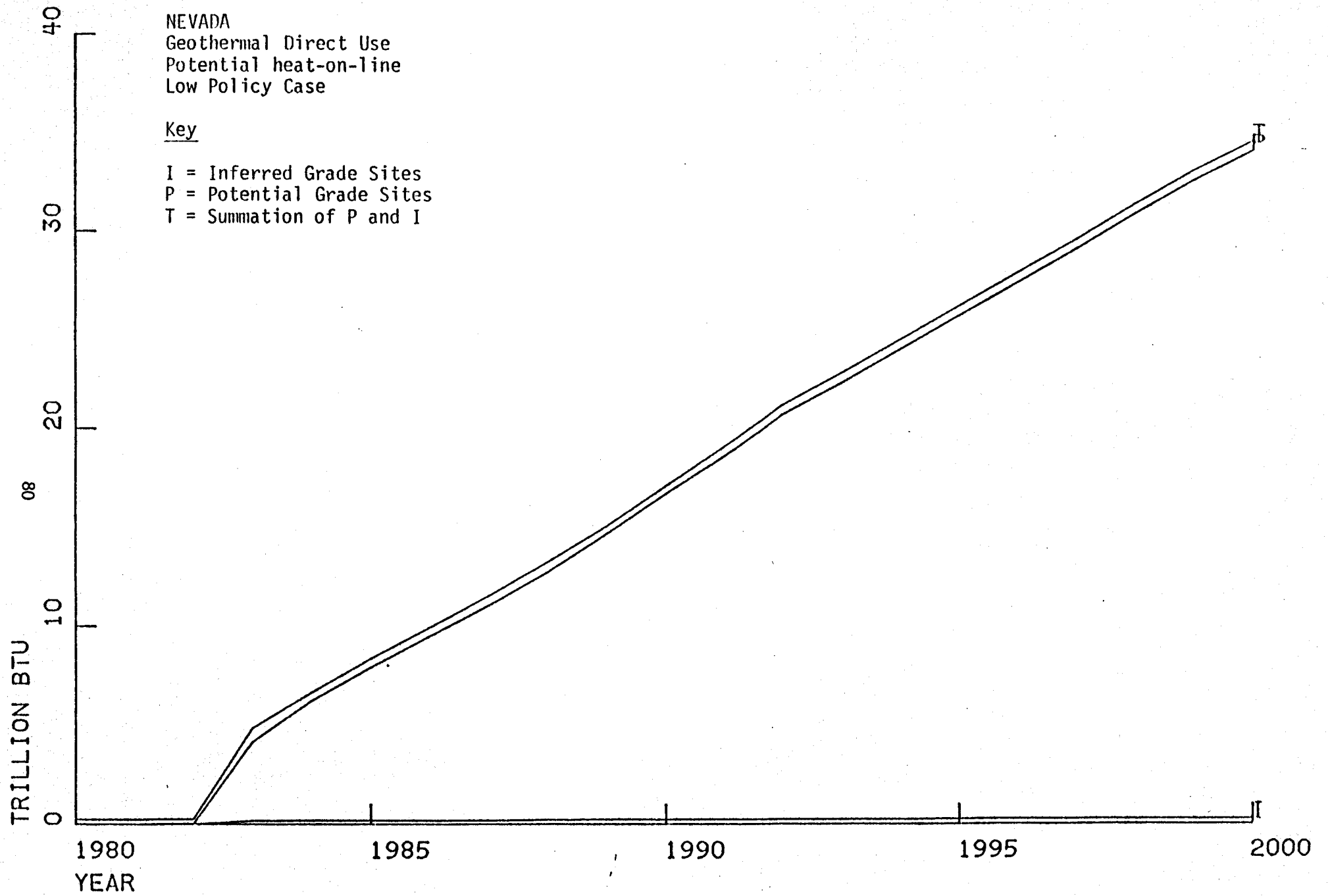
Low Case

If the system development is done by private business, 48 potential and 1 inferred pair are economic within the year 2000 time frame. Existing on line capacity for the state is 2.4×10^{11} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1983. This increases through the year 2000. The economic heat potential for the year 2000 is 1.26×10^{13} Btu/Yr.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1985 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 3.45×10^{13} Btu/Yr. This potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 5.19×10^{13} Btu/Yr of which geothermal could supply 66%. For the city developer 48 potential and 1 inferred site become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1985. It increases to 1.49×10^{13} Btu/Yr by the year 2000.

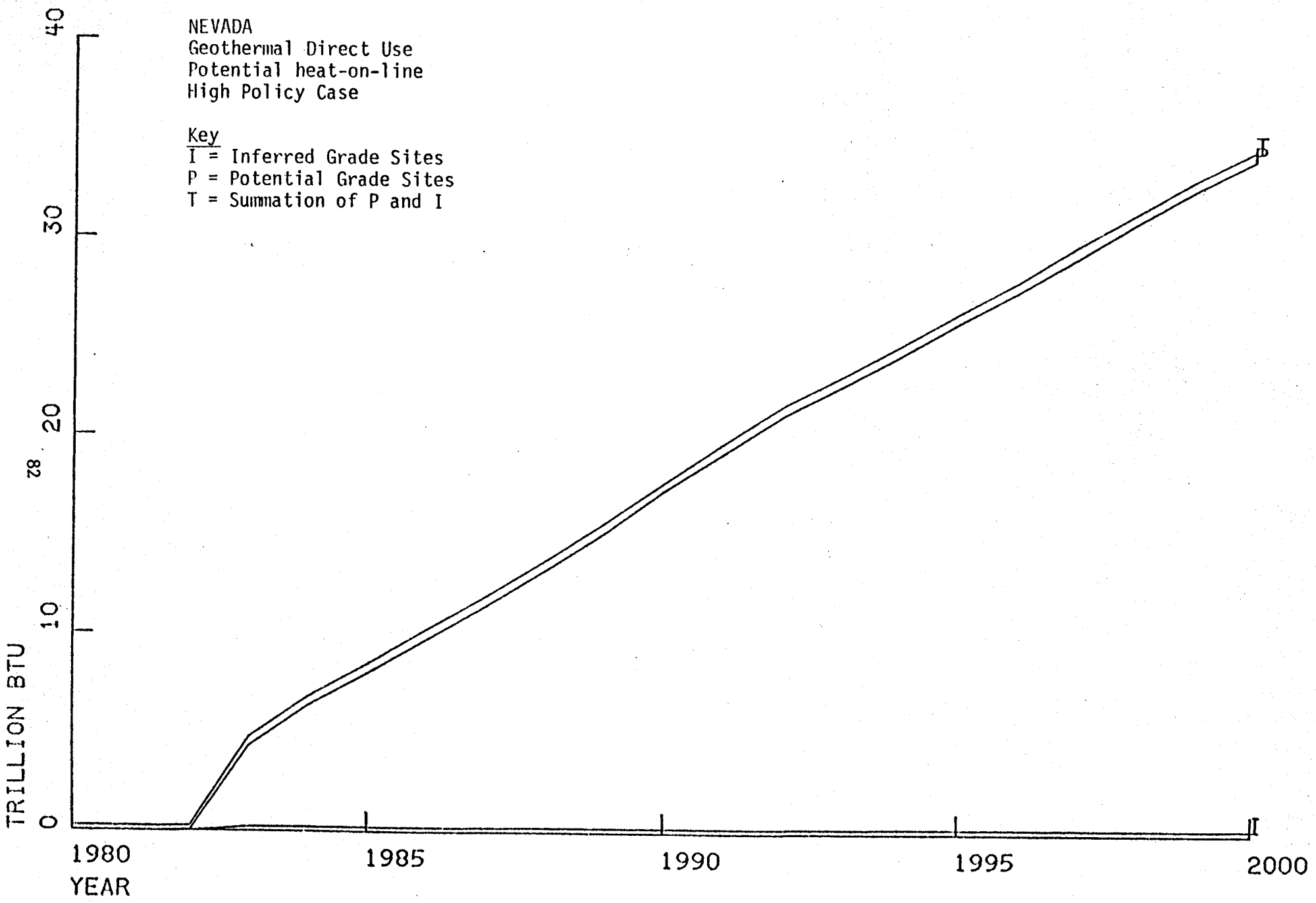


High Case

The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	48	48
	Inferred	1	1
City Developer	Potential	48	48
	Inferred	1	1
Year major growth in potential begins			
Private Developer		1983	1983
City Developer		1983	
Economic heat potential in 2000			
Private Developer		1.26×10^{13}	3.44×10^{13}
City Developer		3.45×10^{13}	3.46×10^{13}
Industrial heat potential in 2000			
Private Developer		1.49×10^{13}	2.85×10^{12}
Percentage of state space heat demand*		66%	67%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.



STATE: NEVADA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
245070 RENO	\$ 2.95	1983	1,449,016
245025 FALLON	3.00	1983	27,649
245021 ELKO CITY	3.08	1983	6,415
245094 WELLS	3.30	1983	0
245086 VERDI	3.41	1983	0
245079 STEAMBOAT	3.50	1983	0
245029 GARDNERVILLE MINDEN	3.66	1983	1,880
245014 CARSON CITY	3.70	1983	166,335
245013 CARLIN	3.75	1983	0
245031 GERLACH	3.92	1983	0
245027 FERNLEY	4.06	1983	0
245087 VIRGINIA CITY	4.09	1983	1,327
245012 CALIENTE	4.16	1983	0
245046 LOVELOCK	4.29	1983	112,365
245030 GENOA	4.34	1983	0
245026 FALLON STATION	4.34	1983	110,595
245089 WADSWORTH	4.38	1983	0
245040 JACKPOT	4.47	1983	0
245093 WELLINGTON	4.67	1983	0
245023 EMPIRE	4.81	1983	0
245033 GOLCONDA	4.81	1983	0
245090 WARM SPRINGS	4.97	1983	0
245017 DAYTON	5.37	1983	0
245076 SILVERPEAK	5.49	1983	0
245050 MC GILL	5.59	1983	0
245022 ELY	5.79	1983	0
245007 BEOWAWE	6.02	1983	0
245071 ROUND MOUNTAIN	6.03	1983	0
245082 TONOPAH	6.58	1983	774
245069 PYRAMID LAKE	6.64	1983	0
245067 PARADISE VALLEY	6.94	1983	0
245056 MONTELLO	7.42	1983	0
245077 SPARKS	3.33	1984	655,275
245097 WINNEMUCCA	4.63	1984	177
245098 YERRINGTON	4.74	1984	0
245044 LATHROP WELLS	7.60	1984	0
245051 MCDERMITT	7.68	1984	0
245034 GOLDFIELD	7.91	1985	0
245028 GABBS	8.07	1985	0

STATE: NEVADA
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
245063 OWYHEE	\$ 8.22	1985	0
245003 AUSTIN	9.48	1988	0
245024 EUREKA	9.94	1988	0
245038 IMLAY	12.13	1992	0
245083 TUSCARORA	14.85	1995	0
245060 NIXON	15.63	1996	0
245057 MOUNTAIN CITY	16.67	1997	0
245006 BEATTY	17.18	1998	0

STATE: NEVADA
INFERRED SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
245069 PYRAMID LAKE	\$ 10.94	1990	0

State of New Mexico

Summary of Results for State Aggregation

66 Potential City/Site Pairs

36 Inferred City/Site Pairs

Low Case

If the system development is done by private business, 2 potential and 3 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 1.86×10^{12} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1991. This increases through the year 2000. The economic heat potential for the year 2000 is 1×10^{13} Btu/Yr.

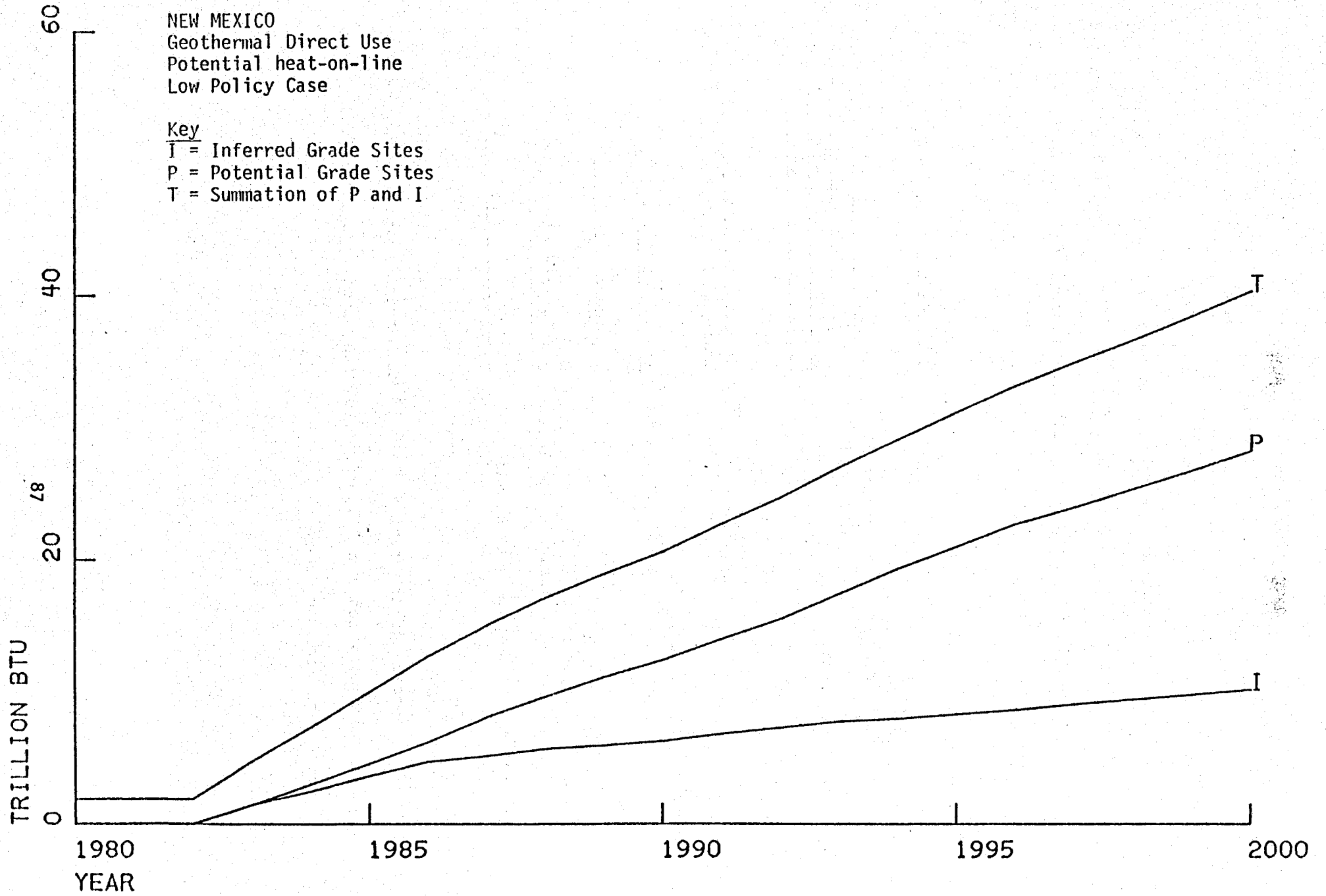
With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 4.04×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 6.72×10^{13} Btu/Yr of which geothermal could supply 60%. For the city developer 34 potential and 30 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1991. It increases to 8.60×10^{12} Btu/Yr by the year 2000.

NEW MEXICO
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key

I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



High Case

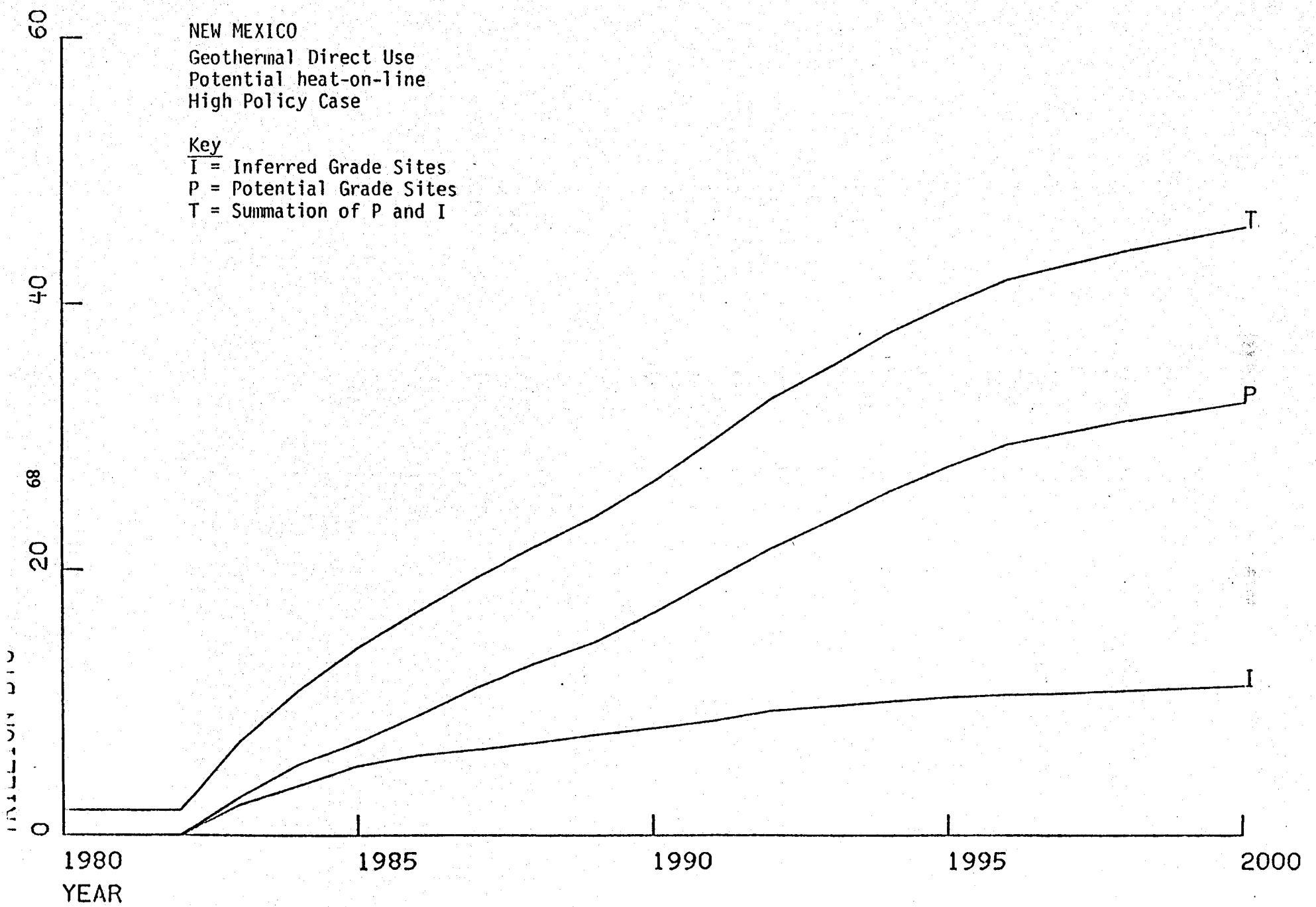
The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	2	41
	Inferred	3	31
City Developer	Potential	34	48
	Inferred	30	34
Year major growth in potential begins			
	Private Developer	1991	1984
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	1×10^{13}	4.25×10^{13}
	City Developer	4.04×10^{13}	4.59×10^{13}
Industrial heat potential in 2000			
	Private Developer	8.60×10^{12}	1.7×10^{13}
Percentage of state space heat demand*		60%	68%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

NEW MEXICO
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: NEW MEXICO
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
255117 MESQUITE	\$ 3.09	1983	1,183,366
255096 LAS CRUCES	3.48	1983	1,824,800
255088 JEMEZ SPRINGS	3.74	1983	0
255189 UNIV PK TORTUGAS	4.03	1983	663,570
255159 SAN MIGUEL	4.09	1983	215,616
255097 LAS VEGAS	4.38	1984	117,231
255185 TRUTH OR CONSEQ	4.77	1985	8,980
255174 TAOS	4.91	1985	46,715
255142 RANCHES DE TAOS	4.96	1986	0
255141 RADIUM SPRINGS	5.50	1986	0
255092 LA MESILLA	5.75	1986	0
255152 RUIDOSO	5.24	1987	0
255087 JEMEZ PUEBLO	5.36	1987	0
255101 LOS ALAMOS	5.46	1987	553
255170 SOCORRO	5.36	1988	118,801
255011 ANTHONY	6.40	1988	0
255042 COLUMBUS	5.73	1989	44,238
255198 WHITE ROCK	5.88	1989	0
255061 ESPANOLA	5.90	1989	2,013
255164 SANTA FE	5.91	1989	326,587
255047 CROWNPOINT	6.16	1989	0
255023 BLOOMFIELD	6.36	1990	58,527
255064 FARMINGTON	6.80	1991	183,566
255106 MAGDALENA	6.84	1992	0
255084 HURLEY	7.09	1992	0
255167 SANTO DOMINGO PUEBLO	7.10	1992	0
255161 SAN YSIDRO	7.12	1992	0
255018 BAYARD	7.46	1993	6,171
255048 CUBA	7.48	1993	0
255007 ALCALDE	8.36	1995	0
255169 SILVER CITY	8.40	1995	6,016
255053 DIXON	8.41	1995	0
255033 CENTRAL	8.73	1995	619
255089 KIRTLAND	8.73	1995	0
255155 SAN ANTONIO	8.64	1996	0
255035 CHAMA	8.91	1996	0
255019 BELEN	8.95	1996	0
255050 DEMING	8.89	1997	142,933
255180 TIERRA AMARILLA	10.40	1998	0
255158 SAN JUAN PUEBLO	10.50	1999	0

STATE: NEW MEXICO
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MYBTU)
255102 LOS LUNAS	\$ 11.20	2000	2,196
255121 MORA	11.74	2000	0

STATE: NEW MEXICO
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
255127 NORTH VALLEY	\$ 2.60	1983	1,149,750
255006 ALBUQUERQUE	3.19	1983	2,299,500
255172 SOUTH VALLEY	3.26	1983	1,149,750
255140 QUESTA	3.81	1983	0
255015 ARROYOSECO	4.16	1983	0
255014 ARROYO HONDO	4.30	1983	0
255081 HOLLOMAN	4.33	1983	663,570
255010 ANIMAS	5.22	1983	0
255118 MILAN	4.63	1984	11,500
255075 GRANTS	4.84	1985	13,670
255175 TAOS PUEBLO	5.15	1986	0
255024 BOSQUE FARMS	5.17	1986	0
255113 MEADOW VISTA	6.02	1987	0
255093 LA UNION	6.05	1987	0
255191 VALDEZ	6.14	1989	0
255173 SPRINGER	5.80	1990	708
255100 LORDSBURG	6.17	1990	586
255195 WAGON MOUND	6.28	1990	0
255109 MAXWELL	7.63	1990	0
255065 FLORA VISTA	6.59	1991	0
255203 ZUNI	6.95	1991	664
255037 CIMARRON	6.87	1992	1,327
255005 ALAMOGORDO	7.35	1992	63,008
255009 ANACONDA	7.53	1993	0
255071 GARFIELD	8.37	1993	5,817
255078 HATCH	8.84	1994	0
255146 RINCON	9.12	1994	0
255034 CERRO	8.91	1996	0
255098 LEMITAR	9.36	1997	0
255055 DULCE	9.76	1997	0
255045 COSTILLA	11.49	2000	0

State of North Dakota

Summary of Results for State Aggregation

<u>128</u>	Potential City/Site Pairs
<u>1</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 5 potential and 0 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 1×10^{10} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1992. This increases through the year 2000. The economic heat potential for the year 2000 is 1.58×10^{13} Btu/Yr.

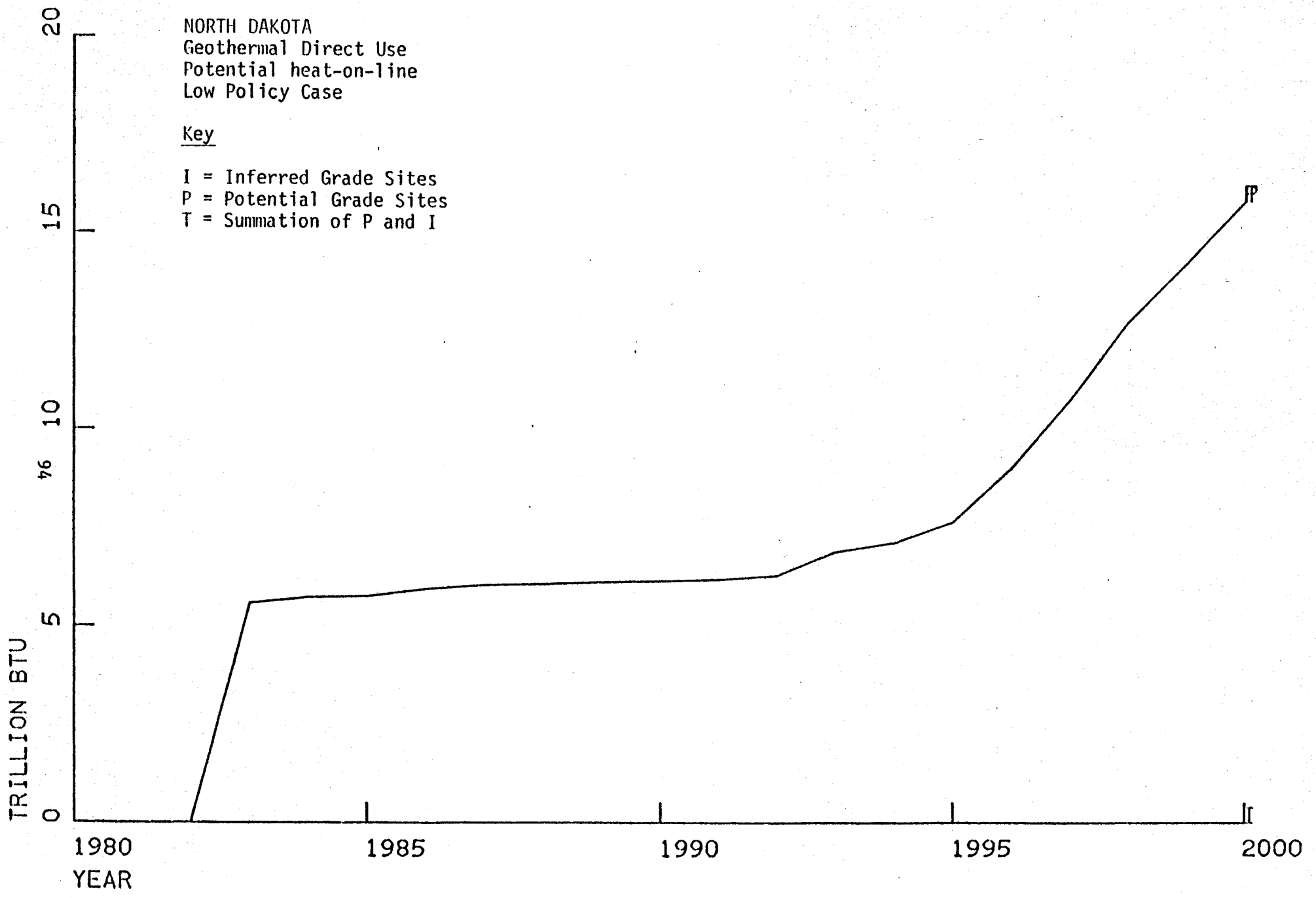
With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 1.58×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 5.29×10^{13} Btu/Yr of which geothermal could supply 30%. For the city developer 135 potential and 0 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1999. It increases to 2.76×10^{11} Btu/Yr by the year 2000.

NORTH DAKOTA
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key

- I = Inferred Grade Sites
- P = Potential Grade Sites
- T = Summation of P and I

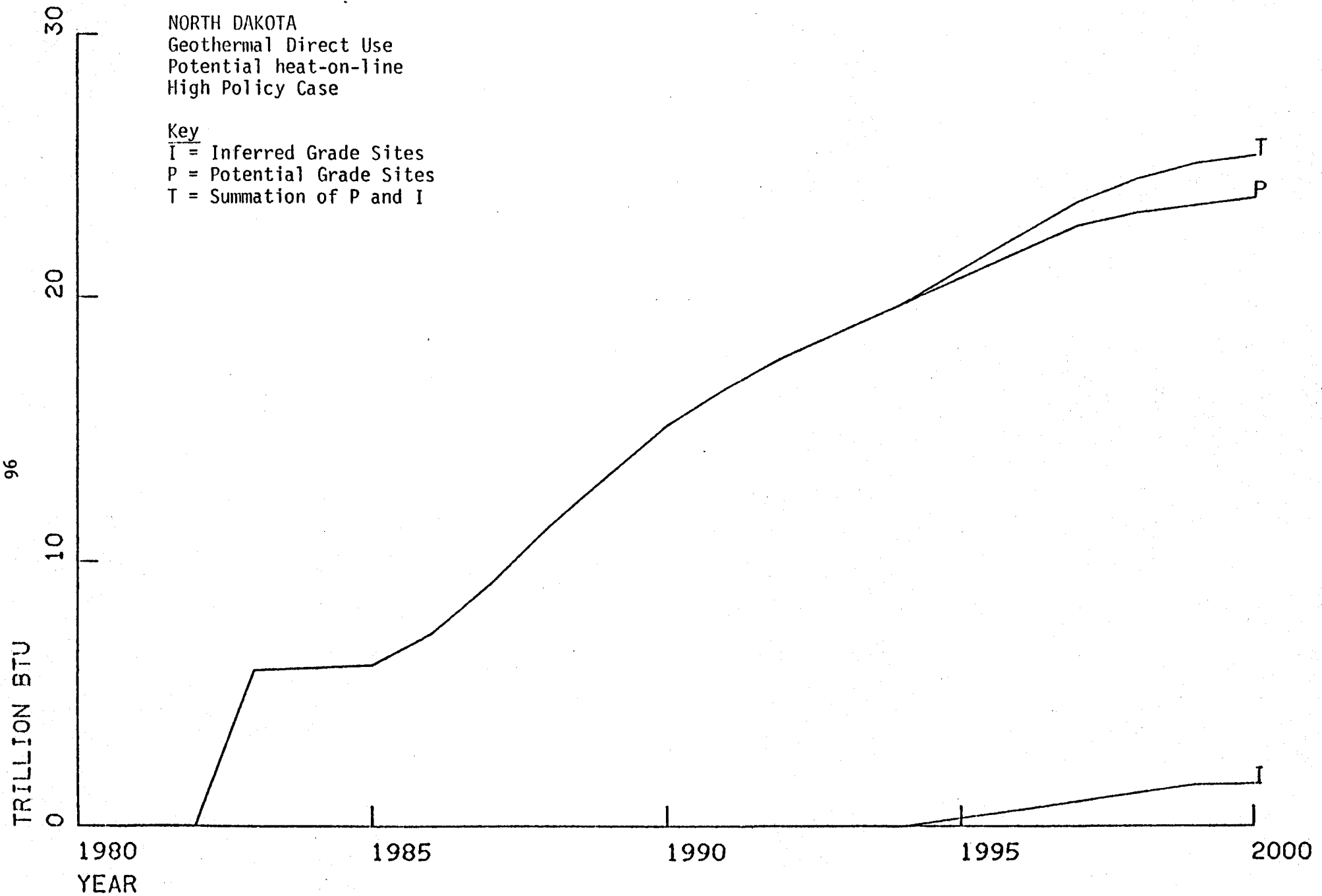


High Case

The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	5	140
	Inferred	0	0
City Developer	Potential	135	146
	Inferred	0	1
Year major growth in potential begins			
	Private Developer	1992	1983
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	1.07×10^{12}	2.32×10^{13}
	City Developer	1.58×10^{13}	2.54×10^{13}
Industrial heat potential in 2000			
	Private Developer	2.76×10^{11}	4.11×10^{12}
Percentage of state space heat demand*		30%	48%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.



STATE: NORTH DAKOTA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
265133 HETTINGER	\$ 3.60	1983	278,065
265242 RUGBY	3.67	1983	119,213
265240 ROLLA	3.78	1983	560
265195 MOHALL	3.82	1983	560
265023 BELCOURT	3.86	1983	12,104
265127 HARVEY	3.89	1983	1,431
265165 LINTON	3.95	1983	34,557
265075 DUNSEITH	3.96	1983	0
265091 FESSENDEN	3.96	1983	553
265288 WESTHOPE	4.02	1983	553
265239 ROLETTE	4.04	1983	0
265171 MADDOCK	4.05	1983	0
265263 STRASBURG	4.05	1983	34,479
265158 LEEDS	4.06	1983	0
265046 CARSON	4.07	1983	7
265266 SYKESTON	4.13	1983	0
265296 WISHEK	4.17	1983	43,094
265257 ST JOHN	4.20	1983	0
265017 ASHLEY	4.21	1983	560
265100 FORT YATES	4.25	1983	6,052
265143 KENMARE	4.26	1983	35,169
265072 DRAKE	4.27	1983	0
265032 BOTTINEAU	4.33	1983	35,722
265301 ZEELAND	4.33	1983	0
265011 ANAMOOSE	4.34	1983	0
265201 NAPOLEON	4.36	1983	560
265270 TIOGA	4.36	1983	12,895
265033 BOWBELLS	4.37	1983	0
265088 ESMOND	4.41	1983	0
265208 NEW TOWN	4.42	1983	10,754
265279 VELVA	4.43	1983	553
265130 HAZELTON	4.44	1983	0
265131 HAZEN	4.44	1983	44,526
265183 MCCLUSKY	4.47	1983	33,599
265062 CROSBY	4.49	1983	119,206
265146 KILLDEER	4.49	1983	553
265051 CENTER	4.49	1983	0
265094 FLASHER	4.57	1983	553
265030 BISBEE	4.59	1983	0
265219 PARSHALL	4.68	1983	553

STATE: NORTH DAKOTA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
265223 PETTIBONE	\$ 4.77	1983	0
265114 GOODRICH	4.78	1983	0
265028 BEULAH	4.81	1983	7
265082 ELGIN	4.84	1983	4,048
265048 CATHAY	4.99	1983	0
265295 WING	5.06	1983	0
265117 GRANVILLE	5.10	1983	0
265160 LEHR	5.16	1983	0
265277 UPHAM	5.29	1983	0
265252 SHERWOOD	5.29	1983	0
265292 WILLOW CITY	5.30	1983	0
265264 STREETER	5.30	1983	0
265249 SELFRIDGE	5.32	1983	0
265122 HALLIDAY	5.58	1983	35,032
265039 BUTTE	5.63	1983	0
265020 BALTA	5.77	1983	0
265260 STANTON	5.85	1983	796
265275 TUTTLE	5.87	1983	34,461
265205 NEW LEIPZIG	5.97	1983	0
265058 COLUMBUS	5.98	1983	0
265138 HURDSFIELD	6.21	1983	0
265155 LANSFORD	6.22	1983	560
265254 SOLEN	6.84	1983	0
265237 ROBINSON	6.91	1983	0
265164 LIGNITE	7.11	1984	7
265211 NOONAN	7.11	1984	0
265174 MANDAREE	7.15	1984	0
265227 PLAZA	7.37	1985	0
265121 HAGUE	7.51	1985	0
265232 REEDER	7.65	1985	0
265297 WOLFORD	7.82	1986	0
265300 ZAP	7.95	1986	0

STATE: NORTH DAKOTA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
265181 MAXBASS	\$ 8.05	1986	0
265095 FLAXTON	8.16	1986	0
265179 MARTIN	8.27	1987	0
265031 BISMARCK	3.64	1988	842,690
265245 RYDER	8.75	1988	0
265187 MERCER	8.76	1988	0
265119 GRENORA	9.03	1988	0
265209 NEWBURG	9.08	1988	0
265149 KRAMER	9.12	1988	0
265112 GOLDENVALLEY	9.21	1988	0
265265 SURREY	3.77	1989	0
265276 UNDERWOOD	3.78	1989	553
265173 MANDAN	3.78	1989	387,804
265193 MINOT	3.86	1989	314,364
265109 GLEN ULLIN	3.90	1989	47,016
265280 VENTURIA	9.27	1989	0
265228 PORTAL	9.45	1989	0
265236 RIVERDALE	3.92	1990	0
265068 DICKINSON	3.98	1990	1,486,607
265285 WASHBURN	4.03	1990	553
265273 TOWNER	4.08	1990	0
265200 MYLO	10.14	1990	0
265142 KARLSRUHE	10.27	1990	0
265207 NEW SALEM	4.20	1991	560
265038 BURLINGTON	4.27	1991	0
265132 HEBRON	4.39	1991	2,765
265034 BOWMAN	4.41	1992	553
265262 STEELE	4.42	1992	560
265286 WATFORD CITY	4.47	1992	560
265274 TURTLE LAKE	4.53	1992	560
265259 STANLEY	4.56	1992	560
265197 MOTT	4.61	1992	553
265019 BALFOUR	11.23	1992	0
265271 TOLLEY	11.47	1992	0
265185 MEDINA	4.78	1993	0
265293 WILTON	4.80	1993	0

STATE: NORTH DAKOTA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
265024 BELFIELD	\$ 4.86	1993	0
265180 MAX	4.90	1993	0
265071 DOUGLAS	11.71	1993	0
265172 MAKOTI	11.85	1993	0
265234 RHAME	12.00	1993	0
265290 WILDROSE	12.10	1993	0
265231 RAY	5.02	1994	0
265026 BERTHOLD	5.19	1994	553
265013 ANTLER	12.94	1994	0
265244 RUTHVILLE	13.01	1994	0
265235 RICHARDTON	5.31	1995	531
265006 ALMONT	14.59	1996	0
265022 BEACH	6.12	1997	15,888
265101 FORTUNA	14.93	1997	0
265069 DODGE	15.64	1997	0
265161 LEITH	15.69	1998	0
265066 DEERING	16.16	1998	0
265204 NEW ENGLAND	6.80	1999	553
265241 ROSS	17.74	2000	0
265298 WOODWORTH	18.07	2000	0

State of Oregon

Summary of Results for State Aggregation

The state geothermal aggregation for Oregon uses 88 Potential and 1 Inferred City/Site pairs as a basis. This is the total number of resource-user matches which are considered for economic evaluation.

Low Case

The number of possible users which could be developed are listed above. Upon analysis using B THERM, some will never prove to be economic within the aggregation time frame.

If the district heating system development is done by private business, 17 potential and 0 inferred city/site pairs are economic within the year 2000 time frame. Existing on-line capacity for the state is 3.33×10^{11} Btu/yr.

Significant growth in quantity of geothermal heat which is economic begins in 1984. This increases steadily through the year 2020. The economic direct use market potential for the year 2000 is 4.74×10^{13} Btu/yr. under the private development scenario.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2020. The economic heat market potential for the year 2000 is 5.08×10^{13} Btu/yr. For the city developer 30 potential and 0 inferred sites become economic by the year 2000. A graph of the city developed, geothermal energy market potential by year for the residential/commercial sectors is presented in Figure 1.

The industrial energy supply market potential with a private developer does not begin until after 1983. It increases to 4.45×10^{13} Btu/yr by the year 2000.

OREGON
Geothermal Direct Use
Market Potential heat-on-line
Low Policy Case

Key
I = Inferred Grade City/Resource Sites
P = Potential Grade Sites
T = Summation of P and I

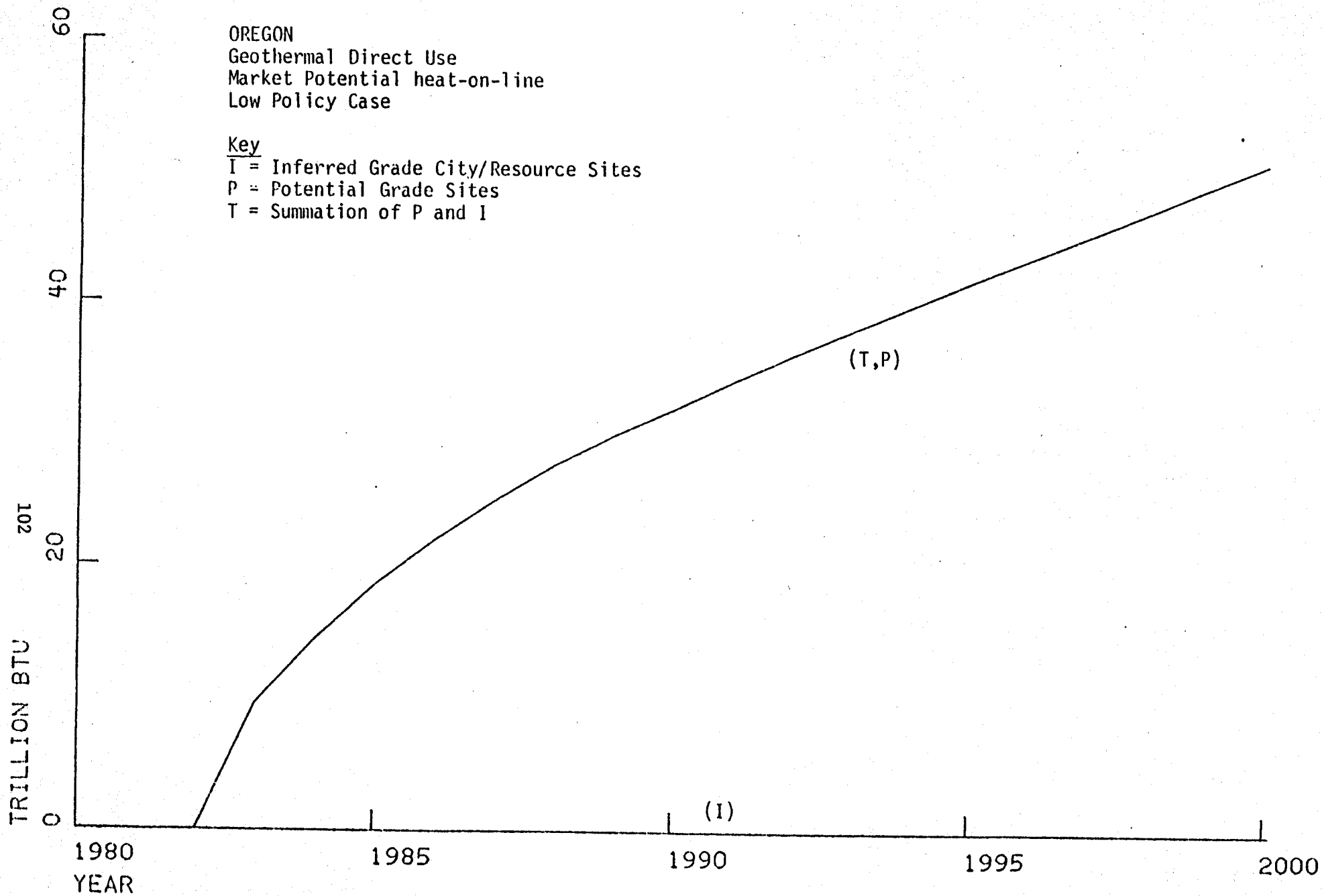


Figure 1

High Case

The high case, a more optimistic case for geothermal development, is quite similar. These results are presented below in tabular form along with the results for low case for comparison. A graph of city developed geothermal energy market potential in the high case, for residential/commercial sectors is presented in Figure 2.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential City/Site	17	30
	Inferred City/Site	0	1
City Developer	Potential City/Site	30	30
	Inferred City/Site	0	1
Year major growth in potential begins			
	Private Developer	1984	1983
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	4.74×10^{13}	5.09×10^{13}
	City Developer	5.08×10^{13}	5.09×10^{13}
Industrial heat potential in 2000			
	Private Developer	4.45×10^{13}	4.55×10^{13}

Summary

It is apparent that geothermal direct use can play an important role in decreasing the state's energy dependence on petroleum and other fuels. It should be noted that the economic comparison was made against the cheapest conventional fuel in the area. This includes inexpensive Northwest hydroelectricity.

Another important benefit is the conservation of present supplies of natural gas and lessened demand for electricity that results from the development of geothermal energy.

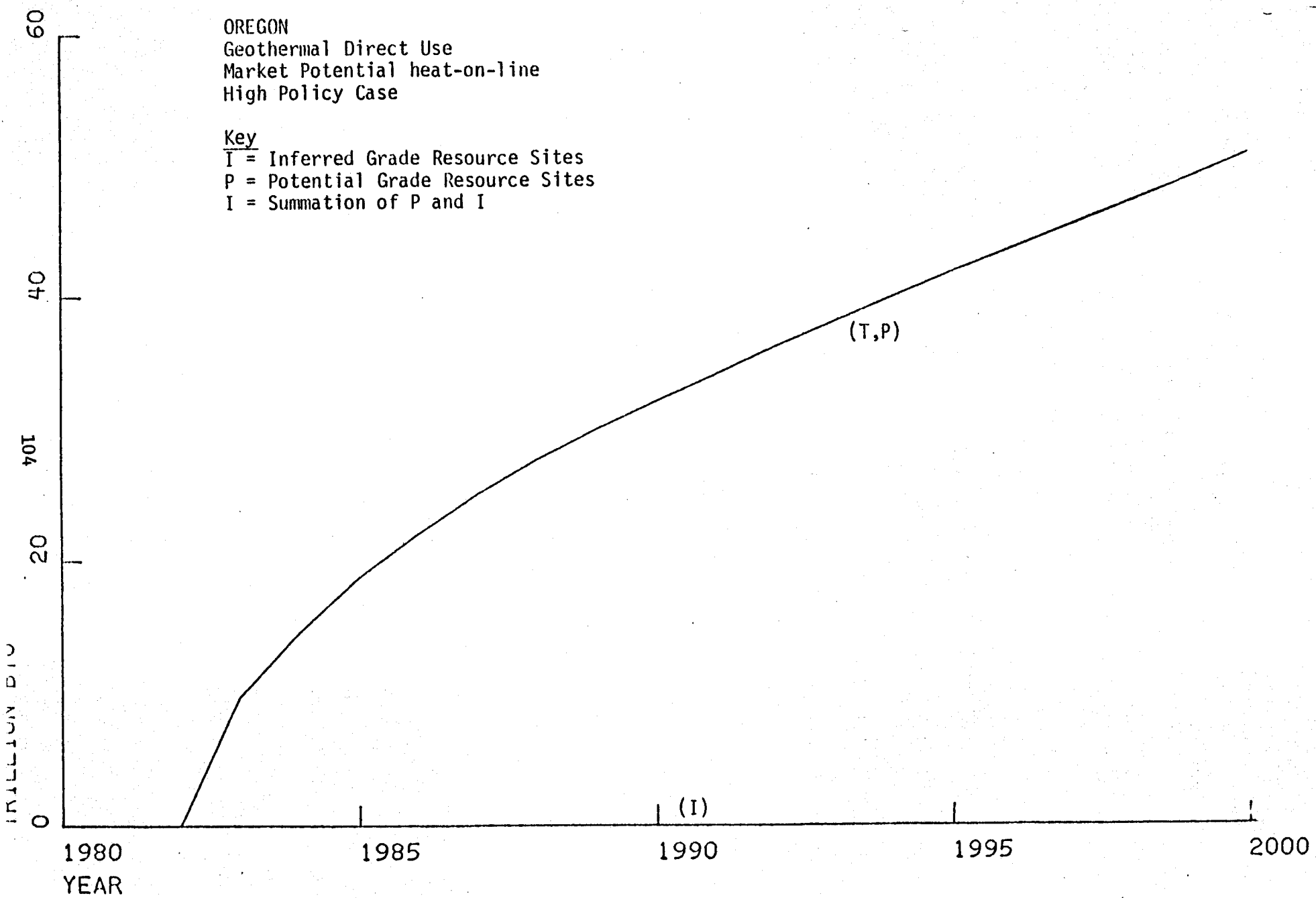


Figure 2

STATE: OREGON
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
335113 KLAMATH FALLS	\$ 1.52	1983
335104 ISLAND CITY	1.98	1983
335114 LA GRANDE	2.23	1983
335118 LAKEVIEW	2.35	1983
335160 ONTARIO	2.38	1983
335222 VALE	2.41	1983
335024 BURNS	2.60	1983
335021 BONANZA	2.83	1983
335085 HAINES	2.84	1983
335099 IDANHA	2.84	1983
335242 BLUE RIVER	3.14	1983
335220 UNION	3.16	1983
335013 BAKER	3.23	1983
335134 MERRILL	3.33	1983
335109 JORDAN VALLEY	3.36	1983
335205 SUMMERSVILLE	3.44	1983
335044 COVE	3.45	1983
335093 HERMISTON	3.59	1983
335100 IMBLER	3.60	1983
335157 NYSSA	3.61	1983
335168 PORTLAND	3.61	1983
335244 CRANE	3.71	1983
335095 HINES	3.71	1983
335156 NORTH POWDER	3.75	1983
335008 ASHLAND	3.75	1983
335241 BEATTY	3.79	1983
335209 TALENT	3.80	1983
335216 TUALATIN	3.84	1983
335247 SPRAGUE RIVER	3.92	1983
335003 ADRIAN	3.95	1983
335211 THE DALLES	4.02	1983
335133 MEDFORD	4.23	1983
335165 PHOENIX	4.28	1983
335159 OAKRIDGE	4.30	1983
335215 TROUTDALE	4.31	1983
335219 UMATILLA	4.32	1983
335051 DETROIT	4.34	1983
335246 MCKENZIE BRIDGE	4.37	1983
335138 MILTON FREEWATER	4.37	1983
335162 PAISLEY	4.38	1983

STATE: OREGON
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
335107 JOHN DAY	\$ 4.41	1983
335061 ELGIN	4.42	1983
335236 WOOD VILLAGE	4.43	1983
335084 GRESHAM	4.47	1983
335184 SANDY	4.52	1983
335170 PRAIRIE CITY	4.54	1983
335231 WESTON	4.70	1983
335098 HUNTINGTON	4.76	1983
335066 FAIRVIEW	4.88	1983
335028 CANYON CITY	4.96	1983
335202 STANFIELD	5.10	1983
335128 MALIN	5.19	1983
335127 MADRAS	5.29	1983
335105 JACKSONVILLE	5.44	1983
335243 BROGAN	5.53	1983
335033 CENTRAL POINT	5.54	1983
335010 ATHENA	5.59	1983
335161 OREGON CITY	5.60	1983
335108 JOHNSON CITY	5.66	1983
335076 GLADSTONE	5.66	1983
335096 HOOD RIVER	5.72	1983
335178 RIVERGROVE	5.83	1983
335034 CHILOQUIN	5.88	1983
335103 IRRIGON	5.89	1983
335139 MILWAUKIE	5.93	1983
335058 EAGLE POINT	6.13	1983
335064 ESTACADA	6.15	1983
335116 LAKE OSWEGO	6.21	1983
335136 MILL CITY	6.25	1983
335020 BOARDMAN	6.30	1983
335060 ECHO	6.62	1983
335218 UKIAH	6.89	1983
335206 SUMPTER	7.03	1983
335146 MOSIER	7.04	1983
335189 SENECA	7.06	1983
335148 MT VERNON	7.08	1983
335221 UNITY	7.54	1983
335073 GATES	8.12	1983
335102 IONE	8.23	1983
335144 MONUMENT	8.31	1983

STATE: OREGON
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
335002 ADAMS	\$ 8.44	1983
335135 METOLIUS	8.63	1984
335120 LEXINGTON	9.01	1984
335091 HELIX	10.36	1987
335176 RICHLAND	11.15	1990
335123 LONG CREEK	11.29	1990
335124 LOSTINE	14.37	1994

State of South Dakota

Summary of Results for State Aggregation

<u>56</u>	Potential City/Site Pairs
<u>12</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 5 potential and 2 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 2.20×10^{10} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1993. This increases through the year 2000. The economic heat potential for the year 2000 is 2.40×10^{12} Btu/Yr.

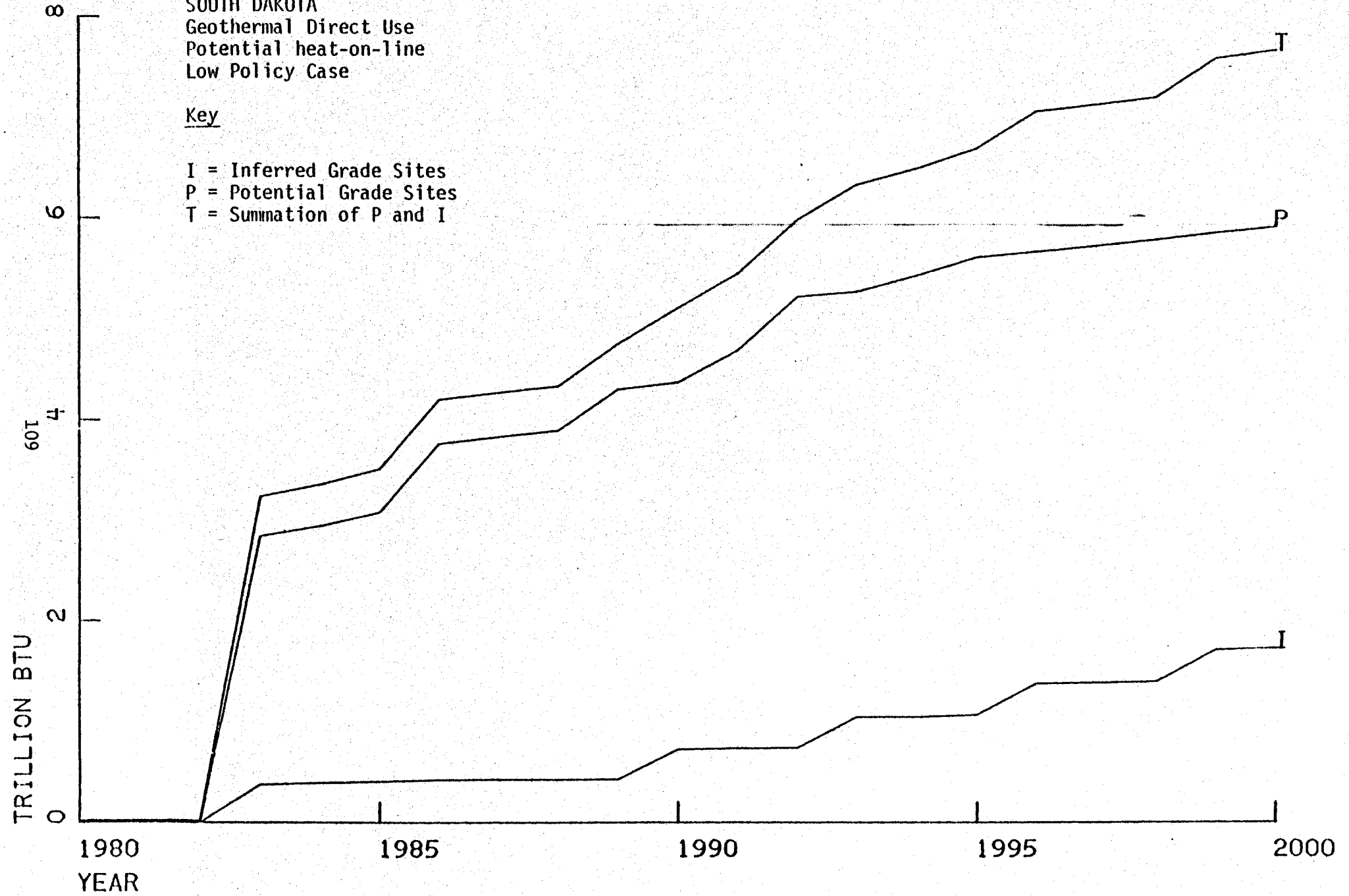
With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1985 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 2.66×10^{12} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 47.0×10^{12} Btu/Yr of which geothermal could supply 6%. For the city developer 46 potential and 11 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1986. It increases to 1.76×10^{11} Btu/Yr by the year 2000.

SOUTH DAKOTA
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key

- I = Inferred Grade Sites
- P = Potential Grade Sites
- T = Summation of P and I



High Case

The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

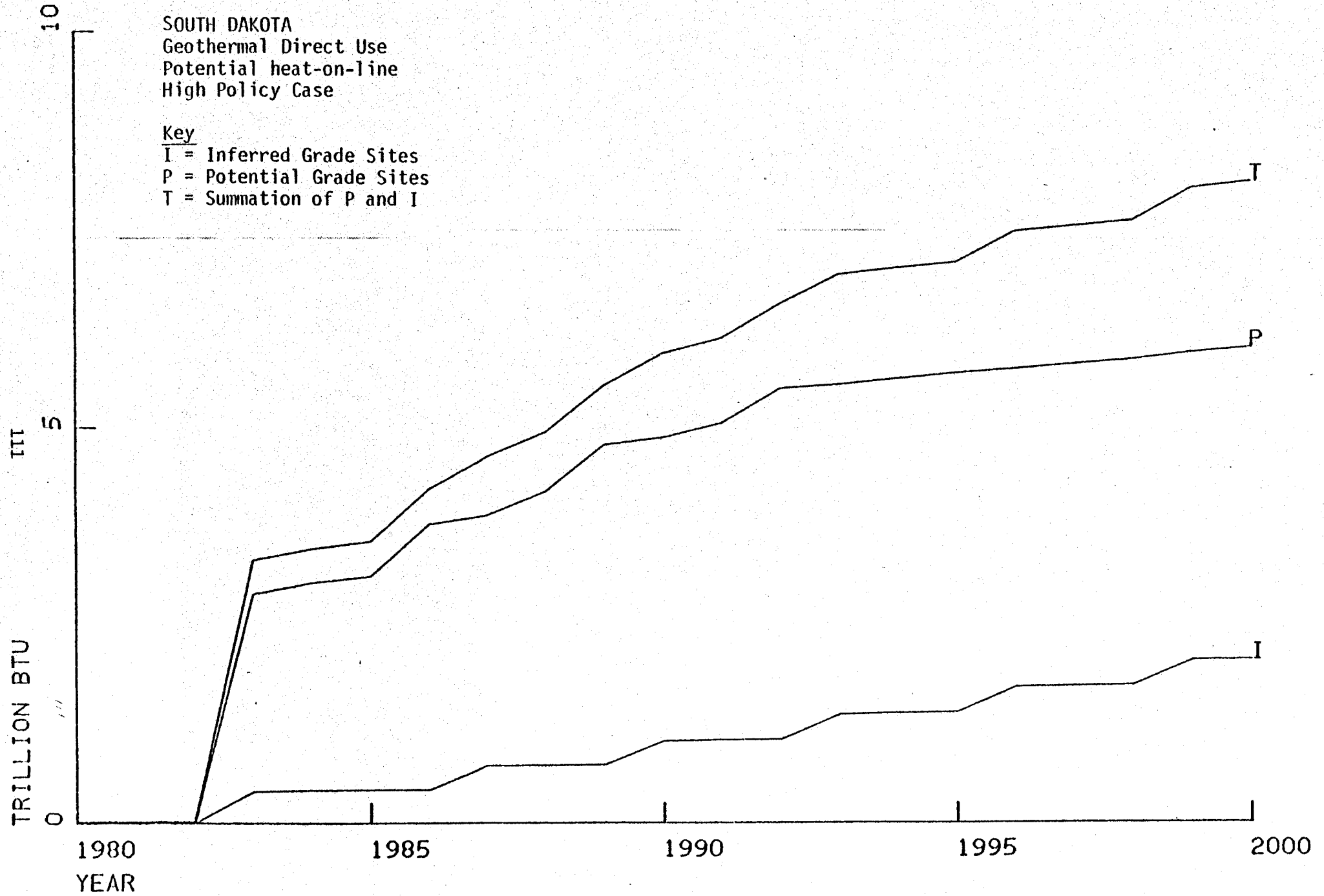
		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	5	45
	Inferred	2	10
City Developer	Potential	46	51
	Inferred	11	11
Year major growth in potential begins			
	Private Developer	1993	1983
	City Developer	1985	1983
Economic heat potential in 2000			
	Private Developer	2.40×10^{12}	7.24×10^{12}
	City Developer	2.66×10^{12}	8.09×10^{12}
Industrial heat potential in 2000			
	Private Developer	1.76×10^{11}	3.66×10^{11}
Percentage of state space heat demand*		6%	17%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

SOUTH DAKOTA
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key

I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: SOUTH DAKOTA
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
275081 EDGEMONT	\$ 3.65	1983	73,869
275131 HOT SPRING	3.70	1983	20,323
275073 DIAMOND RING RANCH	3.86	1983	0
275050 CHAMBERLAIN	4.19	1983	25,163
275094 FAITH	4.50	1983	1,621
275290 WINNER	4.90	1983	0
275099 FORT PIERRE	5.26	1983	17,805
275159 LEMMON	5.54	1983	0
275208 PIERRE	5.57	1983	126,472
275205 PHILIP	5.59	1983	1,621
275190 NEW UNDERWOOD	5.66	1983	0
275142 ISABEL	5.89	1983	0
275078 DUPREE	5.96	1983	1,621
275146 KENNEBEC	5.98	1983	0
275214 PRESKO	6.00	1983	1,423
275193 NORTH EAGLE BUTTE	6.35	1984	0
275112 GETTYSBURG	6.45	1984	1,621
275065 CUSTER	6.74	1985	38,018
275183 MOBRIDGE	6.82	1985	13,578
275189 MURDO	6.92	1985	1,423
275132 HOVEN	7.14	1986	35,084
275178 MIDLAND	7.14	1986	0
275250 TIMBER LAKE	7.36	1986	0
275270 WALL	7.39	1986	0
275091 EUREKA	7.51	1986	0
275174 MCINTOSH	7.59	1987	0
275171 MARTIN	7.85	1987	40,712
275079 EAGLE BUTTE	7.89	1987	3,241
275212 POLLOCK	8.15	1988	0
275173 MC LAUGHLIN	8.39	1988	0
275145 KADOKA	8.90	1989	1,423
275037 BUFFALO	8.97	1989	0
275123 HERREID	9.42	1990	0
275130 HOSMER	9.86	1991	0
275077 DRAPER	10.17	1992	0
275239 SPEARFISH	5.71	1993	13,094
275019 BELLE FOURCHE	5.91	1994	1,858

STATE: SOUTH DAKOTA
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
275038 BUFFALO GAP	\$ 12.07	1995	0
275187 MOUND CITY	12.33	1995	0
275002 AGAR	12.35	1995	0
275158 LEBANON	14.39	1998	0
275020 BELVIDERE	15.38	1999	0

STATE: SOUTH DAKOTA
INFERRED SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
275278 WEBSTER	\$ 5.57	1983	0
275116 GROTON	5.76	1983	0
275032 BRISTOL	7.84	1987	0
275060 CONDE	8.15	1988	0
275207 PIERPONT	8.74	1989	0
275228 ROSLYN	9.18	1990	0
275027 BRADLEY	9.87	1991	0
275001 ASERDEEN	5.39	1992	0
275006 ANDOVER	11.98	1994	0
275195 NORTHVILLE	14.08	1997	0

State of Utah

Summary of Results for State Aggregation

<u>59</u>	Potential City/Site Pairs
<u>91</u>	Inferred City/Site Pairs

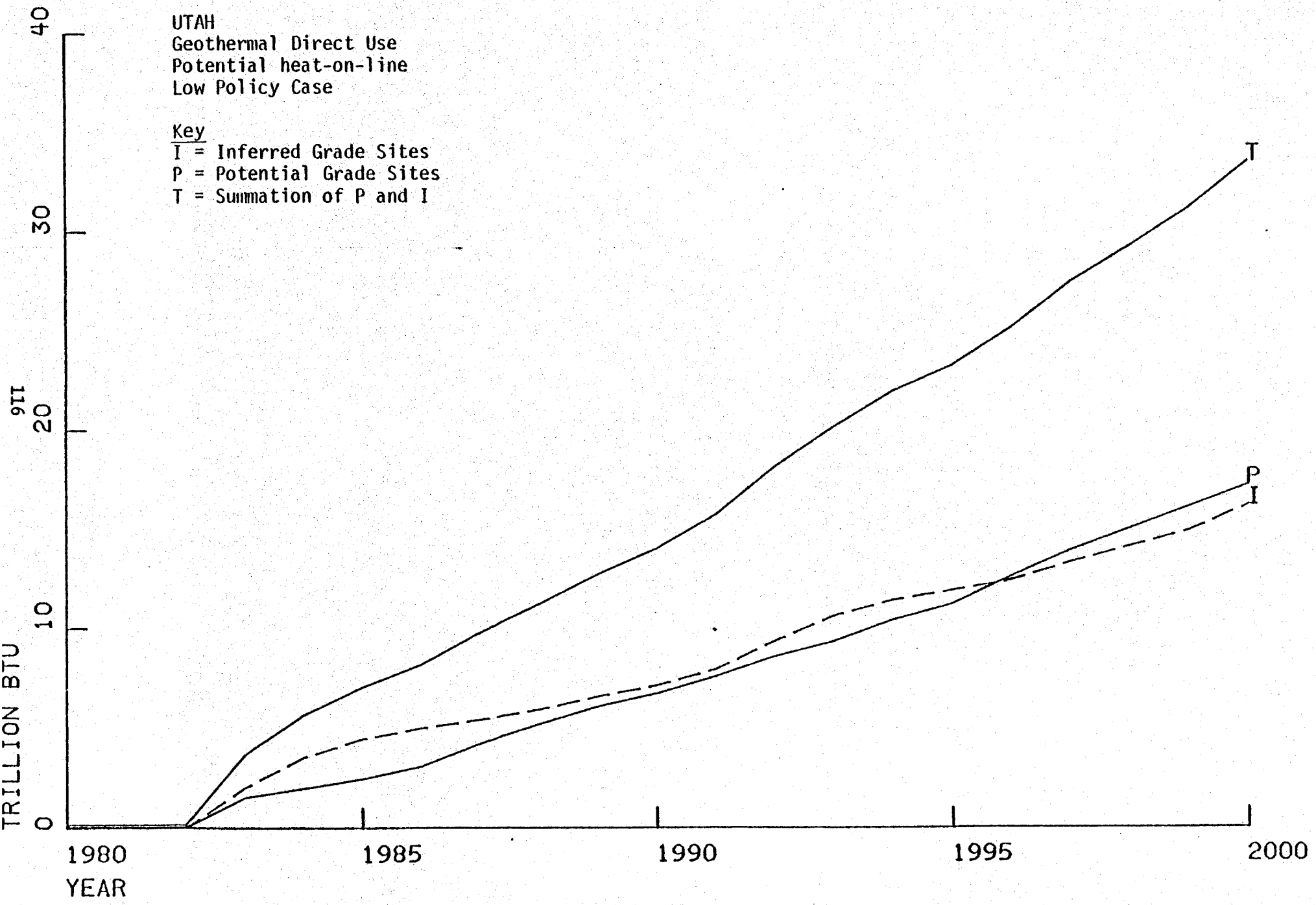
Low Case

If the system development is done by private business, 3 potential and 6 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 1.54×10^{11} Btu/Yr.

Significant growth in quantity of geothermal heat which is economic begins in 1988. This increases through the year 2000. The economic heat potential for the year 2000 is 4.72×10^{12} Btu/Yr.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 3.35×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 11.7×10^{13} Btu/Yr of which geothermal could supply 29%. For the city developer 49 potential and 61 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer begins with significant increases in 1991. It increases to 2.67×10^{13} Btu/Yr by the year 2000.



High Case

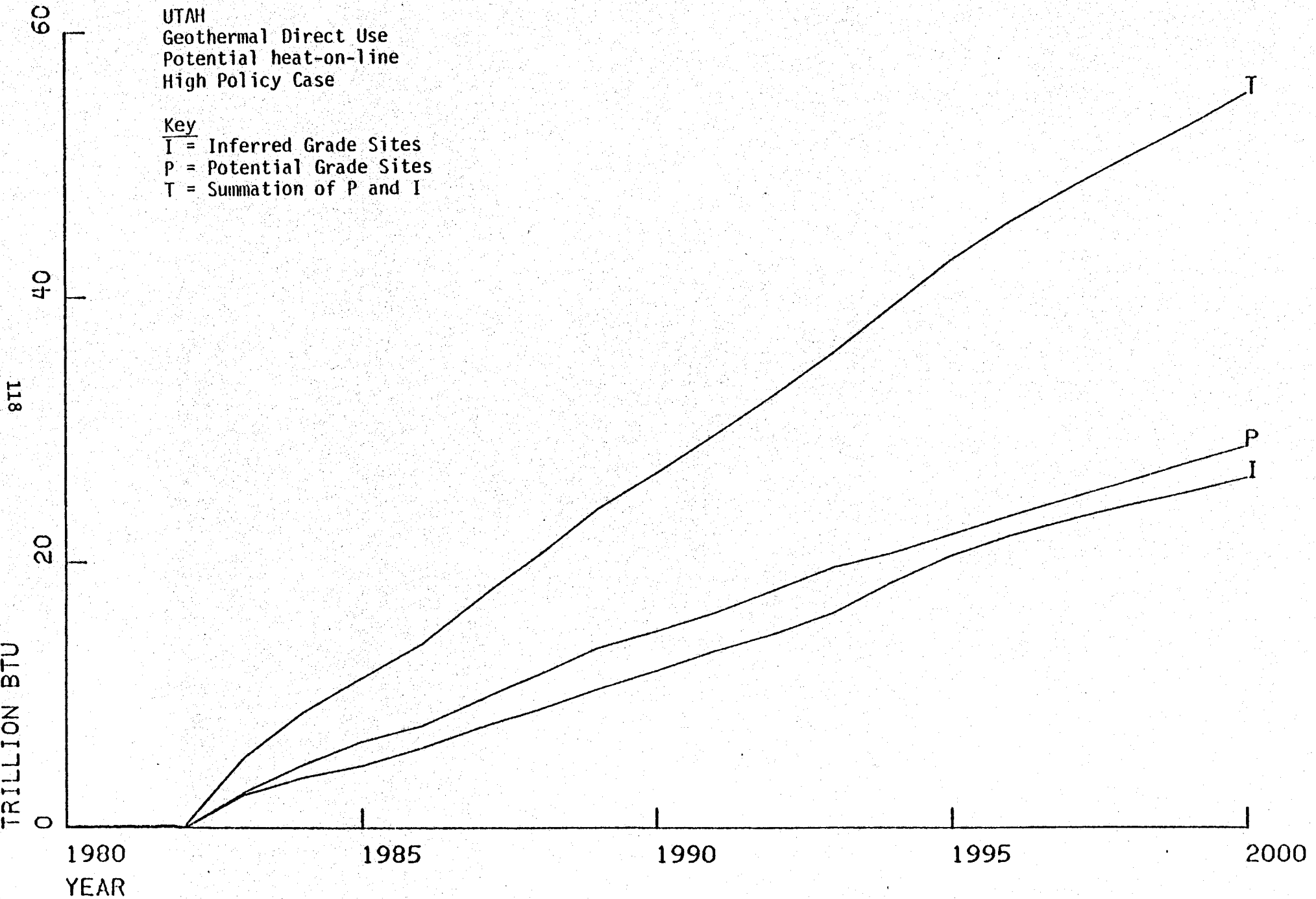
The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	3	54
	Inferred	6	69
City Developer	Potential	49	55
	Inferred	61	80
Year major growth in potential begins			
	Private Developer	1988	1982
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	4.72×10^{12}	4.3×10^{13}
	City Developer	3.35×10^{13}	5.54×10^{13}
Industrial heat potential in 2000			
	Private Developer	2.67×10^{13}	2.19×10^{14}
Percentage of state space heat demand*		29%	47%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

UTAH
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: UTAH
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
285153 NORTH SALT LAKE	\$ 2.22	1983	23,256,642
285232 WEST JORDAN	2.27	1983	2,169,109
285139 MONROE	3.43	1983	0
285206 ST GEORGE	4.47	1983	194,656
285135 MILFORD	4.55	1983	1,946
285149 NEWCASTLE	4.73	1983	0
285052 ELSINORE	4.87	1983	0
285230 WENDOVER	5.03	1983	0
285099 JOSEPH	5.71	1983	0
285128 MARYSVALE	5.80	1983	0
285059 EUREKA	5.87	1983	0
285006 ANNABELLA	6.12	1983	0
285192 SANTA CLARA	7.22	1983	0
285060 FAIRVIEW	7.97	1984	0
285122 MAESER	8.16	1985	0
285144 MT PLEASANT	8.67	1986	0
285114 LEHI	3.48	1988	417,704
285184 RIVERTON	3.52	1988	48,684
285133 MIDVALE	3.54	1988	507,337
285134 MIDWAY	3.58	1988	0
285198 SOUTH JORDAN	3.59	1988	0
285091 HONEYVILLE	3.61	1988	93,364
285142 MORONI	9.57	1988	0
285191 SANDY	3.68	1989	349,297
285044 DRAPER	3.74	1989	105,795
285170 PLEASANT VIEW	3.82	1989	0
285222 VERNAL	6.06	1989	118,595
285218 TREMONTON	3.92	1990	15,118
285238 WOODS CROSS	4.07	1990	0
285005 AMERICAN FORK	4.14	1991	41,267
285168 PLAIN CITY	4.24	1991	0
285231 WEST BOUNTIFUL	4.25	1991	0
285034 CORINNE	4.34	1992	0
285152 NORTH OGDEN	4.35	1992	0
285001 ALPINE	4.42	1992	0
285083 HEBER CITY	4.45	1992	88,023
285032 CLINTON	4.55	1992	0
285098 JENSEN	12.13	1992	0
285190 SALT LAKE CITY	4.59	1993	185,981,889

STATE: UTAH
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
285071 GARLAND	\$ 4.59	1993	0
285009 BEAR RIVER CITY	4.74	1993	0
285061 FARMINGTON	4.79	1993	205,187
285233 WEST POINT	4.80	1993	0
285066 FOUNTAIN GREEN	13.35	1993	0
285212 SYRACUSE	4.88	1994	9,219
285236 WILLARD	4.94	1994	0
285171 PLYMOUTH	4.95	1994	0
285092 HOOPER	5.00	1994	9,345
285167 PERRY	5.75	1996	0
285200 SOUTH SALT LAKE	6.01	1997	0
285026 CHARLESTON	6.36	1998	0
285016 BOUNTIFUL	6.55	1999	678
285053 ELWOOD	6.63	1999	0

STATE: UTAH
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
285219 TRENTON	\$ 3.83	1983	0
285143 MOUNT OLYMPUS	4.43	1983	0
285180 RICHFIELD	4.54	1983	82,059
285039 DELTA	5.01	1983	933,130
285074 GOSHEN	5.50	1983	0
285160 OREM	5.54	1983	6,829
285108 LA VERKIN	5.95	1983	0
285038 DELLE	6.28	1983	1,118,449
285095 HURRICANE	6.40	1983	4,574
285145 MURRAY	6.75	1983	11,058
285125 MANTI	7.11	1983	41,378
285050 EAST MILLCREEK	7.29	1983	0
285055 ENTERPRISE	7.62	1984	0
285036 COTTONWOOD	7.77	1984	0
285154 OAK CITY	7.79	1984	0
285088 HINCKLEY	7.81	1984	0
285217 TORQUERVILLE	7.91	1984	0
285021 CEDAR CITY	6.81	1985	87,018
285080 GUNNISON	8.28	1985	13,139
285056 EPHRAIM	8.95	1986	0
285040 DESERET	9.14	1987	0
285195 SIGURD	10.03	1988	0
285023 CENTERFIELD	10.08	1988	0
285120 LOGAN	3.65	1989	14,736
285189 SALINA	10.70	1989	35,948
285151 NORTH LOGAN	4.08	1990	0
285008 AURORA	11.14	1990	0
285179 REDMOND	11.21	1990	0
285182 RIVER HEIGHTS	4.24	1991	0
285205 SPRINGVILLE	4.30	1991	641,015
285166 PAYSON	4.36	1992	31,564
285127 MAPLETON	4.37	1992	0
285202 SPANISH FORK CITY	4.47	1992	227,386
285188 SALEM	4.47	1992	0
285176 PROVIDENCE	4.56	1992	714
285207 STERLING	12.14	1992	0
285196 SMITHFIELD	4.81	1993	1,135,014
285156 OASIS	13.19	1993	0
285181 RICHMOND	4.94	1994	729,173
285157 OGDEN	4.99	1994	87,136

STATE: UTAH
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
285097 HYRUM	\$ 5.06	1994	206,512
285183 RIVERDALE CITY	5.13	1994	0
285129 MAYFIELD	13.61	1994	0
285223 VIRGIN	13.97	1994	0
285028 CLARKSTON	5.16	1995	0
285150 NEWTON	5.17	1995	0
285082 HARRISVILLE	5.18	1995	0
285211 SUNSET	5.18	1995	0
285116 LEWISTON	5.36	1995	18,005
285229 WELLSVILLE	5.38	1995	486,740
285221 VENICE	14.91	1995	15,185
285201 SOUTH WEBER	5.47	1996	0
285227 WASHINGTON TERRACE	5.68	1996	0
285121 LYNNDYL	15.99	1996	0
285024 CENTERVILLE	5.86	1997	116,963
285136 MILLVILLE	6.00	1997	0
285113 LEAMINGTON	16.11	1997	0
285197 SNOWVILLE	17.04	1997	0
285118 LINDON	6.17	1998	0
285112 LAYTON	6.24	1998	38,454
285069 FRUIT HEIGHTS	6.49	1998	0
285104 KAYSVILLE	6.50	1998	205,187
285141 MORGAN	6.50	1998	28,323
285169 PLEASANT GROVE	6.53	1999	293,039
285123 MAGNA	6.70	1999	1,773,749
285096 HYDE PARK	6.71	1999	0
285049 EAST LAYTON	6.83	1999	0
285058 EUNOCH	18.27	1999	0
285177 PROVO	7.06	2000	14,829
285090 HOLLADAY	7.29	2000	0

State of Washington

Summary of Results for State Aggregation

The state geothermal aggregation for Washington uses 26 Potential and 147 Inferred City/Site pairs as a basis. This is the total number of resource-user matches which are considered for economic evaluation.

Low Case

The number of possible users which could be developed are listed above. Upon analysis using BTHERM, some will never prove to be economic within the aggregation time frame.

If the district heating system development is done by private business, 4 potential and 6 inferred city/site pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 0.

Significant growth in quantity of geothermal heat which is economic begins in 1998. This increases steadily through the year 2020. The economic direct use market potential for the year 2000 is 12.4×10^{12} Btu/yr. under the private development scenario.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2020. The economic heat market potential for the year 2000 is 95.5×10^{12} Btu/yr. For the city developer 23 potential and 29 inferred sites become economic by the year 2000. A graph of the city developed, geothermal energy market potential by year for the residential/commercial sectors is presented in Figure 1.

The industrial energy supply market potential with a private developer does not begin until after 1990. It increases to 4.26×10^{12} Btu/yr by the year 2000.

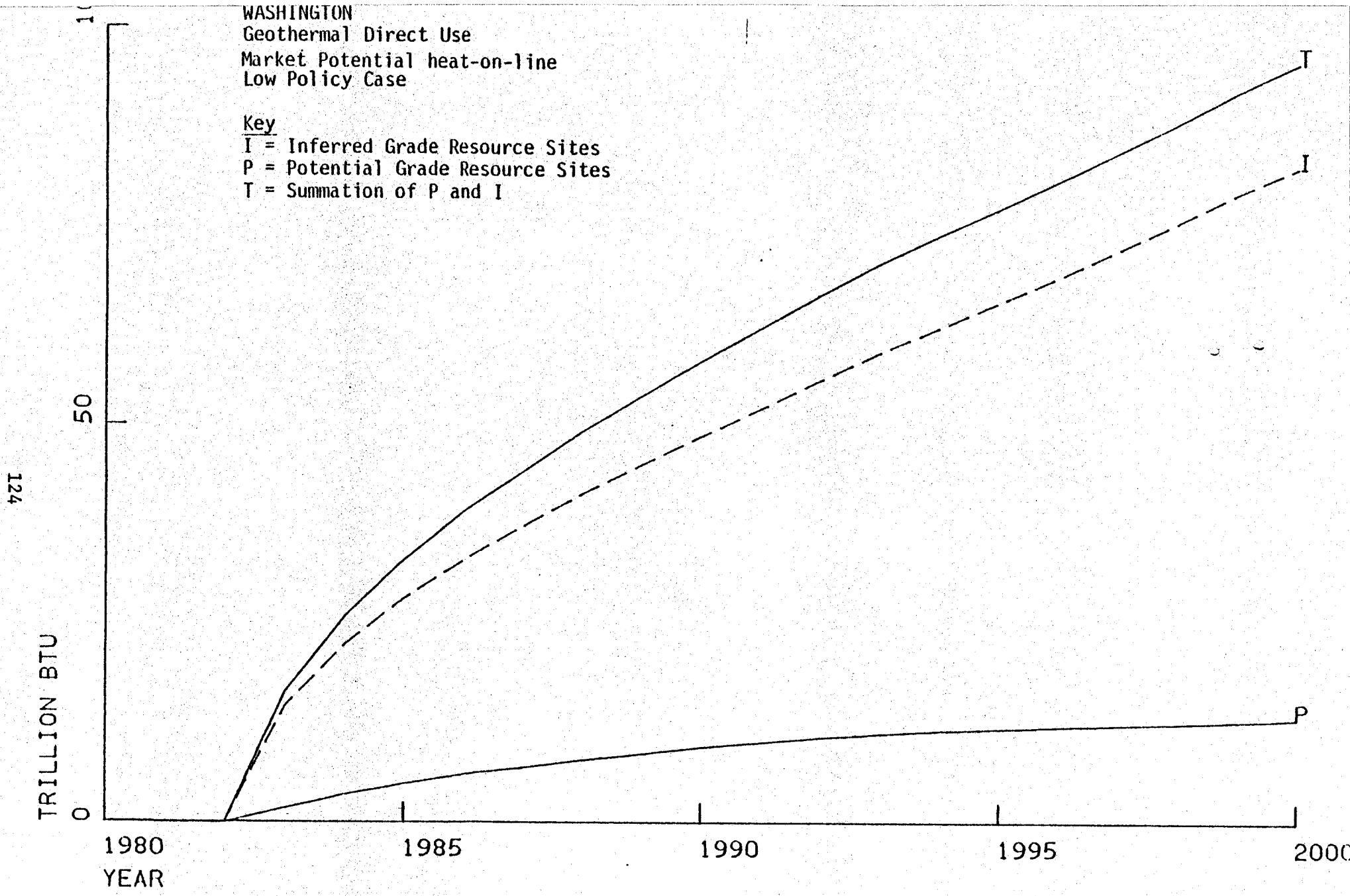


Figure 1

High Case

The high case, a more optimistic case for geothermal development, is quite similar. These results are presented below in tabular form along with the results for low case for comparison. A graph of city developed geothermal energy market potential in the high case, for residential/commercial sectors is presented in Figure 2.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential City/Site	4	25
	Inferred City/Site	6	30
City Developer	Potential City/Site	23	25
	Inferred City/Site	29	30
Year major growth in potential begins			
	Private Developer	1998	1983
	City Developer	1983	1983
Economic heat potential in 2000			
	Private Developer	1.24×10^{13}	9.58×10^{13}
	City Developer	9.55×10^{13}	9.61×10^{13}
Industrial heat potential in 2000			
	Private Developer	4.26×10^{12}	6.67×10^{13}

Summary

It is apparent that geothermal direct use can play an important role in decreasing the state's energy dependence on petroleum and other fuels. It should be noted that the economic comparison was made against the cheapest conventional fuel in the area. This includes inexpensive Northwest hydroelectricity.

Another important benefit is the conservation of present supplies of natural gas and lessened demand for electricity that results from the development of geothermal energy.

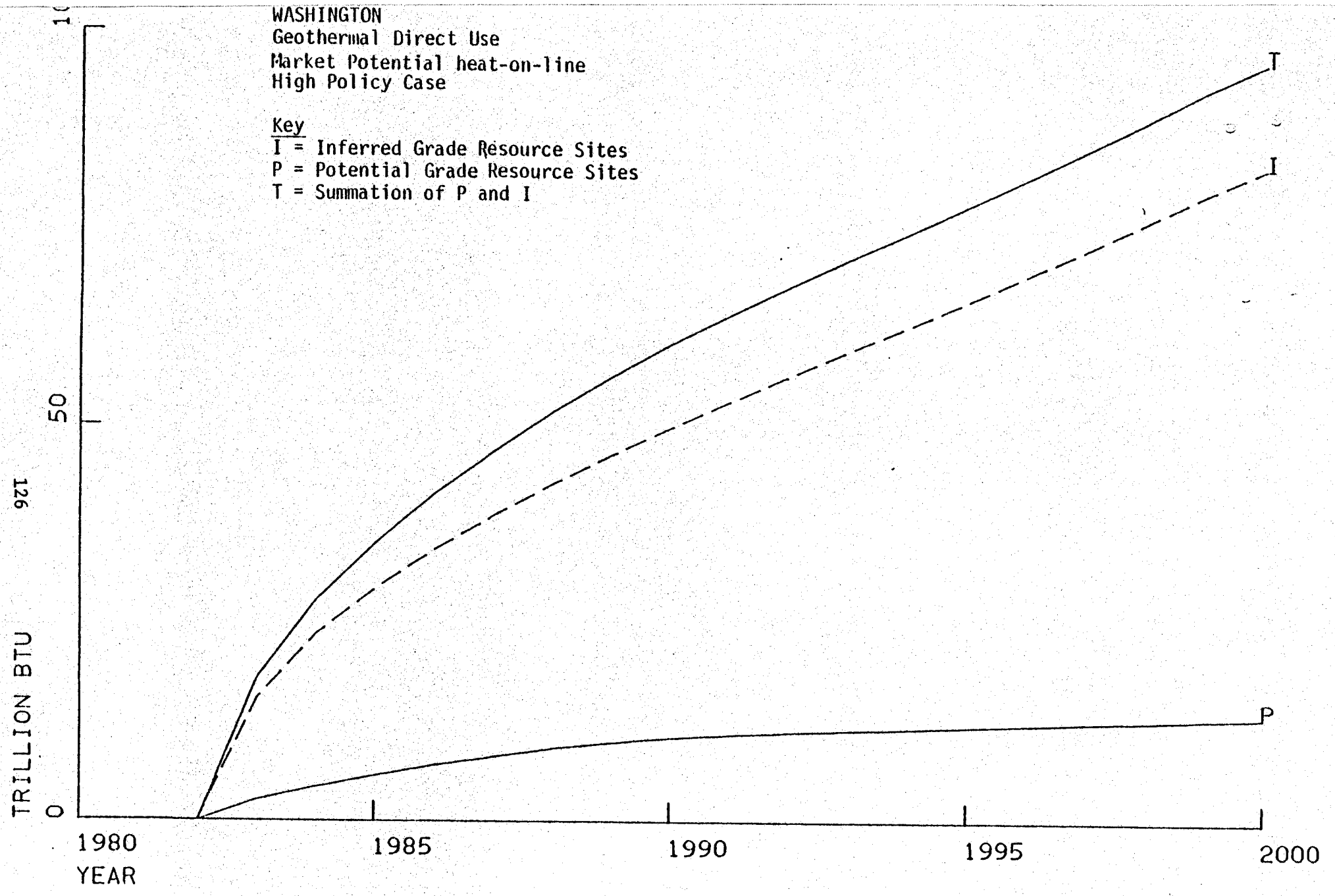


Figure 2

STATE: WASHINGTON
 POTENTIAL SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
345167 OROVILLE	\$ 3.04	1983
345279 CARSON	3.04	1983
345144 MOSES LAKE	3.16	1983
345242 WALLA WALLA	3.54	1983
345281 PACKWOOD	3.62	1983
345176 FORT ANGELES	3.87	1983
345065 ELLENSBURG	3.92	1983
345108 KITTITAS	4.27	1983
345250 WEST RICHLAND	4.29	1983
345255 WILSON CREEK	4.52	1983
345189 RENTON	4.80	1983
345070 ENUMCLAW	4.97	1983
345016 BLACK DIAMOND	4.99	1983
345024 BUCKLEY	5.48	1983
345100 ISSAQUAH	5.50	1983
345156 NORTH BEND	5.51	1983
345209 SNOQUALMIE	6.19	1983
345188 REDMOND	6.70	1983
345046 CONCRETE	7.34	1983
345329 MAPLE VALLEY	7.37	1984
345282 RANDLE	7.38	1985
345054 DARRINGTON	7.66	1985
345345 RAVENSDALE	8.36	1987
345292 BIRDSVIEW	12.17	1993
345348 ROCKPORT	16.68	1998

STATE: WASHINGTON
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
345227 TACOMA	\$ 2.44	1983
345105 KENT	3.55	1983
345104 KENNEWICK	3.70	1983
345133 MEDICAL LAKE	3.77	1983
345309 DISHMAN	3.80	1983
345148 MOXEE CITY	3.81	1983
345262 YAKIMA	3.86	1983
345307 COWICHE	3.90	1983
345042 COLLEGE PLACE	3.94	1983
345074 FAIRFIELD	3.95	1983
345218 ST JOHN	3.97	1983
345172 PASCO	3.98	1983
345092 HARRINGTON	4.00	1983
345181 PROSSER	4.01	1983
345049 COULEE CITY	4.01	1983
345085 GOLDENDALE	4.01	1983
345216 SPRAGUE	4.03	1983
345197 ROSALIA	4.03	1983
345228 TEKOA	4.03	1983
345036 CHENEY	4.04	1983
345196 ROCKFORD	4.07	1983
345003 ALBION	4.07	1983
345279 CARSON	4.12	1983
345169 OTHELLO	4.13	1983
345230 TIETON	4.13	1983
345204 SELAH	4.14	1983
345077 FIFE	4.15	1983
345038 CLARKSTON	4.15	1983
345071 EPHRATA	4.16	1983
345225 SUMNER	4.17	1983
345055 DAVENPORT	4.18	1983
345252 WHITE SALMON	4.19	1983
345150 NACHES	4.19	1983
345323 KLUCKITAT	4.21	1983
345243 WAPATO	4.21	1983
345160 OAKESDALE	4.24	1983
345183 PUYALLUP	4.25	1983
345191 RICHLAND	4.25	1983
345163 ODESSA	4.25	1983
345233 TOPPENISH	4.25	1983

STATE: WASHINGTON
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
345009 AUBURN	\$ 4.26	1983
345195 ROCK ISLAND	4.26	1983
345136 MESA	4.26	1983
345184 QUINCY	4.27	1983
345210 SOAP LAKE	4.27	1983
345244 WARDEN	4.28	1983
345266 BUENA	4.28	1983
345313 FEDERAL WAY	4.30	1983
345008 ASOTIN	4.30	1983
345047 CONNELL	4.31	1983
345222 STEVENSON	4.31	1983
345237 UNION GAP	4.31	1983
345120 LIND	4.35	1983
345014 BENTON CITY	4.35	1983
345193 RITZVILLE	4.37	1983
345140 MILTON	4.38	1983
345175 POMEROY	4.38	1983
345182 PULLMAN	4.38	1983
345112 LA CROSSE	4.39	1983
345200 ROYAL CITY	4.40	1983
345056 DAYTON	4.41	1983
345241 WAITSBURG	4.42	1983
345214 SPANGLE	4.43	1983
345238 UNIONTOWN	4.43	1983
345091 HARRAH	4.43	1983
345068 ENDICOTT	4.45	1983
345078 FIRCREST	4.46	1983
345041 COLFAX	4.47	1983
345087 GRANDVIEW	4.48	1983
345126 MABTON	4.50	1983
345226 SUNNYSIDE	4.50	1983
345275 WHITE SWAN	4.50	1983
345157 NORTH BONNEVILLE	4.51	1983
345268 GLEED	4.51	1983
345276 WILEY	4.51	1983
345082 GEORGE	4.52	1983
345180 PRESCOTT	4.53	1983
345043 COLTON	4.54	1983
345088 GRANGER	4.54	1983
345270 PARKER	4.54	1983

STATE: WASHINGTON
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
345101 KAHLOTUS	\$ 4.61	1983
345267 DIXIE	4.62	1983
345131 MATTAWA	4.63	1983
345170 PACIFIC	4.70	1983
345015 BINGEN	4.70	1983
345127 MALDEN	4.71	1983
345220 STARBUCK	4.73	1983
345215 SPOKANE	4.75	1983
345339 OPPORTUNITY	4.75	1983
345171 PALOUSE	4.76	1983
345058 DES MOINES	4.79	1983
345269 PALISADES	4.79	1983
345361 VERADALE	4.79	1983
345146 MOUNT VERNON	4.81	1983
345118 LATAH	4.81	1983
345002 AIRWAY HEIGHTS	4.81	1983
345083 GIG HARBOR	4.83	1983
345007 ARLINGTON	4.84	1983
345318 GREENACRES	4.86	1983
345075 FARMINGTON	4.87	1983
345030 CASHMERE	4.89	1983
345026 BURLINGTON	4.89	1983
345353 SPANAWAY	4.89	1983
345203 SEDRO WOOLLEY	4.91	1983
345221 STEILACOOM	4.94	1983
345357 UNDERWOOD	4.94	1983
345274 WHEELER	4.95	1983
345271 SAWYER	4.98	1983
345219 STANWOOD	5.02	1983
345004 ALGONA	5.02	1983
345155 NORMANDY PARK	5.04	1983
345119 LEAVENWORTH	5.05	1983
345018 BONNEY LAKE	5.05	1983
345081 GARFIELD	5.07	1983
345249 WENATCHEE	5.08	1983
345295 BURIEN	5.15	1983
345355 THORP	5.24	1983
345201 RUSTON	5.43	1983
345139 MILLWOOD	5.45	1983
345035 CHELAN	5.61	1983

STATE: WASHINGTON
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE
345061 EAST WENATCHEE	\$ 5.61	1983
345297 BURTON	5.80	1983
345168 ORTING	5.85	1983
345246 WASHTUCNA	6.03	1983
345340 OTIS ORCHARDS	6.51	1983
345273 WALLULA	6.87	1983
345039 CLE ELUM	6.96	1983
345272 TOUCHET	7.03	1984
345245 WASHOUGAL	7.18	1984
345198 ROSLYN	7.21	1984
345123 LYMAN	7.22	1984
345247 WATERVILLE	7.27	1984
345187 REARDAN	7.33	1984
345128 MANSFIELD	7.49	1985
345027 CAMAS	7.54	1985
345022 BRIDGEPORT	7.74	1985
345330 MEAD	7.78	1985
345093 HARTLINE	8.17	1986
345212 SOUTH CLE ELUM	8.67	1987
345005 ALMIRA	10.06	1990
345064 ELECTRIC CITY	10.15	1990
345052 CRESTON	10.45	1990
345173 PATEROS	10.81	1991
345310 EASTON	11.22	1992
345090 HAMILTON	11.56	1992
345069 ENTIAT	13.67	1995

State of Wyoming

Summary of Results for State Aggregation

<u>10</u>	Potential City/Site Pairs
<u>20</u>	Inferred City/Site Pairs

Low Case

If the system development is done by private business, 2 potential and 0 inferred pairs are economic within the year 2000 time frame. Existing on line capacity for the state is 1×10^{13} Btu/Yr.

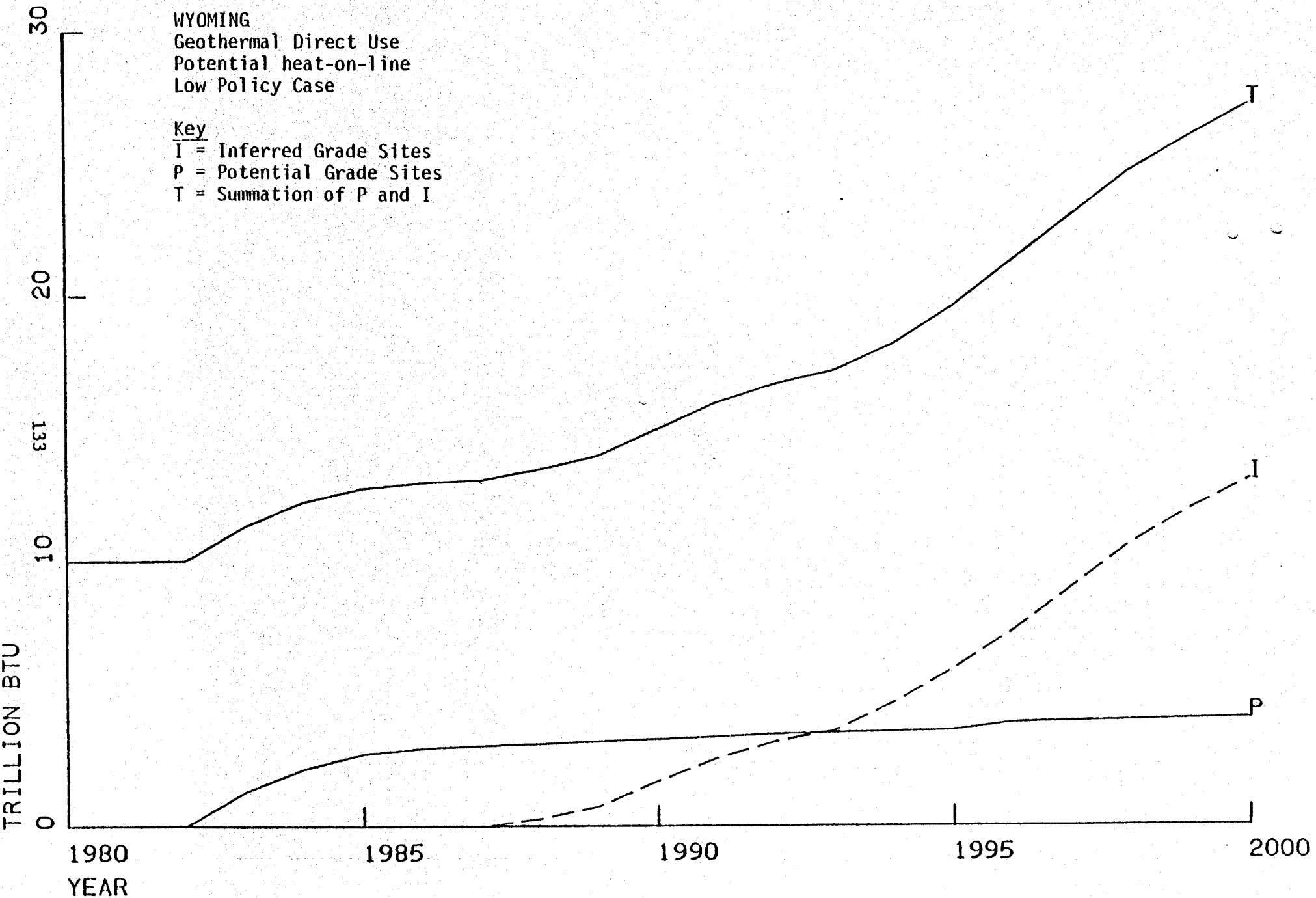
Significant growth in quantity of geothermal heat which is economic begins in 1980. This increases through the year 2000. The economic heat potential for the year 2000 is 1.09×10^{13} Btu/Yr.

With the city as the developer, economic heat-on-line increases much faster. Major increases begin in 1983 and rise steadily through the year 2000. The economic heat potential for the year 2000 is 3.11×10^{13} Btu/Yr. The potential heat-on-line can be compared to the present energy use in the residential/commercial sector which could be penetrated if resources were available everywhere. This total state demand is 4.97×10^{13} Btu/Yr of which geothermal could supply 63%. For the city developer 7 potential and 16 inferred sites become economic by the year 2000. A graph of geothermal energy potential by year is presented below.

The industrial energy supply potential with a private developer does not begin until after 2000. It increases to 1×10^{13} Btu/Yr by the year 2000.

WYOMING
Geothermal Direct Use
Potential heat-on-line
Low Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



High Case

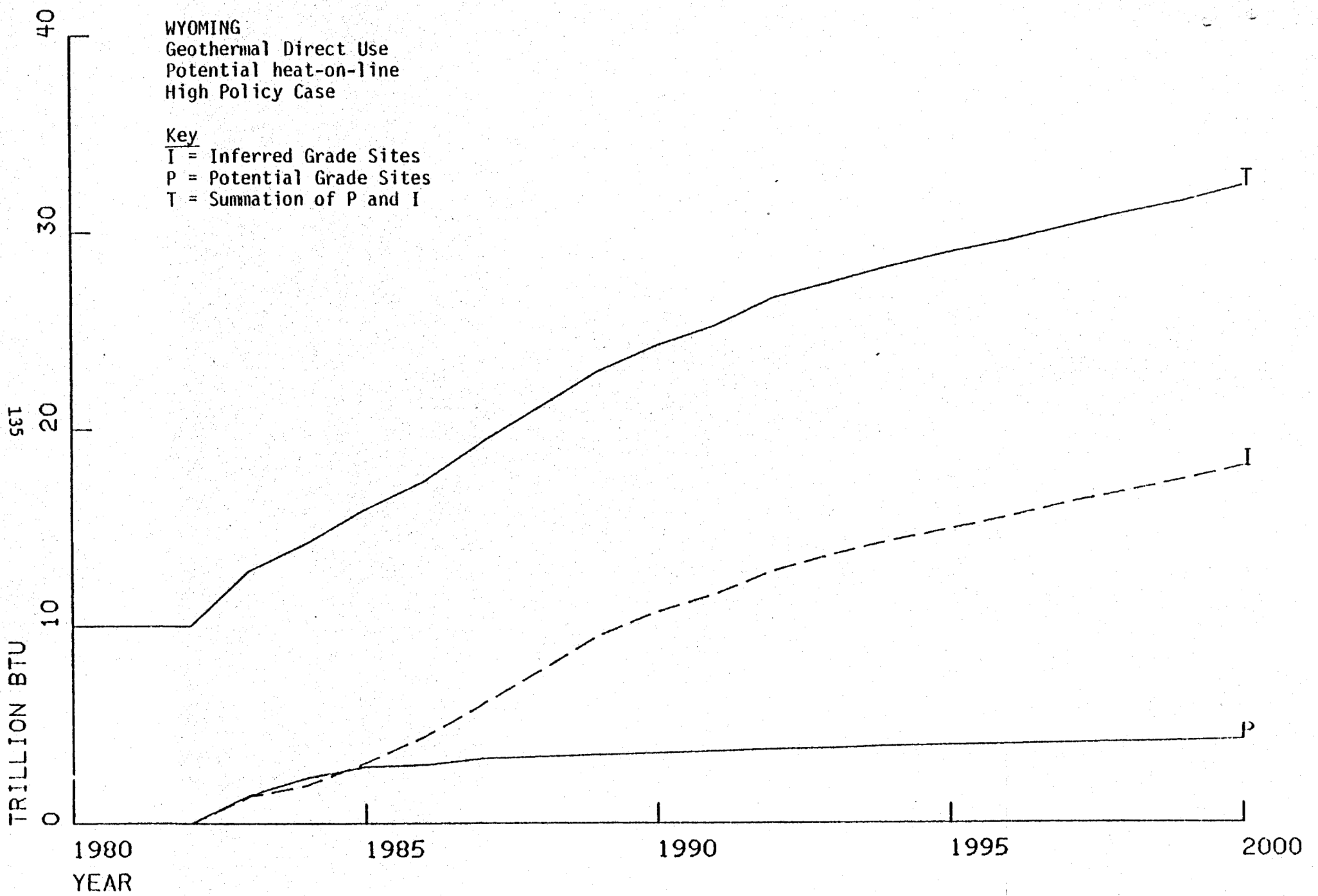
The high case, a more optimistic case for geothermal development, is quite similar but with higher figures. These results are presented below in tabular form along with the results for low case for comparison.

		<u>Low Case</u>	<u>High Case</u>
Pairs economic by year 2000			
Private Developer	Potential	2	8
	Inferred	0	19
City Developer	Potential	7	9
	Inferred	16	19
Year major growth in potential begins			
	Private Developer	1980	1980
	City Developer	1883	1980
Economic heat potential in 2000			
	Private Developer	1.09×10^{13}	3.00×10^{13}
	City Developer	3.11×10^{13}	3.23×10^{13}
Industrial heat potential in 2000			
	Private Developer	1×10^{13}	1.51×10^{13}
Percentage of state space heat demand*		63%	65%

*That portion of the residential and commercial space heating and hot water demand which could be supplied with direct use geothermal, if it were available everywhere.

WYOMING
Geothermal Direct Use
Potential heat-on-line
High Policy Case

Key
I = Inferred Grade Sites
P = Potential Grade Sites
T = Summation of P and I



STATE: WYOMING
POTENTIAL SITES
FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
295070 JACKSON	\$ 3.14	1983	38,244
295024 CODY	3.20	1983	771,820
295034 EAST THERMOPOLIS	3.21	1983	0
295002 AFTON	3.77	1983	310
295050 FT WASHAKIE	3.62	1985	0
295117 SARATOGA	3.70	1985	1,893
295085 LOVELL	4.33	1991	767,463
295094 MIDWEST	8.30	1999	0

STATE: WYOMING
 INFERRED SITES
 FOR CITY DEVELOPER

CITY ID AND NAME	PRICE OF GEO	YEAR ON-LINE	ANNUAL HEAT DEMAND (MMBTU)
295098 MOUNTAIN VIEW	\$ 3.84	1986	398
295019 CASPER	3.95	1986	3,443,928
295024 CODY	4.10	1987	0
295095 MILLS	4.13	1987	79,274
295041 EVANSVILLE	4.14	1987	21,610
295103 PARADISE VALLEY	4.27	1988	0
295096 MOORCROFT	4.42	1988	0
295032 DOUGLAS	4.69	1989	9,445
295119 SHERIDAN	4.07	1990	0
295051 GILLETTE	4.79	1990	0
295059 GUERNSEY	4.84	1990	0
295100 NEWCASTLE	5.31	1992	0
295071 JEFFEREY CITY	5.77	1993	0
295086 LUSK	5.85	1993	2,820
295124 STOREY	5.01	1994	0
295013 BUFFALO	5.99	1994	0
295107 POWELL	5.54	1995	158,593
295053 GLENROCK	6.36	1995	18,978
295132 UPTON	8.28	1999	0

Appendix

Personnel

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Published Reports

- 30 - 11 Geothermal Site Data for Rocky Mountain Basin and Range, An Informal Report, Pat O'Dea, et al., December, 1980.
- 30 - 12 Forecasting the Market Penetration of a New Technology - A Critique, Kim Knauf, et al., January, 1980.
- 30 - 13 State Team Handout, Salt Lake City Conference, Roy Cunniff, et al., January, 1980.
- 30 - 14 Potential Geothermal - Use Cities of New Mexico -An Informal Report, Gary Glazner, et al., February, 1980.
- 30 - 15 Geothermal Potential Sites in the Rocky Mountain Basin and Range - An Informal Report for URRI, Pat O'Dea, March, 1980.
- 30 - 16 Information for DOE Rural Initiative Program, Keith Brown, et al., April 1980.
- 30 - 17 Market Share Forecasts for Geothermally Produced Electricity in the Rocky Mountain Basin and Range Region, 1980-1990, Paul K. McDevitt, Kenneth Nowotny, Nancy Gallant, Bruce Stockton.
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- 30 - 20 Energy Demand Projections for Geothermal Market Penetrations, Kenneth Nowotny, Paul McDevitt, Bruce Stockton, Nancy Gallant, Fekru Debebe, Mark Houldsworth, January, 1980.
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- 61 - 3 Description of Data Files of the Geothermal Operations Research, Project for the Rocky Mountain Basin and Range Region, P.L. O'Dea, New Mexico State University, November, 1980.

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- 61 - 5 National Market Penetration for Geothermal, James Munson, New Mexico State University, December, 1980.