GL01341

J. Griffith

DATA PACKET

STATE TEAM HANDOUT

Salt Lake City Conference

January 22-24, 1980

by

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Distribution List

1 copy RMB&R State Teams
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1 copy (each) DOE Regions 9 and 10

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FORWARD

This data package was prepared to serve as preliminary advance copy of the data developed by the NMEI team during the period January - December 1979. As such, the data represents the initial draft report of results, conclusions, and observation concerning geothermal potential development in the ten states of the Rocky Mountain Basin and Range.

A final report is in preparation which expands on the data contained herein, and which also provides additional data and judgements.

Data are not to be used for reference, quotation, or distribution without prior release by NMEI.

BRIEFING OUTLINE

- Overview of Methodology
    - Market Program
    - Geothermal Market Penetration
- Geothermal Electricity Potential
    - Electricity Export/Import States
    - Rocky Mountain Electrical Capacity
    - Electrical Capacity vs Retained Capacity
- Geothermal Direct-Use Potential
    - Data Files
    - Policy Options
    - Fuel Price Data
    - Fuel Price Increases
    - Cities Served
    - Geothermal Direct-Use Potential
    - Geothermal Market Shares
    - Economically Possible Market Penetration
        - High Case
        - Mid Case
    - Policy Options vs Payback by 1990
    - Required Drilling Programs by 1990
    - Summary Cost and Benefit Analysis by 2020

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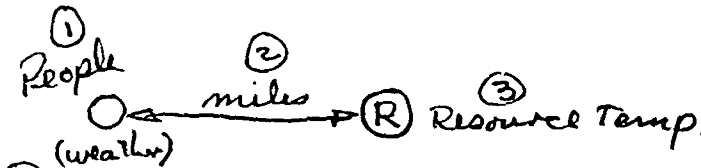
MARKET PROGRAM



- Operates on City and Site Files
- Input Parameters (Population, Distance, Temperature)
- Assigns Weighting Factors
  - Resource temperature
  - City-Site Distance
- Computes and arrays:
  - Optimum city-site pairing
  - Unique city-site relationship
  - Resource name, temperature, city name, population, distance from resource, and weather data
  - Residential heat demand
- Commercial and Industrial Demand Computed Separately

BTHERM

GEOTHERMAL MARKET PENETRATION

RESOURCE DATA
- (SITEX)

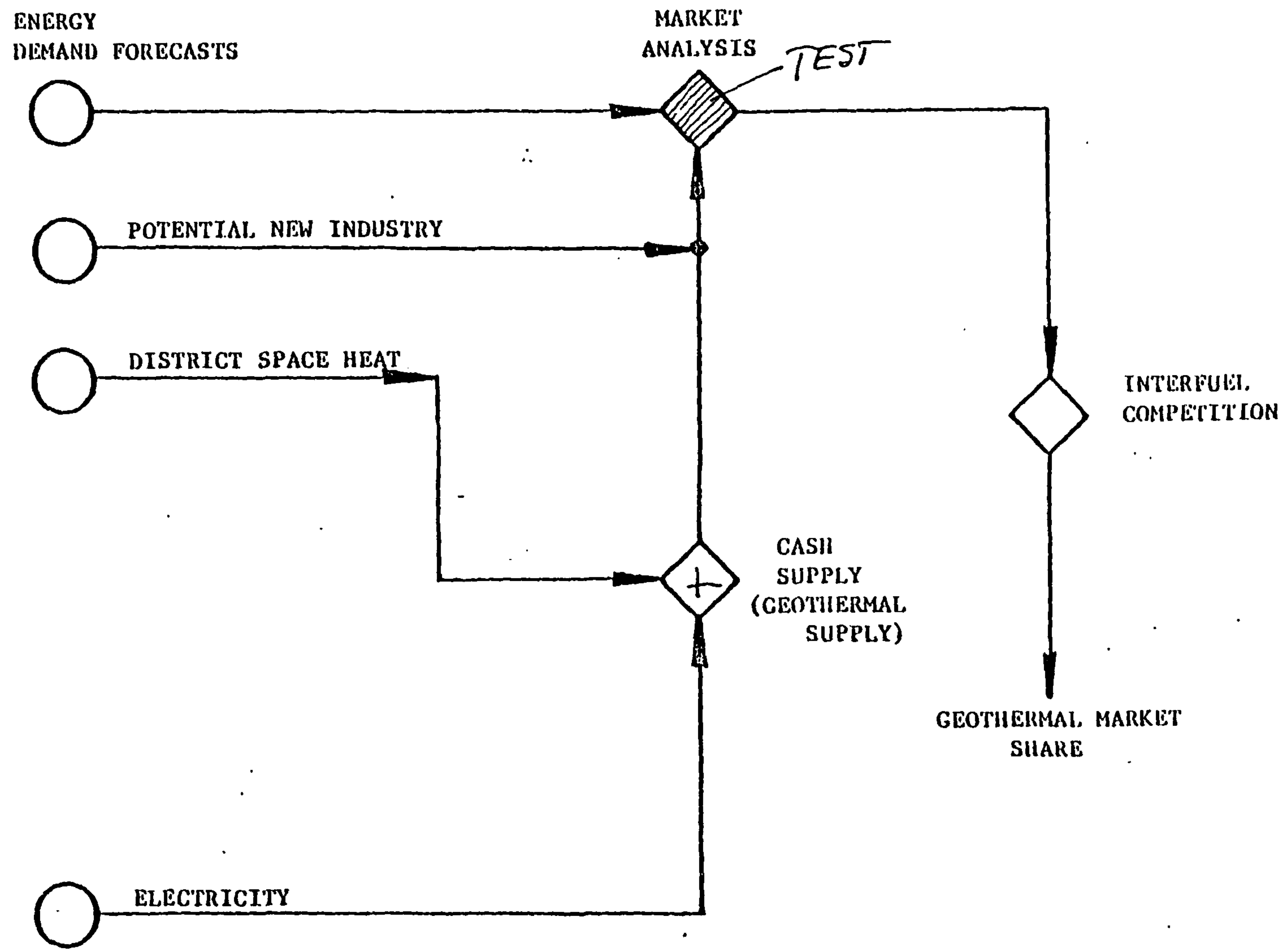
CONSUMERS
- CITY2
- INDUSTRIAL
- NEW INDUSTRY

ENERGY DATA
- CONSUMPTION
- PRICE

WEATHER DATA
- HEATING *degree days of CITY2 file*

GROWTH FACTORS
- POPULATION
- INDUSTRY
- VALUE ADDED
- PRICE
- PER CAPITA INCOME

ENERGY SUPPLY
- CONVENTIONAL
- SYN-FUELS
- IMPORTED FUELS
- SOLAR
- HYDRO

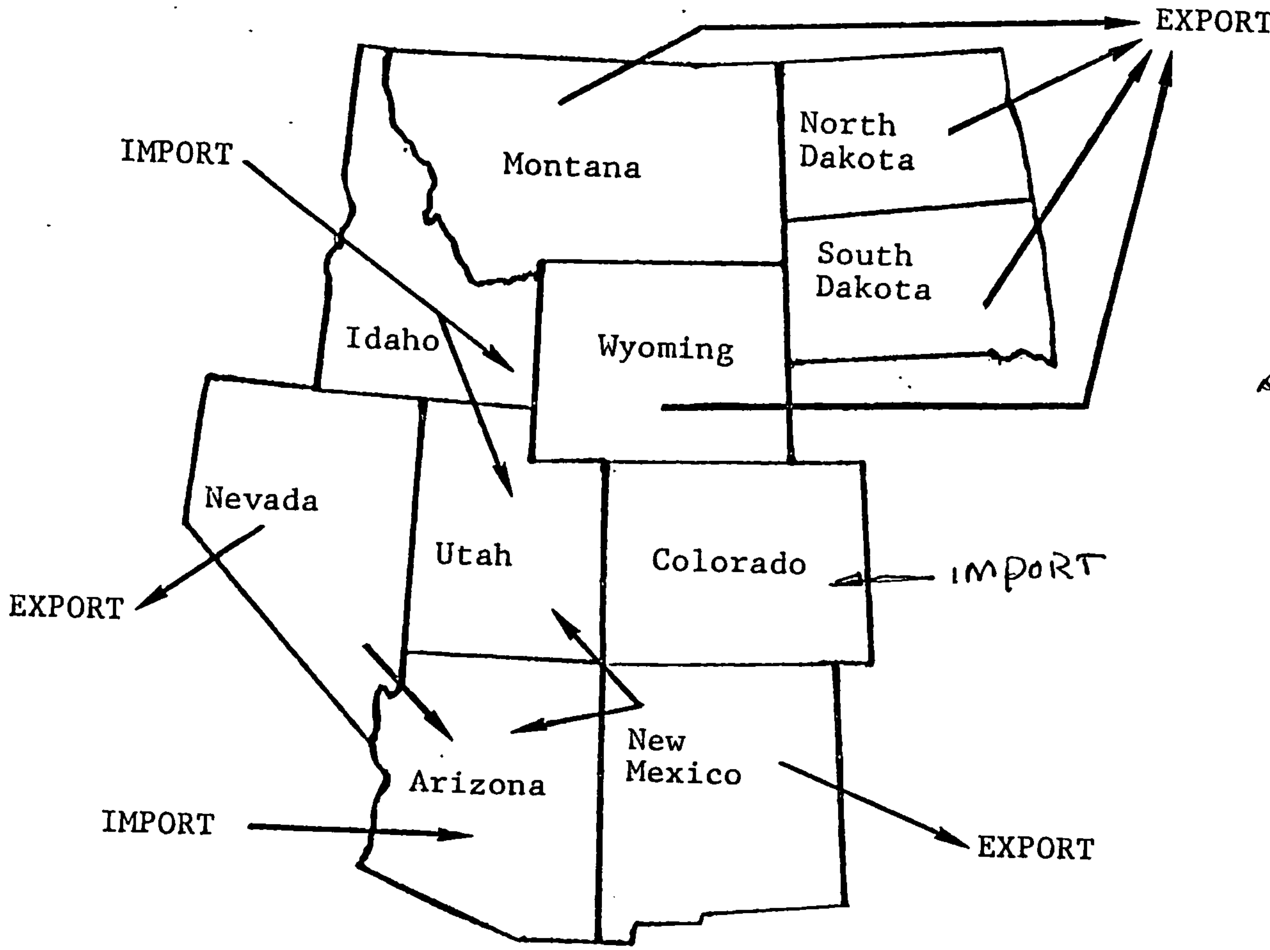


GEOTHERMAL ELECTRICITY POTENTIAL

(10 States)

	MW Potential	
12 Sites, Temperature Higher than 200° C	4,950 - 5,500	(~ 5 - 5½ nuclear plant eq)
94 Sites, Temperature between 149-199° C	4,100 - 11,150	(~ 4 - 11 nuclear plant eq)
TOTAL POTENTIAL	9,050 - 16,650	(~ 9 - 16 1000 MWe plant eq)

Rocky Mountain Basin & Range
Electricity Export/Import States



states:
4 import
6 export

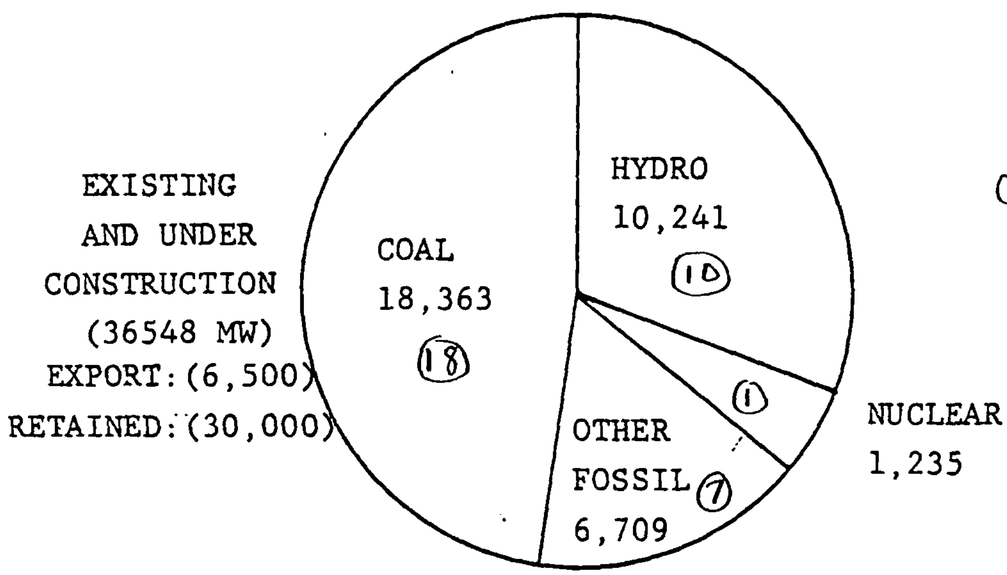
°C

STATE	TEMP ≥ 200 # SITES	MWE	MWO	TEMP > 149 < 199 SITES	MWE	MWO
AZ	Ø	Ø	Ø	9	184	450
CO	1	30	50	6	45	300
ID	2	35	100	35	1792	7100 ← probably much too high
MT	Ø	Ø	Ø	Ø	Ø	Ø
NV	5	1286	1400	24	1360	2000
NM	2	2747	2800	12	235	600
ND	Ø	Ø	Ø	Ø	Ø	Ø
SD	Ø	Ø	Ø	Ø	Ø	Ø
UT	1	964	1000	8	475	700
WY	1	121	150	Ø	Ø	Ø
TOTALS	12	5,183	5,500	94	4091	11,150

16,650

TITLE: ELECT POT. of 10 RM States for 200 an 150-200°

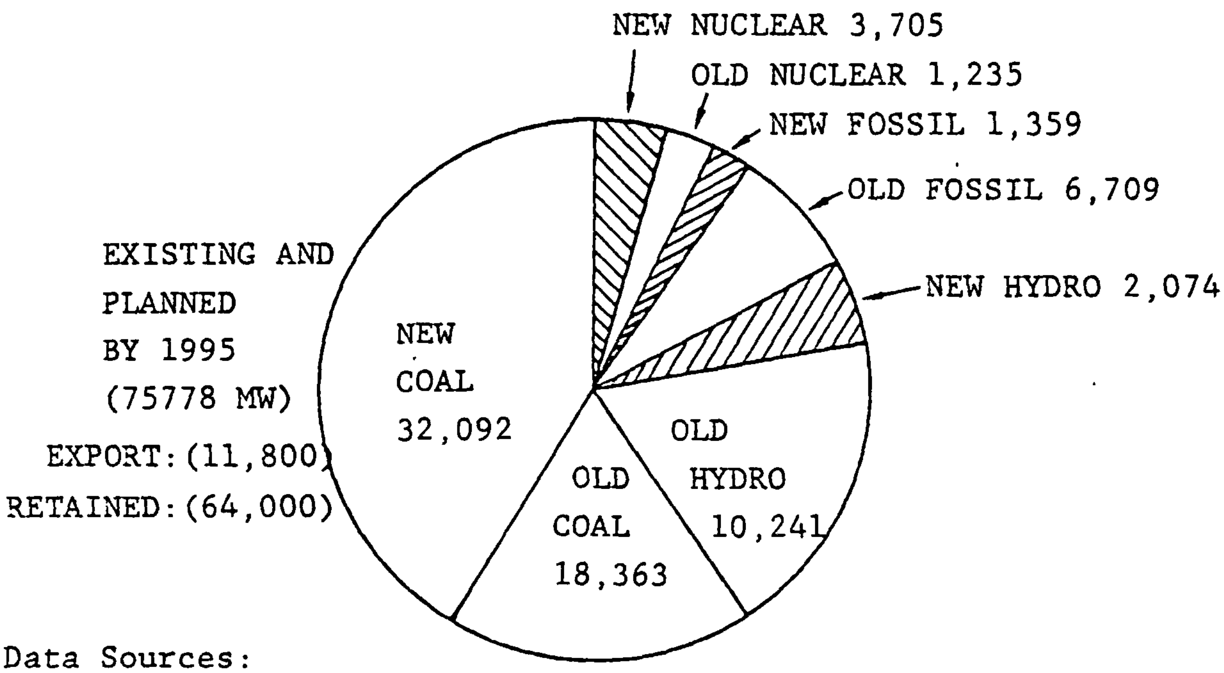
Rocky Mountain Basin and Range
Electrical Capacity by Fuel
(MEGAWATTS)



1000 MWe units

	Now	1995
coal	18	50
hydro	10	12
nuc	1	5
other	7	8
	36	75
export	6	12
	30	63

2000



Data Sources:

1. Western Interstate Energy Board.
2. DOI - Projects to Expand Energy Sources in the Western States.
3. The 1975 Energy Production System in the States of the Rocky Mountain Region: Los Alamos Scientific Laboratory.
4. Basin Electric Power Cooperative: Bismarck, ND.

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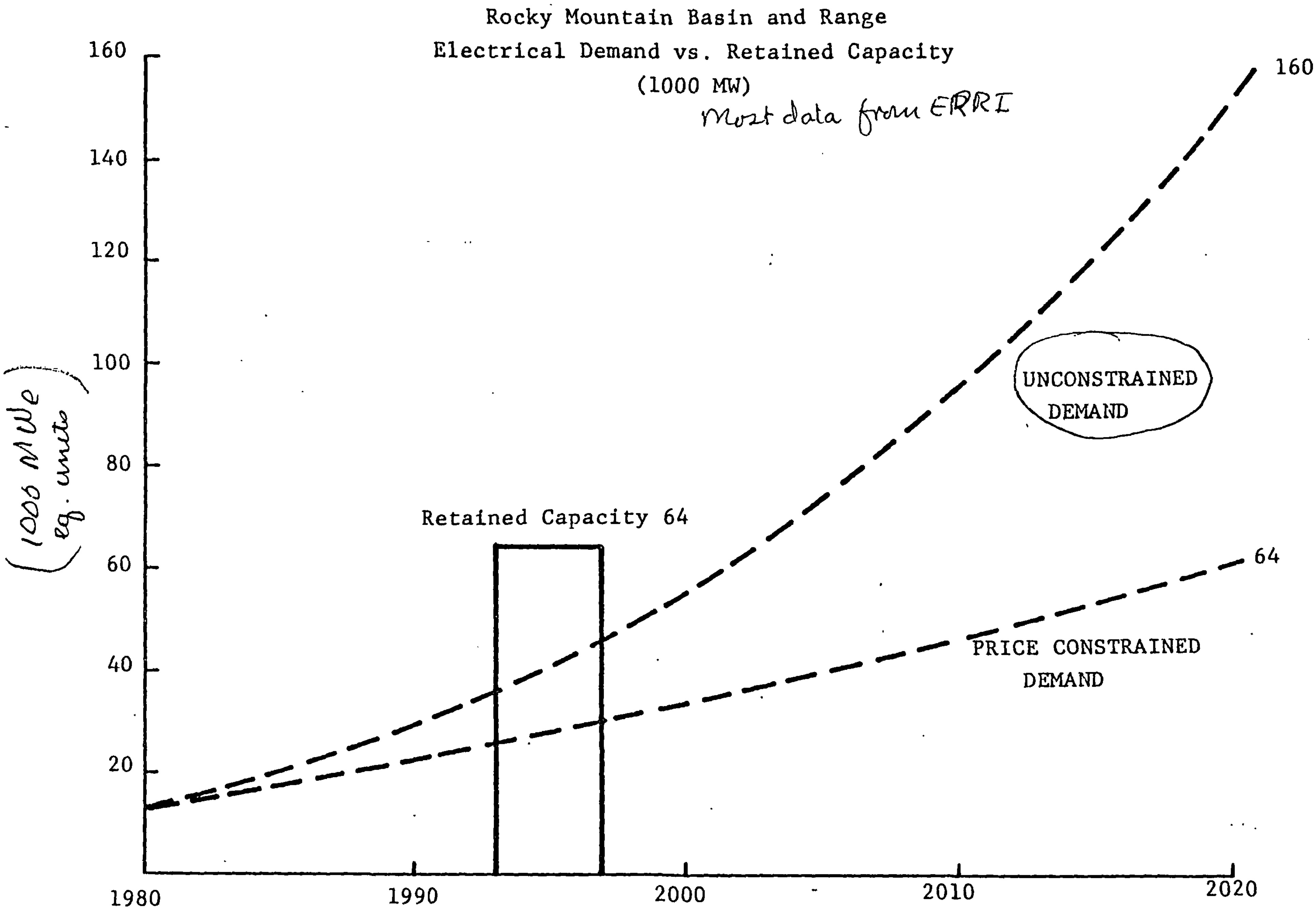
Rocky Mountain Basin and Range
Electrical Demand vs. Retained Capacity
(1000 MW)
Most data from ERRI
(1000 MWe eq. units)
160
140
120
100
80
60
40
20
1980
1990
2000
2010
2020
160
64
UNCONSTRAINED DEMAND
PRICE CONSTRAINED DEMAND
Retained Capacity 64

150°C
90°C

DATA FILES

What is the bottom temp ?

STATE	TOTAL CITIES	POPULATION	TOTAL INDUSTRIES	Geothermal Resource Information: geothermal resource TOTAL SITES	ELECTRIC POTENTIAL (MW)	DIRECT THERMAL QUAD BTU 50°C
ARIZONA	182	1,956,626	1280	72	450	81.88
COLORADO	313	2,037,580	3600	113	350	6.37
IDAHO	261	560,395	1100	310	7200	155.81
MONTANA	332	574,800	800	136	0	6.92
NEVADA	97	487,150	161	307	3400	31.74
NEW MEXICO	192	908,016	1000	114	3400	25.55
NORTH DAKOTA	260	403,603	379	161	0	10.35
SOUTH DAKOTA	258	443,439	383	67	0	1.24
UTAH	225	950,053	1816	224	1700	13.50
WYOMING	137	306,600	488	64	150	11.00
TOTALS	2,257	8,628,262	11,007	1,568	16650	344.36

MWe pot of Res. with temp above 150°C

50 — 150°C

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Define:
R1 ≡ rate of return 1st 5 yrs
R2 ≡ " " " next 25 yrs
PSS ≡ success ratio for drilling injection / production

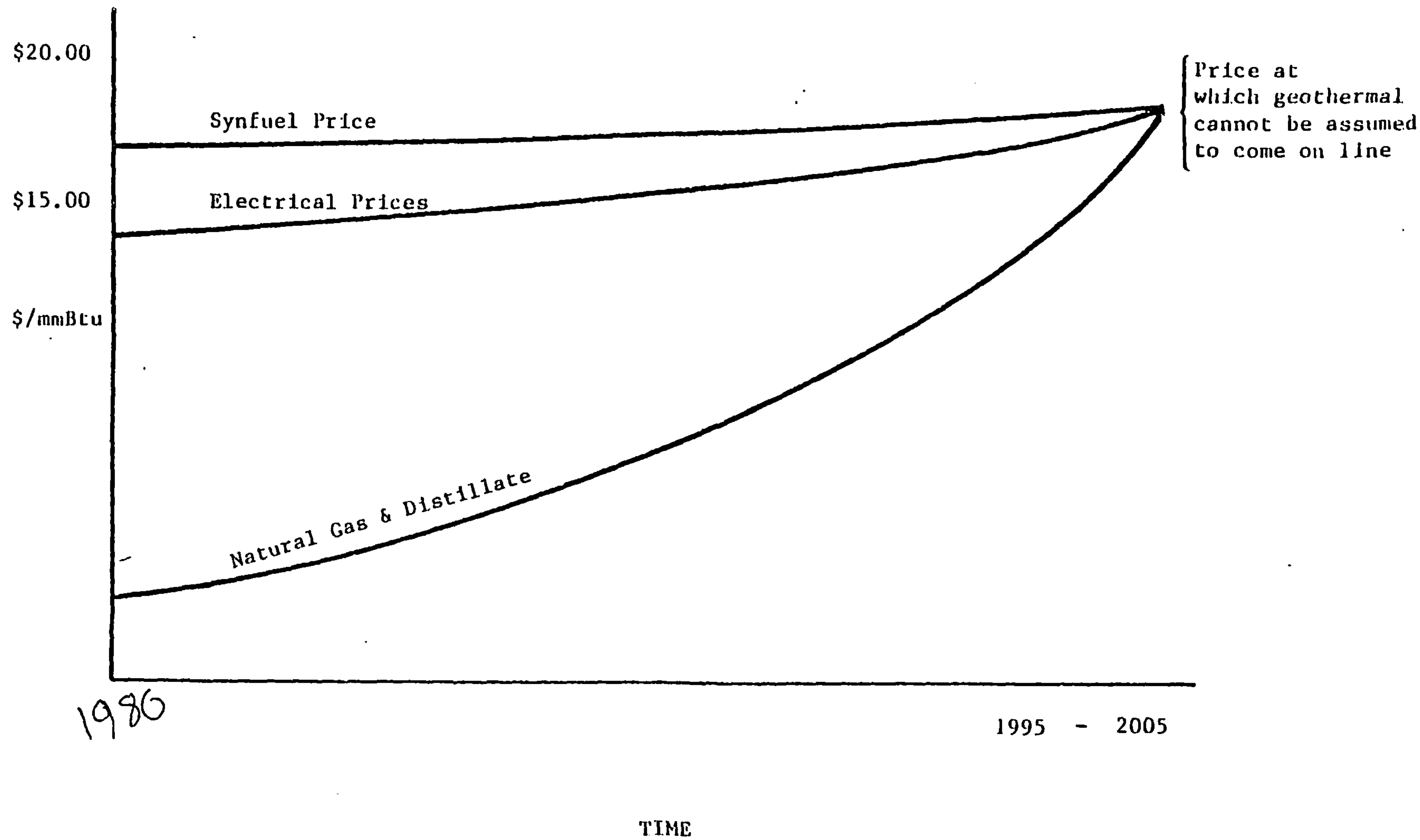
POLICY OPTIONS

FEDERAL STIMULUS		OTHER FACTORS
HIGH	100% Reservoir Confirmation 25% Matching Fund Investment and Depletion Credits	R1 = 0.2, R2 - 0.12 PSS = 0.9 / 0.7
MID	100% Reservoir Confirmation Investment and Depletion Credits	R1 = 0.2, R2 = 0.12 PSS = 0.9 / 0.7
LOW	50% Reservoir Confirmation Investment and Depletion Credits	R1 = R2 = 0.25 PSS = 0.5 / 0.2
LOW-LOW	Investment Credits and Depletion Allowance Expire Per Current Legislation	R1 = R2 = 0.35 PSS = 0.5 / 0.2

All Four Cases Used Synthetic Fuel Price Limit: $20/MMBTU
($100-120 per barrel oil)

what is
R1
R2
PSS

POSSIBLE INTER-FUEL COMPETION



ROCKY MOUNTAIN BASIN & RANGE
REGION WIDE PRICE RANGE BY FUEL
Dollars / MMBTU

Natural Gas	Distillate	LPG
2.37 - 6.03	4.39 - 7.20	5.33 - 12.11
	(fuel oil)	

STATE WIDE PRICE RANGE
of Conventional Fuels
Dollars / MMBTU
(Oct. 1979)

5 Southern Rocky Mt. States

STATE	NATURAL GAS	DISTILLATE	LP GAS
Arizona	$ 3.39 - 3.55	5.59 - 6.19	5.33 - 7.16
Colorado	2.38 - 4.89	4.94 - 5.30	5.55 - 5.70
Nevada	3.04 - 3.67	6.89 - 7.02	6.90 - 8.12
New Mexico	3.56 - 4.40	4.39 - 5.01	6.22 - 7.80
Utah	2.37 - 2.56	4.85 - 7.17	6.00 - 12.11
	2.37 - 4.89	4.39 - 7.17	5.33 - 12.11
	$3.61	$5.78	$8.72

Range Hi+Lo
{AV of range

EXCLUDES EFFECTS OF

Mexico gas agreement
Canadian gas price increase
December, 1979 OPEC Nations oil price increases

2.37
4.89
7.26
3.61

7.17
4.39
11.56
5.78

12.11
5.33
17.44

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Southern ~~Northern~~	3.61	5.78	8.72
Northern	4.29	6.13	6.53
	$4.00	$6.00	$8.00

STATE WIDE PRICE RANGE
of Conventional Fuels
Dollars / MMBTU
(Oct. 1979)

5 Northern Rocky Mt. States

STATE	NATURAL GAS	DISTILLATE	LP GAS
Idaho	4.18 - 4.45	5.07 - 5.28	5.87 - 6.60
Montana	5.65 - 6.03	6.43 - 7.20	6.53 - 6.95
North Dakota	2.55 - 2.98	6.37 - 6.86	6.70 - 7.19
South Dakota	2.87 - 3.34	5.28 - 5.67	5.88 - 6.12
Wyoming	2.60 - 3.45	5.69 - 5.90	6.01 - 6.37
	2.55 - 6.03 $4.29	5.07 - 7.20 6.13	5.87 - 7.19 6.53

EXCLUDES EFFECTS OF

Mexico gas agreement
Canadian gas price increase
December, 1979 OPEC Nations oil price increases

255 + 603 = 858   507 + 720 = 1227   5.87 + 7.19 = 13 06

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REAL PRICE GROWTH RATES
(BY FUEL TYPE AND CONSUMING SECTOR)

TIME FRAME	RESIDENTIAL			
	ELEC	DIST	LPG	N. GAS
1980-1990	.026	.04	.044	.066
1990-2020	.02	.03	.035	.05

	COMMERCIAL			
	ELEC	DIST	LPG	N. GAS
1980-1990	.027	.042	.052	.066
1990-2020	.02	.032	.045	.05

	INDUSTRIAL			
	ELEC	DIST	LPG	N. GAS
1980-1990	.039	.035		.085
1990-2020	.03	.03		.06

* Cities within an acceptable limit distance from resource (perhaps 50 miles)

CITIES SERVED

CASE	1990	2000	2010	2020	* CITIES CONSIDERED	File 2,257
HIGH	961	995	1000	1000	1014.	
MID	461	716	850	897	1014	
LOW	87	141	173	186	1014	

POPULATION SERVED (MILLIONS)

CASE	1990	2000	2010	2020	POPULATION CONSIDERED (1976)	File 8.63 Millions
HIGH	5.75	6.99	8.36	10.14	4.39	
MID	3.23	5.59	7.96	9.84	4.23	
LOW	0.86	2.16	3.43	4.43	1.63	

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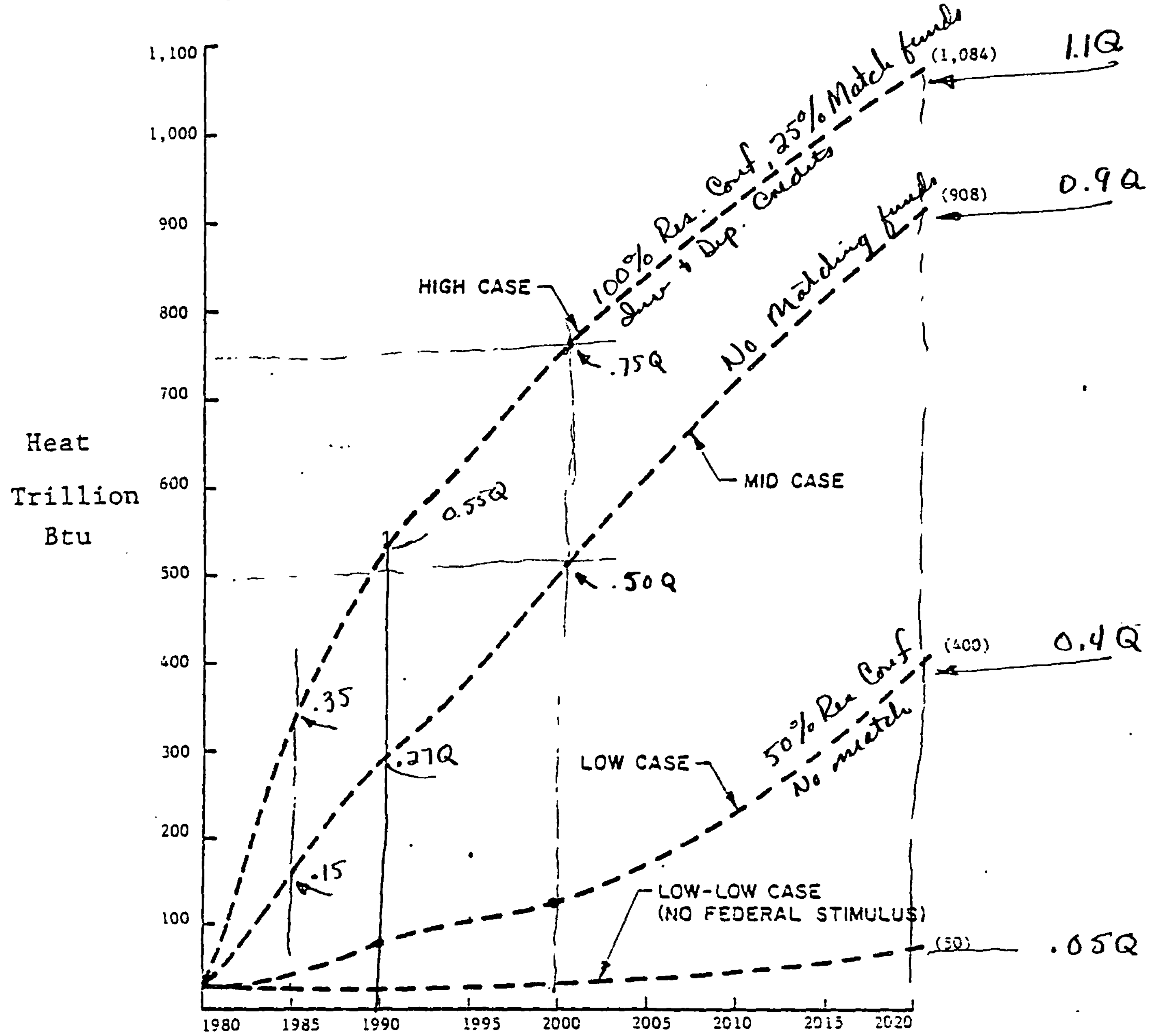
GEOTHERMAL DIRECT-USE POTENTIAL

Rocky Mountain Basin & Range (10 states)



Resources above 50°C
Within 50 miles
and Economic

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Does this assume if its economical the people switch

ROCKY MOUNTAIN BASIN & RANGE

Geothermal Economical Market Shares (%)

	HIGH	MID	LOW	LOW-LOW
Total Demand				
1990	28.65	14.43	2.81	.70
2020	24.91	26.05	11.43	1.12
Co-Located Market				
1990	41.67	21.04	4.16	1.12
2020	47.24	39.6	17.44	2.2

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Rocky Mountain Basin & Range

High Case

Economically Possible Market Penetration (optimum)

(Trillion Btu)

		Heat on Line 2000	2020
Potential	Residential/Commercial	272.2	421.7
	Industrial	96.0	110.0
Inferred	Residential/Commercial	275.1	376.8
	Industrial	139.3	165.7
Total	Residential/Commercial	547.3 } .78Q	798.5 } 1.1 Q
	Industrial	235.3	275.7
	Totals	782.6	1084.2

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Rocky Mountain Basin & Range

Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line 2000	Heat on Line 2020
Potential	Residential/Commercial	164.2	358.1
	Industrial	85.7	103.4
Inferred	Residential/Commercial	135.1	299.4
	Industrial	111.5	146.6
Total	Residential/Commercial	299.3 } .5Q	657.5 } .9Q
	Industrial	197.2	250.0
	Totals	496.5	907.5

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POLICY OPTIONS
VS
PAYBACK BY 1990

CASE	NET FEDERAL OUTLAY $ BILLIONS (NOMINAL)	CONSUMER SAVINGS $ BILLIONS (DISCOUNTED)	CITIES SERVED	HEAT ON LINE QUADS	FOREIGN OIL DISPLACEMENT MMBBL/YEAR
HIGH	5.86	36.3	961	0.55 - 0.9*	305**
MID	1.70	9.9	461	0.27	122
LOW	0.28	0.2	87	0.15 ← 0.06	70
LOW-LOW	N/A	0.06	20	0.015	20

* Includes 0.35 Quad for New Industrial Parks in Oregon, Washington, Idaho

** Assumes 2 to 1 ratio of oil imports to final end-use consumption

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REQUIRED DRILLING PROGRAM (BY 1990)

CASE	RESERVOIR CONFIRMATION	PRODUCTION WELLS (4-8 wells/reservoir site)	REINJECTION WELLS (2-4 wells/site)
HIGH	650	3000 - 4000	1500 - 2000
MID	350	1500 - 2000	750 - 1000
LOW	150	500 - 1000	250 - 500

* COMPARES WITH 50,000 - 60,000 1000 FEET OR DEEPER NATURAL GAS AND OIL WELLS/YEAR

500

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HIGH CASE

ROCKY MOUNTAIN BASIN AND RANGE

DISCOUNTED COSTS AND BENEFITS THRU 2020

($ BILLIONS)

	INVESTMENTS	TAXES & ROYALTIES	CONSUMER SAVINGS	TRILLION BTU/YEAR HEAT ON LINE
ARIZONA	2.3	0.35	18.6	176
COLORADO	1.5	0.28	14.0	244
IDAHO	1.2	0.24	14.7	178
MONTANA	0.9	0.07	3.2	51
NEVADA	0.2	0.04	3.6	75
NEW MEXICO	0.6	0.13	5.6	99
NORTH DAKOTA	0.4	0.14	3.6	51
SOUTH DAKOTA	0.2	0.03	1.6	15
UTAH	0.8	0.17	8.5	145
WYOMING	0.5	0.08	3.7	56
	8.6	1.51	77.1	1,090

- Requires $5.86 Billion Federal Outlay
- Provides up to 305 million barrels/year Foreign Oil Displacement by 1990
- Requires 660 Reservoir Confirmation wells next two years Too High
- Requires 3000 - 4000 Production wells by 1990 3-400/year

This assumes the saving over a 30 year operating period

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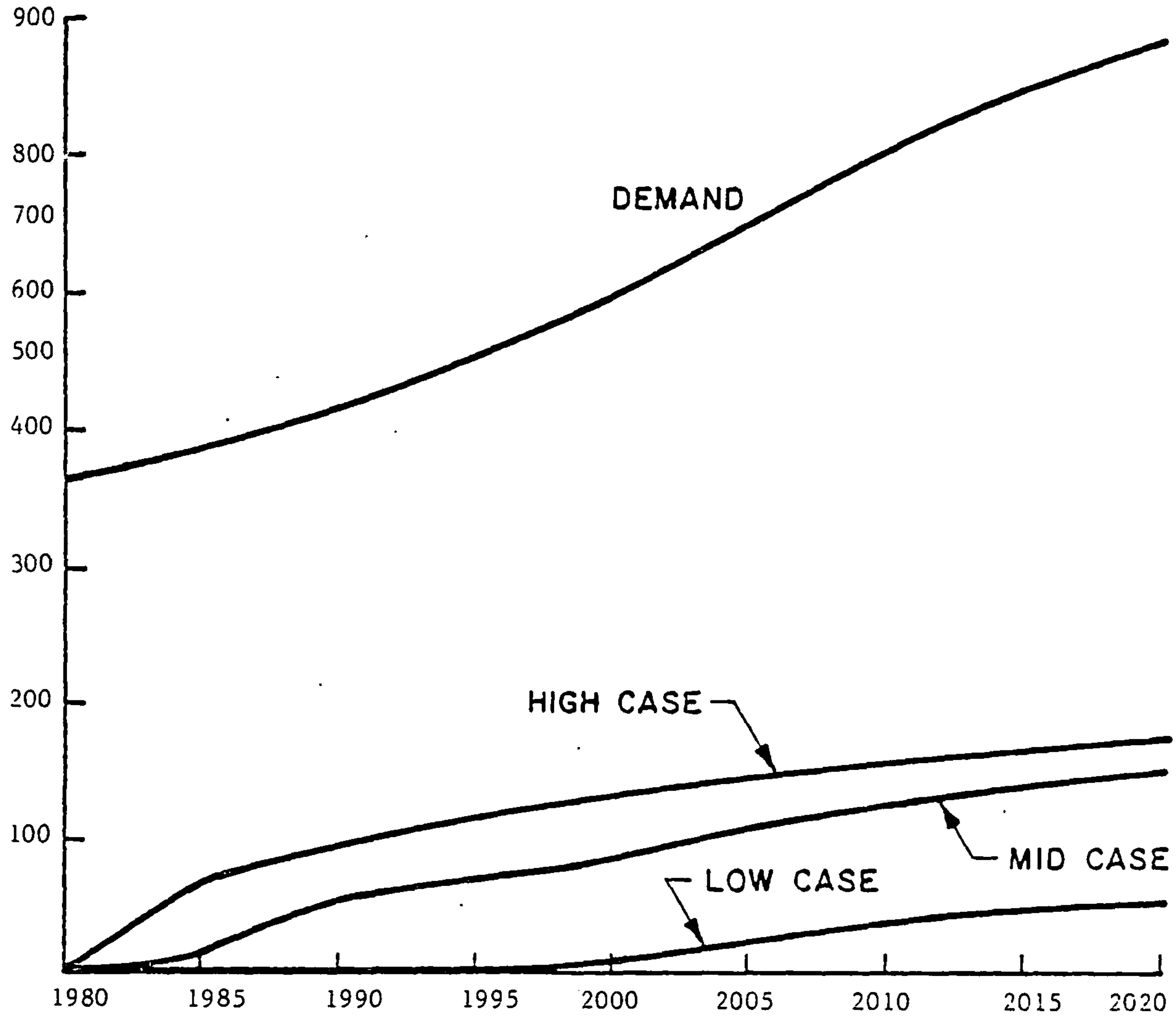
Part II. Advance copies of Individual State Data.

ARIZONA ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



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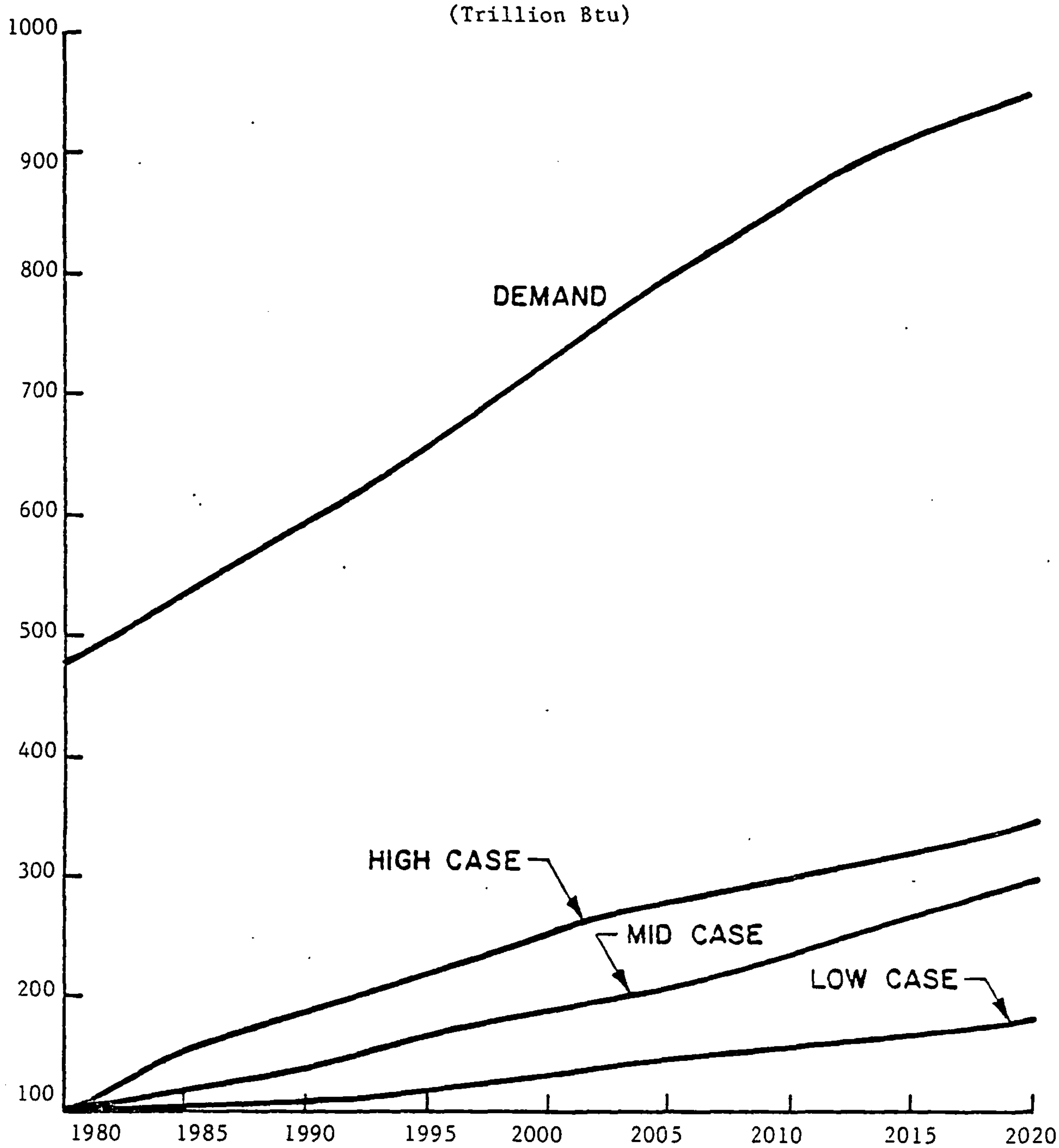
COLORADO ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)

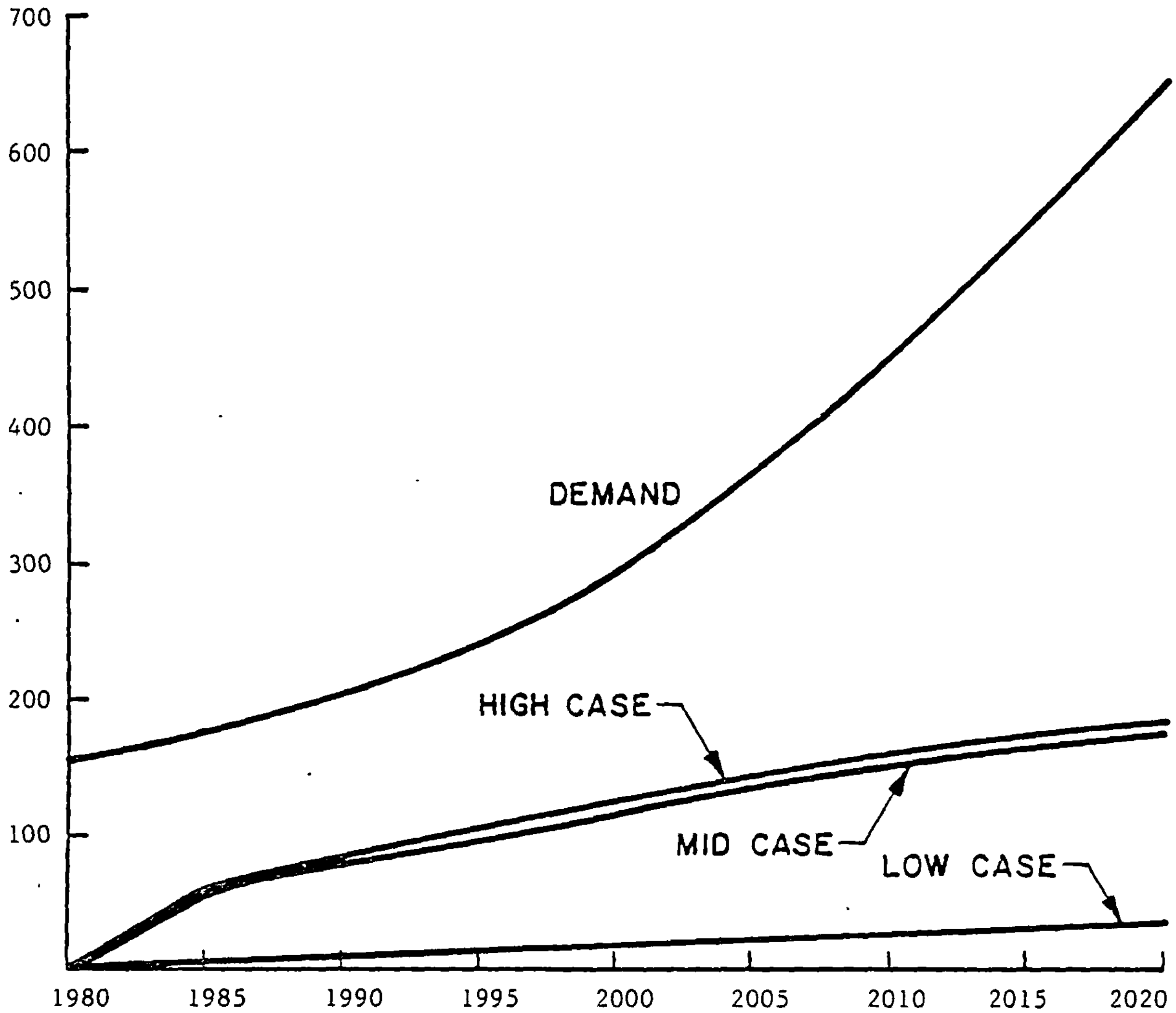


IDAHO ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



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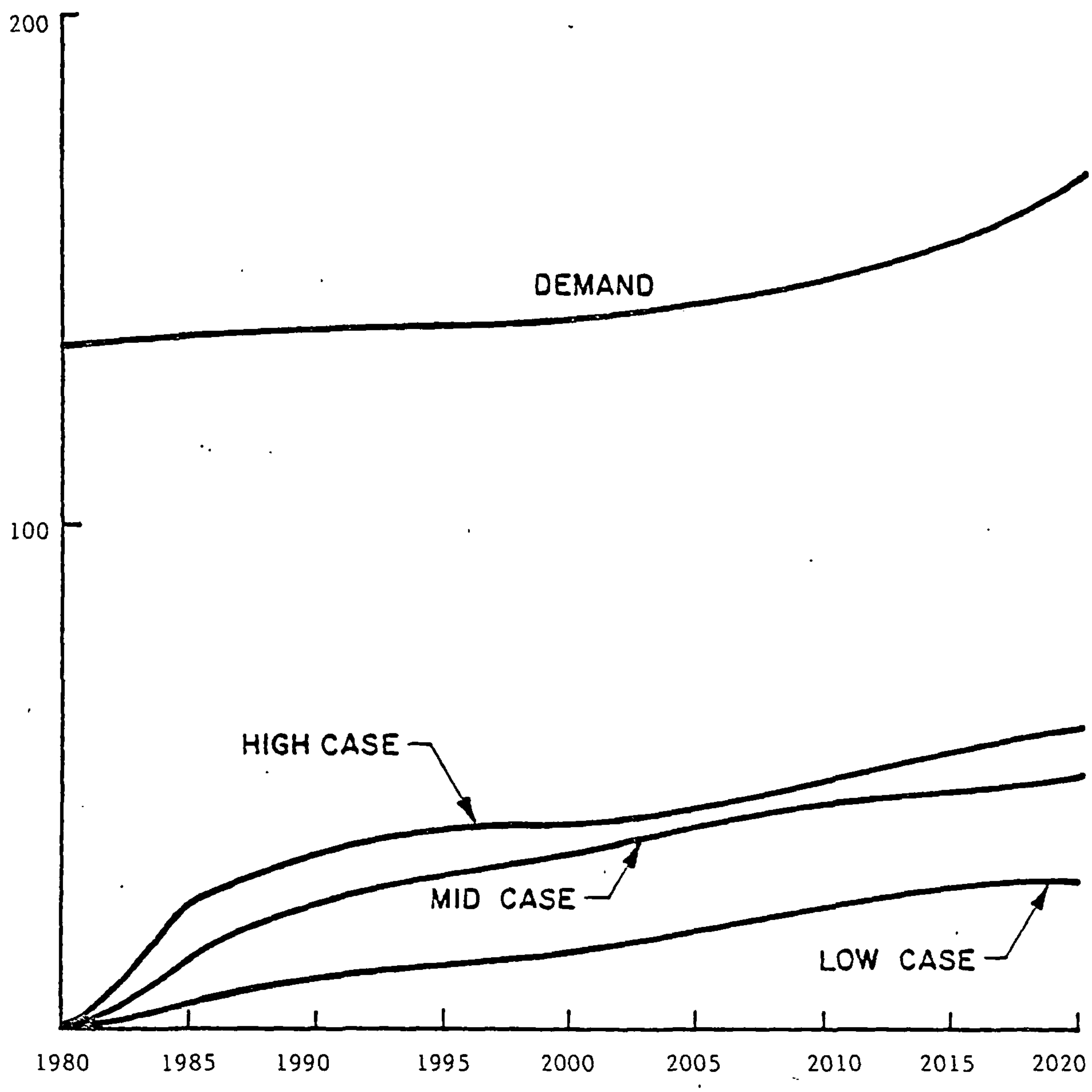
MONTANA ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



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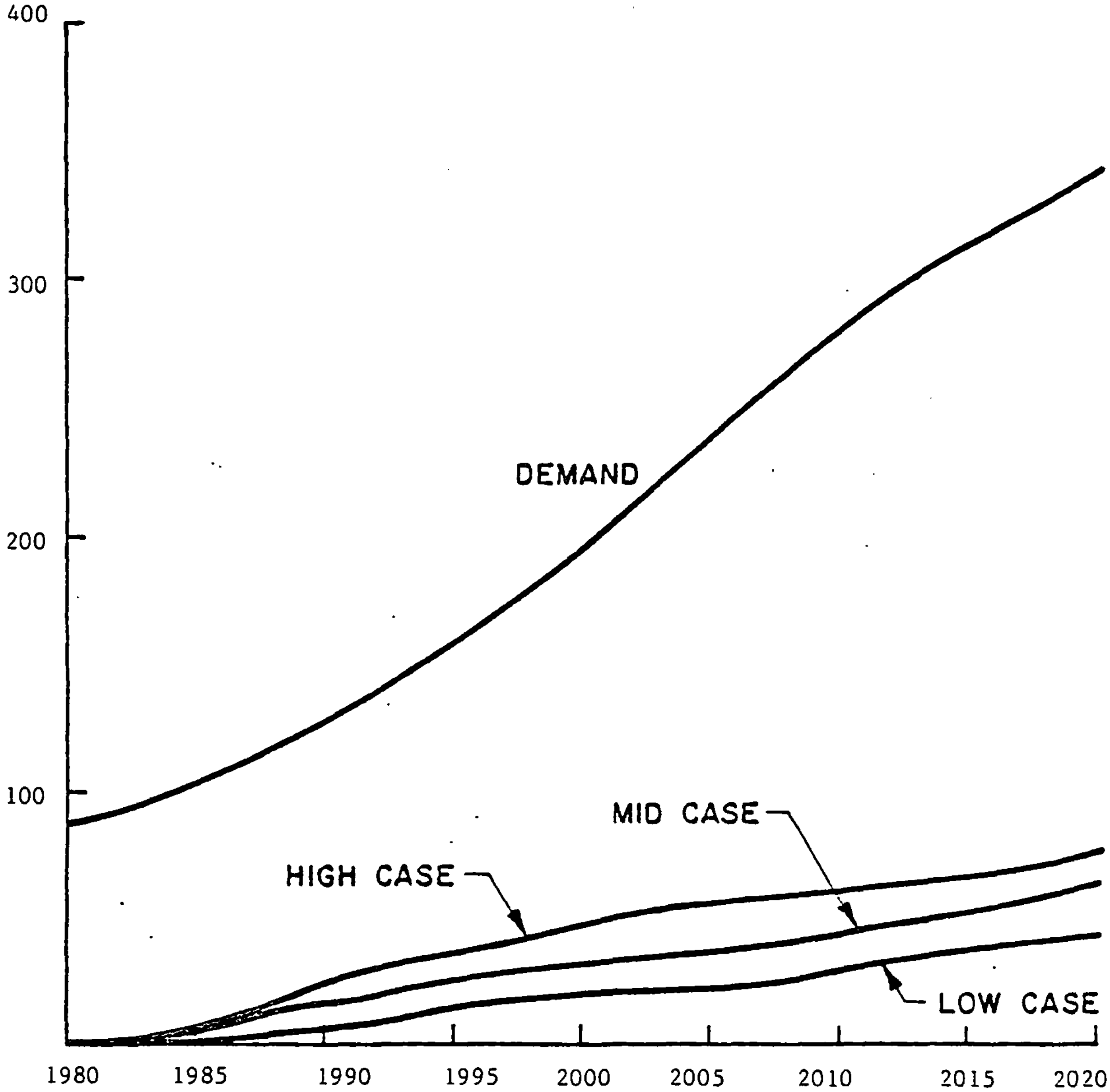
NEVADA ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



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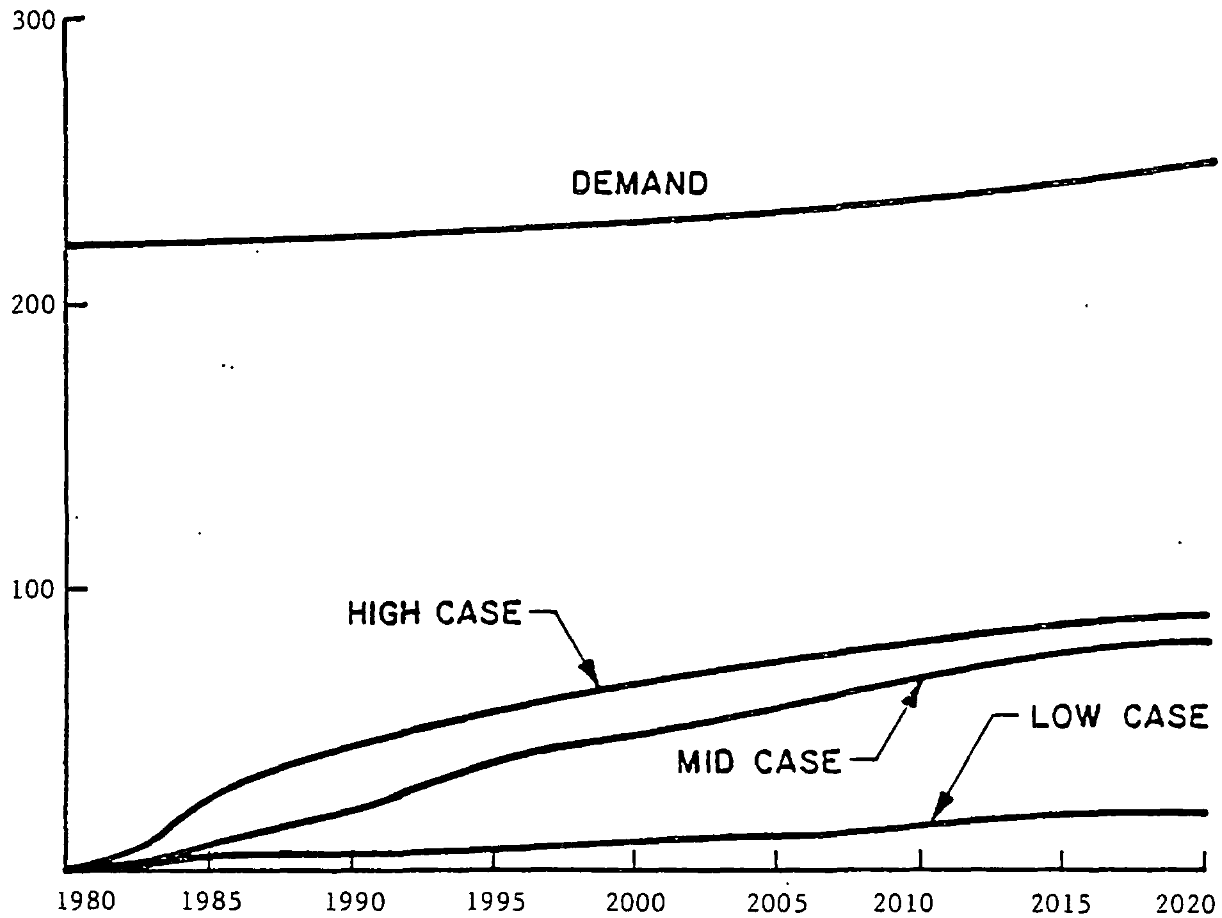
NEW MEXICO ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)

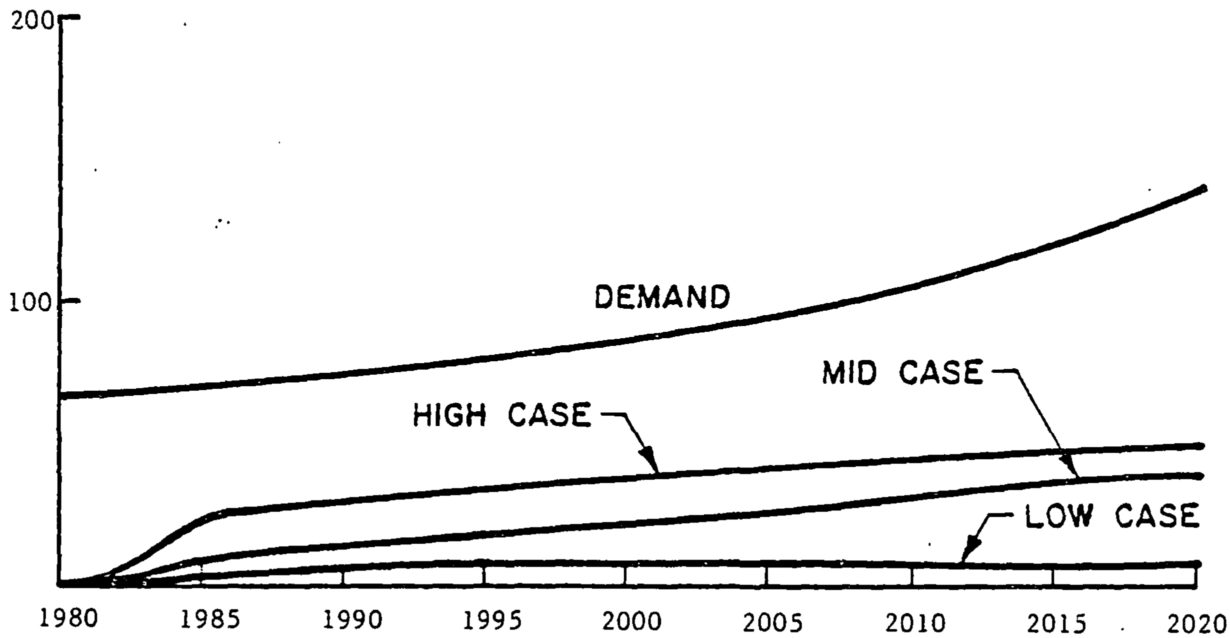


NORTH DAKOTA ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



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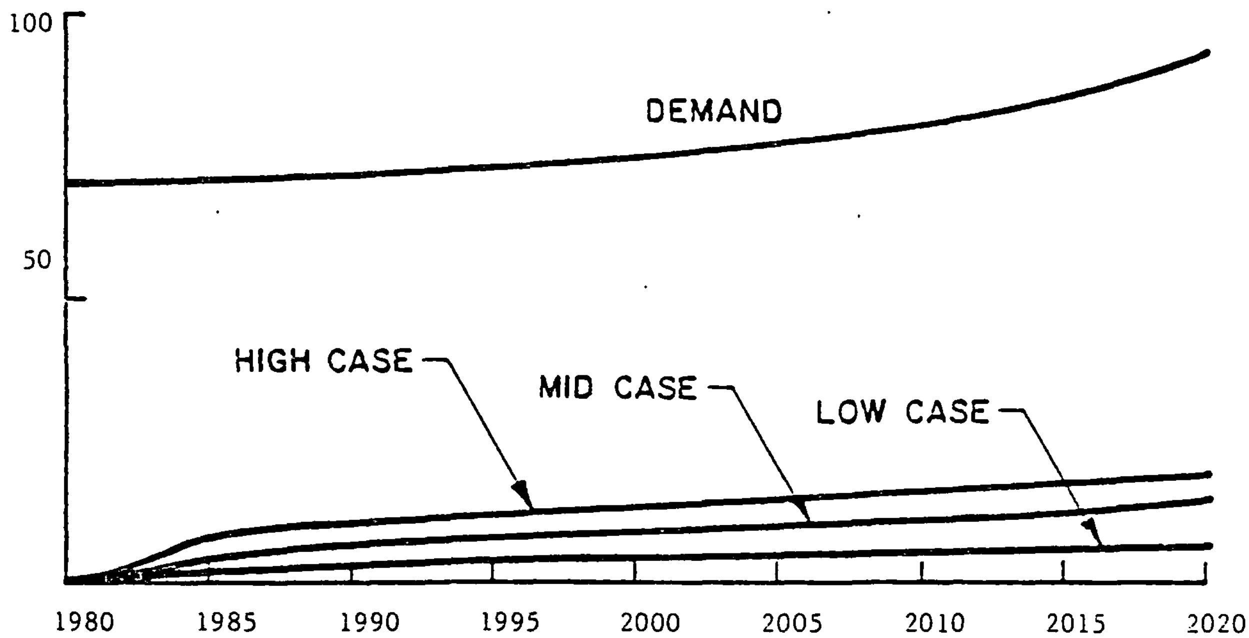
SOUTH DAKOTA ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)

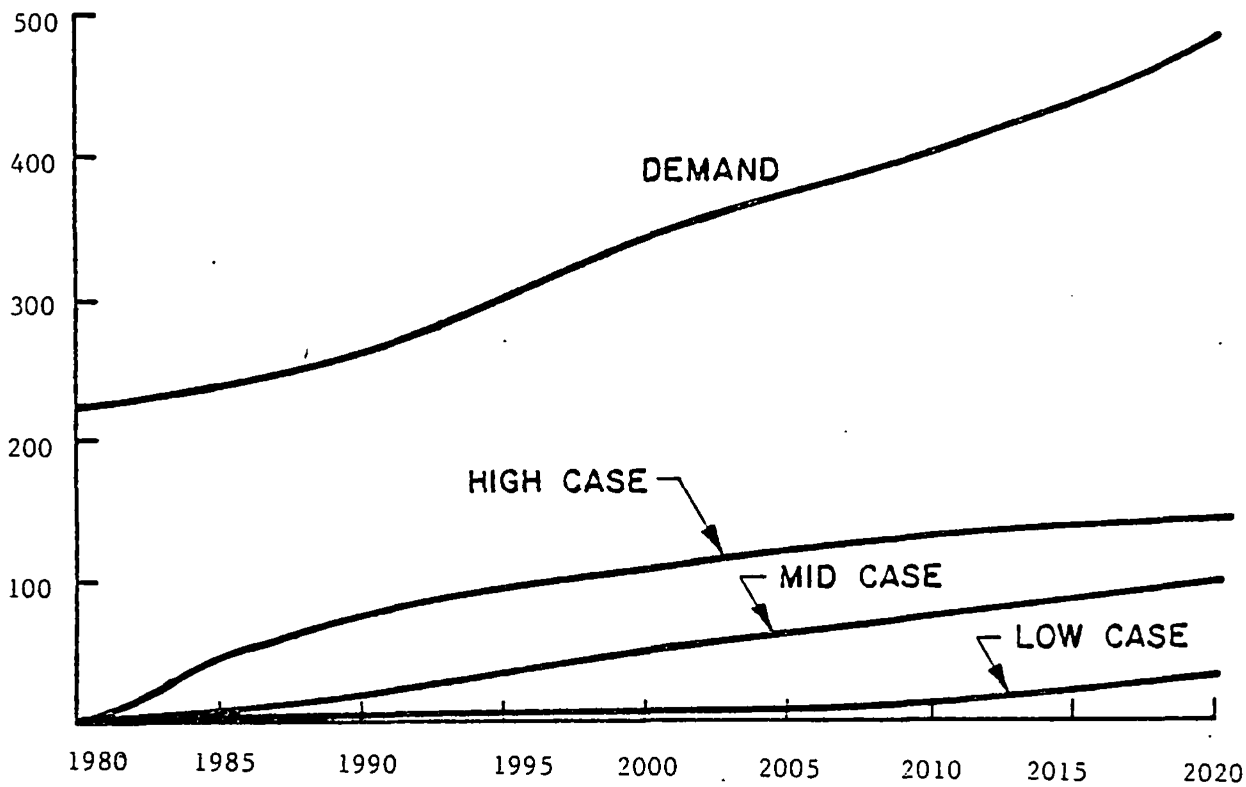


UTAH ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)

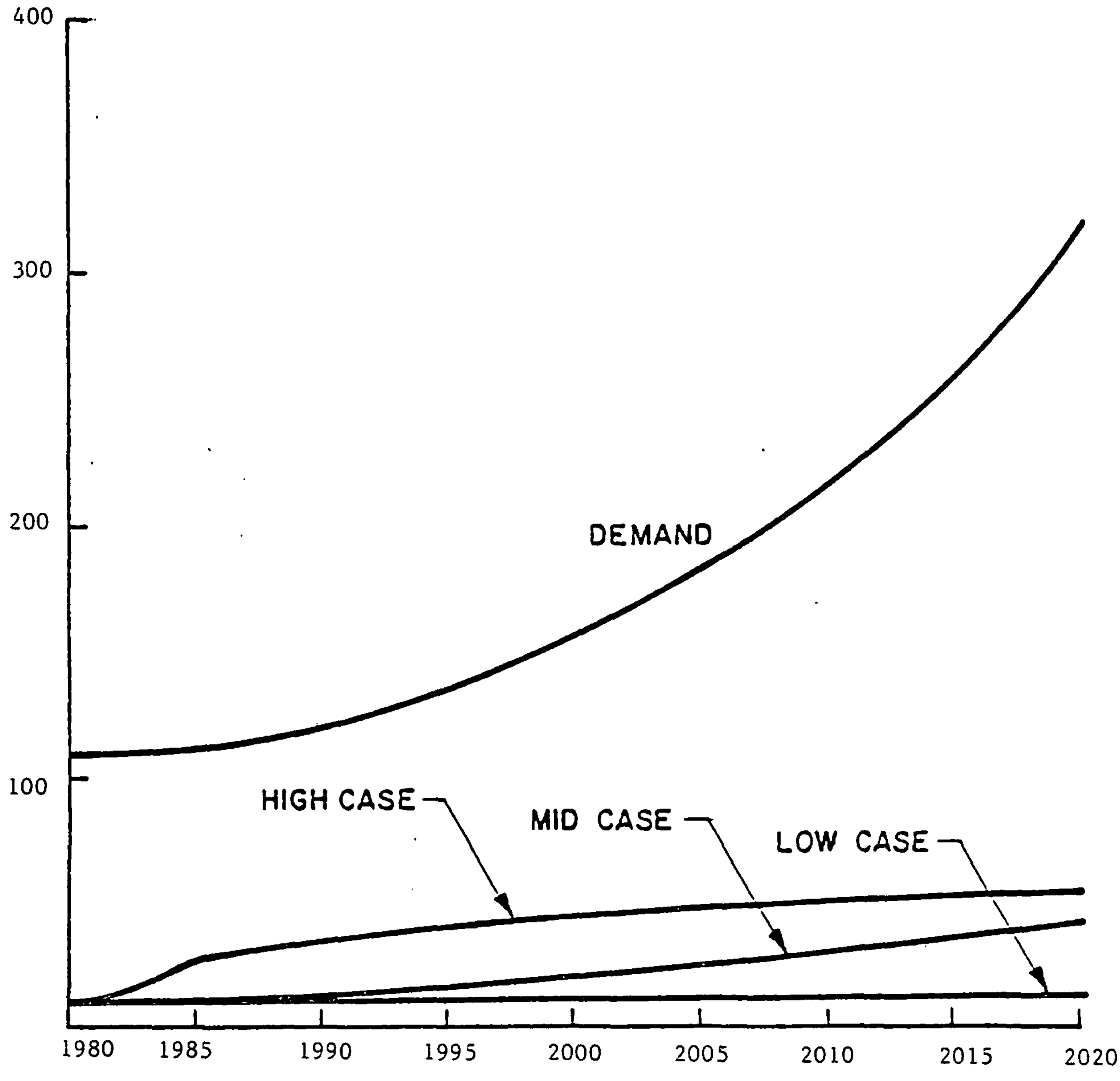


WYOMING ENERGY DEMAND

v.s

POTENTIAL GEOTHERMAL SUPPLY

(Trillion Btu)



Arizona

Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	17.1	52.0
	Industrial	38.4	47.8
Inferred	Residential/Commercial	5.8	21.3
	Industrial	22.0	26.8
Total	Residential/Commercial	22.9	73.3
	Industrial	60.4	74.6
	Totals	83.3	147.9

Colorado

Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	41.0	87.7
	Industrial	8.8	9.5
Inferred	Residential/Commercial	27.2	84.6
	Industrial	7.9	11.9
Total	Residential/Commercial	68.2	172.3
	Industrial	16.7	21.4
	Totals	84.5	193.7

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Idaho

Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	16.1	40.1
	Industrial	8.4	10.3
Inferred	Residential/Commercial	44.1	70.6
	Industrial	46.3	55.1
Total	Residential/Commercial	60.2	110.7
	Industrial	54.7	65.4
	Totals	114.9	176.1

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Montana

Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	11.9	16.8
	Industrial	.3	.4
Inferred	Residential/Commercial	16.0	22.8
	Industrial	6.5	7.4
Total	Residential/Commercial	27.9	39.6
	Industrial	6.8	7.8
	Totals	34.7	47.4

Nevada
Mid-Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	23.5	57.9
	Industrial	3.2	3.4
Inferred	Residential/Commercial	.3	.4
	Industrial	0.0	0.0
Total	Residential/Commercial	23.8	58.3
	Industrial	3.2	3.4
	Totals	27.0	61.7

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New Mexico

Mid - Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	21.3	47.6
	Industrial	8.6	9.7
Inferred	Residential/Commercial	10.4	16.8
	Industrial	8.1	11.1
Total	Residential/Commercial	31.7	64.4
	Industrial	16.7	20.8
	Totals	48.4	85.2

North Dakota

Mid - Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	15.8	32.1
	Industrial	4.9	6.1
Inferred	Residential/Commercial	0.0	1.8
	Industrial	0.0	.3
Total	Residential/Commercial	15.8	33.9
	Industrial	4.9	6.4
	Totals	20.7	40.3

South Dakota

Mid - Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	7.8	9.6
	Industrial	.3	.4
Inferred	Residential/Commercial	2.3	4.8
	Industrial	.04	.05
Total	Residential/Commercial	10.1	14.4
	Industrial	.34	.45
	Totals	10.44	14.85

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Utah

Mid - Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	7.6	10.7
	Industrial	2.0	4.3
Inferred	Residential/Commercial	25.0	53.3
	Industrial	17.1	28.8
Total	Residential/Commercial	32.6	64.0
	Industrial	19.1	33.1
	Totals	51.7	97.1

Physical Science Laboratory

Wyoming

Mid - Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	2.1	3.6
	Industrial	10.8	11.5
Inferred	Residential/Commercial	4.0	23.0
	Industrial	3.6	5.2
Total	Residential/Commercial	6.1	26.6
	Industrial	14.4	16.7
	Totals	20.5	43.3

Physical Science Laboratory

Arizona

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line 2000	2020
Potential	Residential/Commercial	45.2	72.2
	Industrial	42.8	49.1
Inferred	Residential/Commercial	19.8	26.6
	Industrial	24.7	28.4
Total	Residential/Commercial	65.0	98.8
	Industrial	67.5	77.5
	Totals	132.5	176.3

Physical Science Laboratory

Colorado

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line 2000	2020
Potential	Residential/Commercial	54.2	96.8
	Industrial	10.3	11.8
Inferred	Residential/Commercial	79.5	120.0
	Industrial	13.7	15.8
Total	Residential/Commercial	133.7	216.8
	Industrial	24.0	27.6
	Totals	157.7	244.4

Physical Science Laboratory

Idaho

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line 2000	Heat on Line 2020
Potential	Residential/Commercial	24.2	40.2
	Industrial	6.9	7.8
Inferred	Residential/Commercial	51.6	80.7
	Industrial	43.2	49.6
Total	Residential/Commercial	75.8	110.9
	Industrial	50.1	57.4
	Totals	125.9	178.3

Physical Science Laboratory

Montana

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	14.1	16.8
	Industrial	.5	.6
Inferred	Residential/Commercial	20.5	24.1
	Industrial	8.3	9.6
Total	Residential/Commercial	34.6	40.9
	Industrial	8.8	10.2
	Totals	43.4	51.1

Nevada

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line 2000	Heat on Line 2020
Potential	Residential/Commercial	42.3	71.4
	Industrial	3.3	3.8
Inferred	Residential/Commercial	.3	.4
	Industrial	0.0	0.0
Total	Residential/Commercial	42.6	71.8
	Industrial	3.3	3.8
	Totals	45.9	75.6

New Mexico

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	39.0	56.4
	Industrial	9.1	10.2
Inferred	Residential/Commercial	13.1	18.1
	Industrial	5.3	6.1
Total	Residential/Commercial	52.1	74.5
	Industrial	14.4	16.3
	Totals	66.5	90.8

North Dakota

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	32.9	42.2
	Industrial	5.2	5.9
Inferred	Residential/Commercial	2.3	2.5
	Industrial	.3	.4
Total	Residential/Commercial	35.2	44.7
	Industrial	5.5	6.3
	Totals	40.7	51.0

South Dakota

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	8.19	9.93
	Industrial	.43	.49
Inferred	Residential/Commercial	4.51	4.99
	Industrial	.05	.06
Total	Residential/Commercial	12.70	14.92
	Industrial	.48	.55
	Totals	13.18	15.47

Physical Science Laboratory

Utah

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	9.2	11.9
	Industrial	6.0	8.6
Inferred	Residential/Commercial	56.9	74.2
	Industrial	39.1	50.4
Total	Residential/Commercial	66.1	86.1
	Industrial	45.1	59.0
	Totals	111.2	145.1

Wyoming

High Case

Economically Possible Market Penetration

(Trillion Btu)

		Heat on Line	
		2000	2020
Potential	Residential/Commercial	2.9	3.9
	Industrial	11.5	11.7
Inferred	Residential/Commercial	26.6	35.2
	Industrial	4.7	5.4
Total	Residential/Commercial	29.5	39.1
	Industrial	16.2	17.1
	Totals	45.7	56.2

Part III. Data for Discussion at State Team Caucus.

BTHERM MODEL

Sensitivity Analysis

- Large Impact on Cost
  - Grants (City Share of Money)
  - Distance
  - Resource Depth ?
  - Population
  - Industrial Demand and Annual Hours of Operation
  - Retrofit and Hookup Costs
  - Time (Years), Duration of Investment
  - Rate of Return on Investment
  - Flow Rate
  - Research Investment

Production Success Ratio

- Moderate Impact on Cost
  - Population and Industrial Growth Rates
  - Heating Degree Days
  - Resource Temperature
  - Well Life
  - Investment Tax Credit
  - Royalty Rate (Within Normal Limits)

- Low Impact on Cost
  - Bond Rate (Within Normal Limits)
  - Depletion Allowance
  - State Tax Rate
  - Property Tax Rate

1.

CITY SHARE OF MONEY (CSM)

	CSM	PRICE	% CHANGE	
50% gov't funding	.5	3.21		0 1/2
	.6	4.38	36.4	
	.7	5.55	26.7	230%
	.8	6.72	21.0	
	.9	7.89	17.4	
0% gov't funding	1.0	9.06	14.08	300%

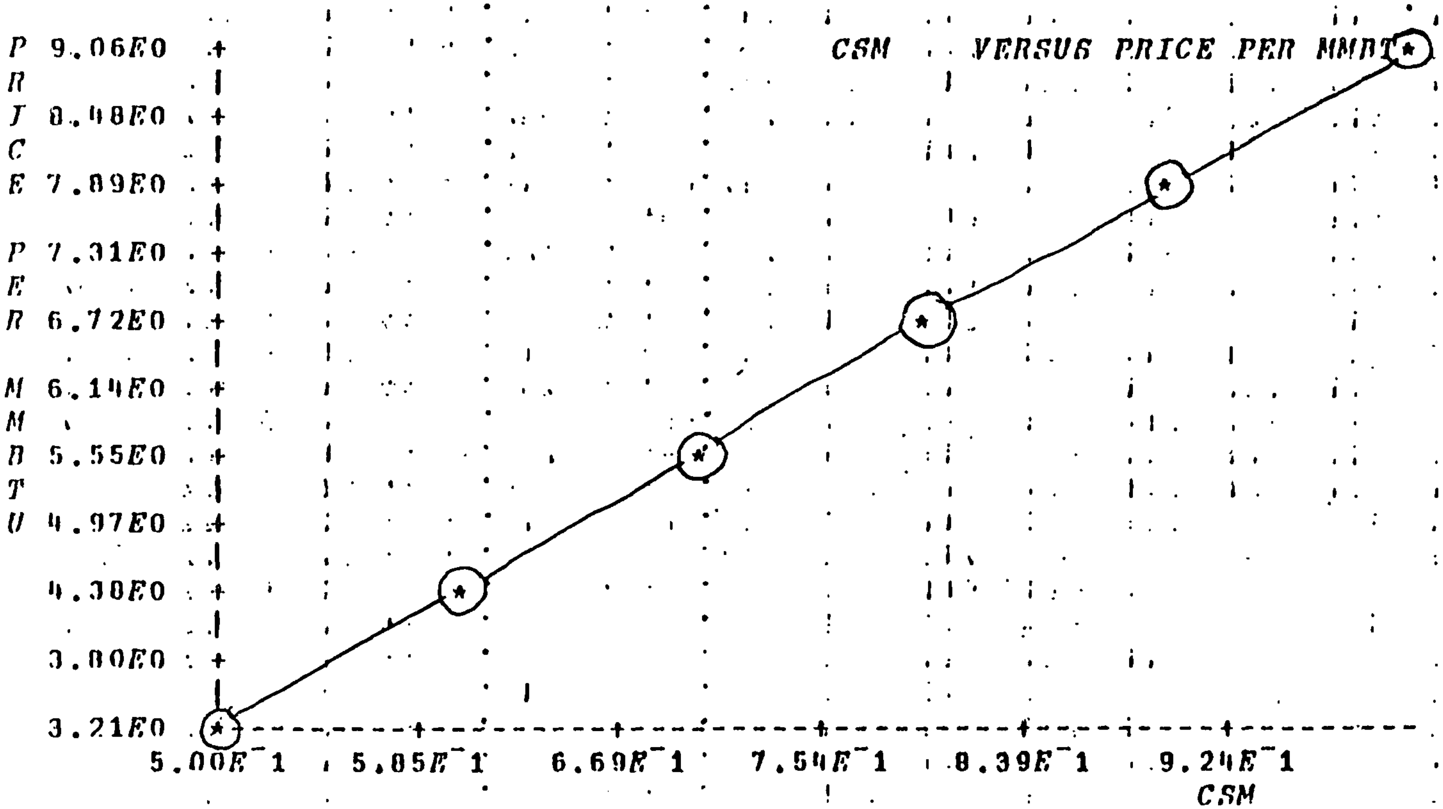
CSM (City Share of Money) is a variable which allows the BTHERM model to take into account the possibility of a grant. At CSM = 1.0 the private or city developer covers all investment costs himself and the price per million BTU's charged to consumer is indicative of this. At CSM = 0.5, it is assumed that 50 percent of the required investment is obtained from grants, and therefore the price charged will drop accordingly. The example shown above is of Avondale, Arizona, a city which because of its depressed economic state, has been indicated by H.U.D. as being eligible for an Urban Development Action Grant. At a 50% matching grant, the city of Avondale could get geothermal energy at a price competitive with current natural gas prices.

For the High Case (10-State Region), CSM was set at 0.75, which is the case in which one dollar of Federal money is granted for three dollars of private or city funds.

ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...CSM+.5 .6 .7 .8 .9 1.0
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...AVONDALE
...

CSM	PRICE PER MMBTU
0.5	3.21
0.6	4.30
0.7	5.55
0.8	6.72
0.9	7.89
1	9.06

* TEMP+60 * DEPTH+3000 * POP+6900 * DIST+0 * LT+36 * DEGD+1550 *
PHDI+.42E10 * POPG1+.032 * POPG2+.020 * STXRT+0
GRAPH OF CSM VERSUS PRICE PER MMBTU ?? YES



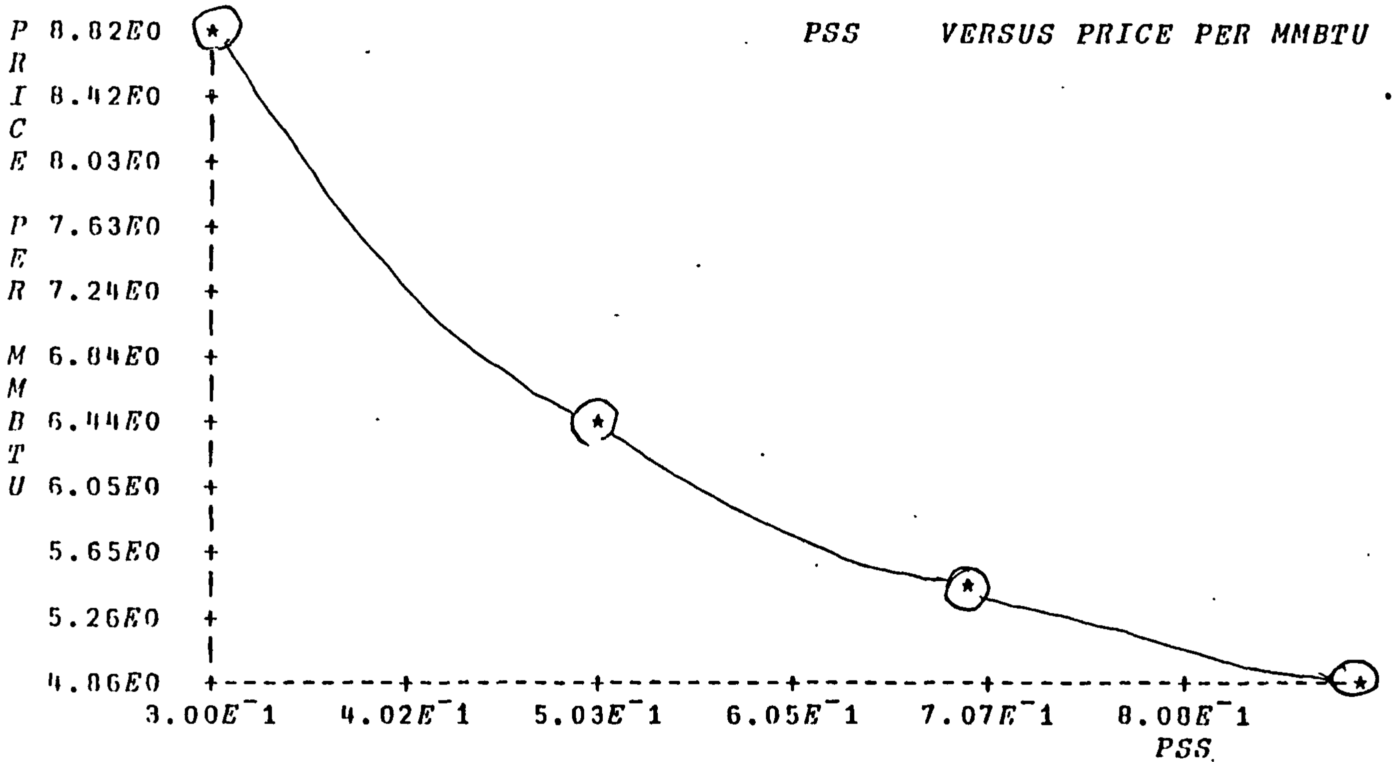
2. <u>PSS</u> (Production Success Ratio)

PSS	out of 10 # Dry	Price	%Δ
.3	7	8.82	
.5	5	6.44	2.7
.7	3	5.43	15.6
.9	1	4.86	10.4

The price per MMBTU's charged to consumers in a geothermal district space heating system is highly dependent on the success ratio of drilling efforts. The policy conclusions are that, if through reservoir confirmation programs or resource assessment programs the number of dry holes out of every 10 that are drilled can be reduced from 7 to 1 in the case mentioned above, a 45% reduction in the price per MMBTU's could be achieved.

```
RUN
      RUN
THE DATE IS  28  DEC   1979,  TIME   8:34
ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...PSS←.3 .5 .7 .9
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...TUCSON
...NG←1
...
    PSS       PRICE PER MMBTU
   0.3              8.82
   0.5              6.44
   0.7              5.43
   0.9              4.86

 ¤ TEMP←60 ¤ DEPTH←2000 ¤ POPG1←.019 ¤ POPG2←.011 ¤ POPI←.03 ¤ SYN←20 ¤
 DIST←0 ¤ DEGD←1705 ¤ LT←38 ¤ POP←3000 ¤ PHDI←3E10 ¤ NG←1
GRAPH OF      PSS      VERSUS PRICE PER MMBTU ??  YES
```



3.

INVESTORS RESOURCE INVESTMENT (MFRNV)
vs.
INVESTORS RATE OF RETURN ON INVESTMENT (ROR)

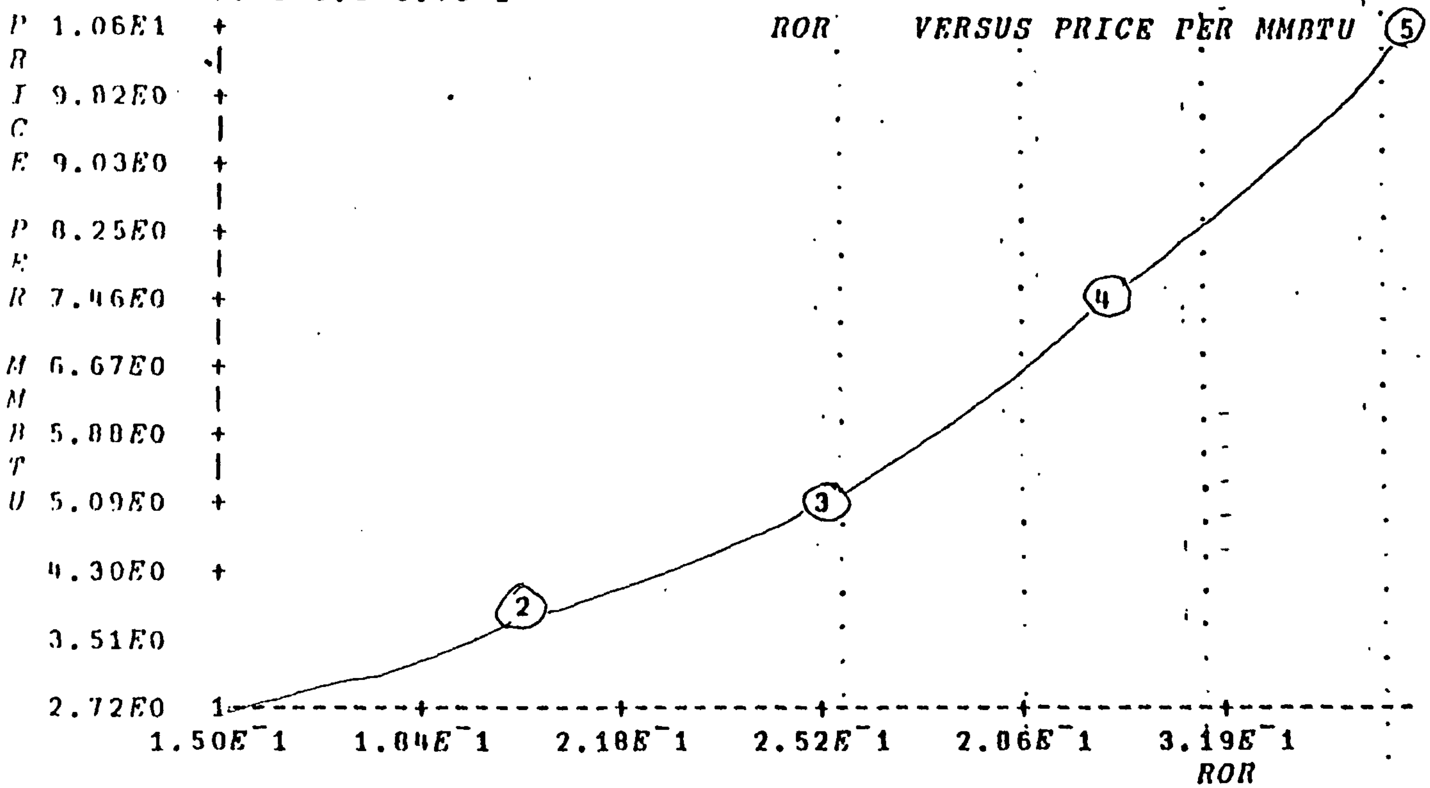
One of the many considerations which a developer must take into account when considering an investment is what the rate of return requirements will be for a given investment level. In theory, the higher the investment for a particular developer, the higher the perceived risk, and hence the higher the required rate of return. The output here shows the possible impact on the price charged given that an increasing research investment induces a higher rate of return requirement. The policy conclusion is that, if through publicly financed reservoir confirmation a lower return on investment to the developer can be effected, the required price may drop by as much as 290%.

The MFRNV multiplier is used to act on a preset Research Investment of $1.0 million per site. Thus, a 0.5 value is translated into an investment of $500,000, and 1.0 is $1.0 million. For some of the sites we analyzed, we used as much as $2.5 million for the Research Investment.

MRFNV	ROR	PRICE $/MMBTU
.0	.15	2.716
.5	.25	5.239
1.0	.35	10.615
↑ Investment in Resource by Pot Dev.	Rate of Return for Pot Dev ↑ R1 and R2	

```
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...OURAY
...
ENTER THE VARIABLE TO RANGE OVER, AND ITS VALUES
...MFRNV←0 .25 .5 .75 1.0
      .150     2.716
      .200               3.722
      .250                         5.239
      .300                                   7.484
      .350                                            10.615
GRAPH  ??  YES


MFRNV = 0 0.25 0.5 0.75 1
```



4. GEOCRED (Geothermal/Tax Credit)

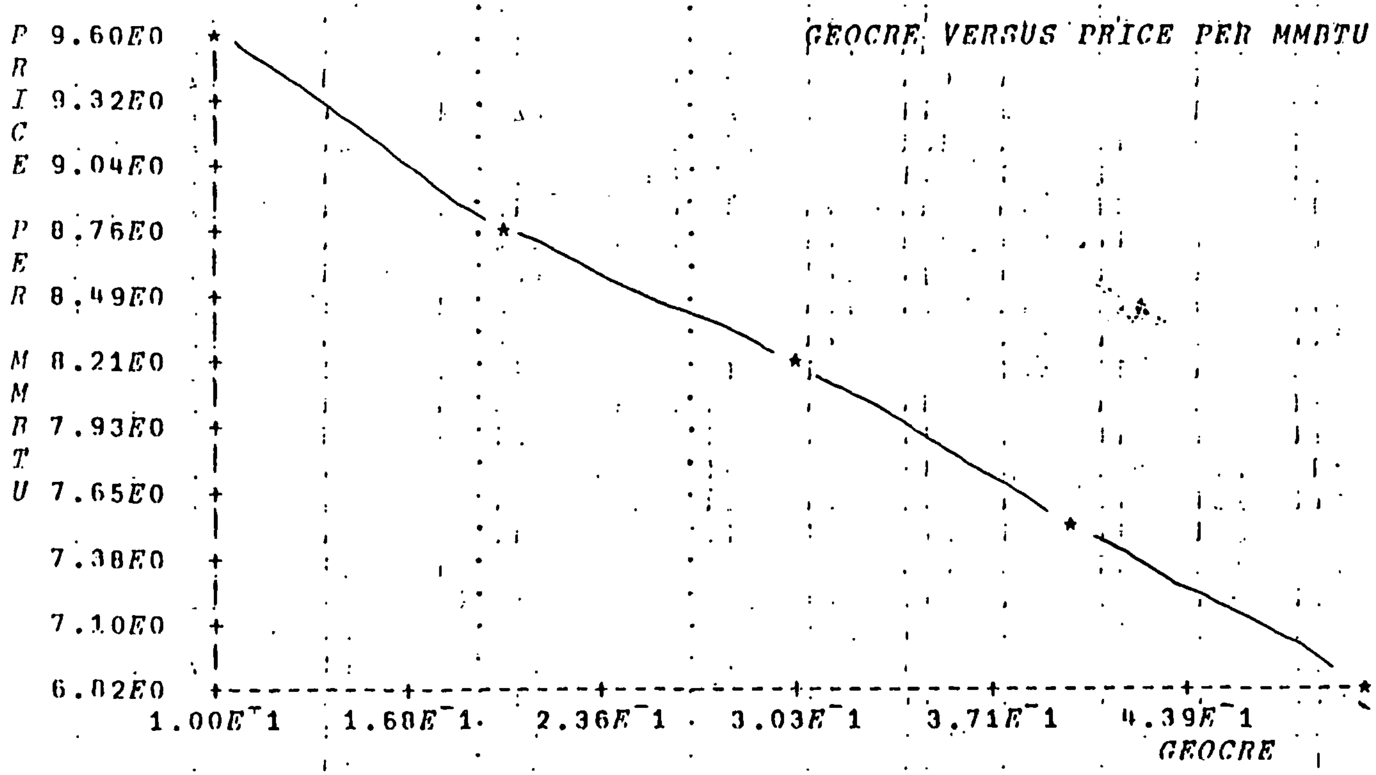
Tax Credit GEOCRED	¢/MMBTU Price	$\%\Delta$
.1	9.60	
.2	8.79	8.4
.3	8.19	6.8
.4	7.49	8.5
.5	6.82	8.9

GEOCRED is defined in BTHERM as the tax credit rate which applys to the geothermal investment. The obvious policy conclusion is that public sector adjustments or increments in this tax credit rate would serve to diminish the effective price to consumers and thereby maximize the potential savings to consumers.

```
RUN
THE DATE IS  20  DEC   1979,  TIME   8:10
ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...GEOCRED+.1 .2 .3 .4 .5
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...GLOBE
...
```

GEOCRE	PRICE PER MMBTU
0.1	9.6
0.2	8.79
0.3	8.19
0.4	7.49
0.5	6.82

```
 * TEMP+80 * DEPTH+4200 * POP+7800 * DIST+21 * LT+29 * DEGD+3010 *
 PHDI+.961E10 * POPG1+.008 * POPG2+0 * POPI+.015
GRAPH OF     GEOCRE  VERSUS PRICE PER MMBTU ?? YES
```



5. RI (Real Price Increase)

RI	2020 Savings (000)	%Δ
.04	21,992	
.05	36,366	65.3
.06	55,536	52.7
.07	76,450	37.6
.08	97,523	27.5

The savings which accrue to consumers is a function of the price of geothermal energy, the price of the alternate fuel, the rate of real increase in the price of the alternate fuel, and the quantity consumed. At a slower real growth rate in the price of alternate fuels the savings which accrue as a result of the price differential are much smaller than they would be at a higher growth rate. Where,

$$\text{Savings } 2020 = (PALT_{2020} \times Q_{2020}) - (PGEO_{2020} \times Q_{2020})$$

and $PALT_{2020}$ is a direct function of R.I.

Also, given that RI is the main determinant of PALT in time period t ($PALT_t = PALT \times (1 + RI)^t$) the RI is the main determinant of the year in which geothermal will become price competitive and hence "on line". Note: "Year on Line" in the Cost and Benefit Summary's.

```
RUN
THE DATE IS  20  DEC   1979,  TIME   8:57
ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...RI←.04 .05 .06 .07 .08  (Price or Rate Increase)
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...DURANGO
...PALT←2.80
...
PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.226

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
      FED TAX    TAX CREDIT      ROYALTY          STATE TAX ST SALES TAX  PROPERTY TAX
   $5,860,000   $2,028,000    $2,425,000          $617,000               $0   $2,014,000
NET SAVINGS THROUGH YEAR:       1990            2000            2020
                                  $0    $5,991,000  $21,992,000
PRICE OF GEO:    $3.94     PRICE OF ALT FUEL:    $2.80     YEAR ON LINE:  1991

PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.226

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
      FED TAX    TAX CREDIT      ROYALTY          STATE TAX ST SALES TAX  PROPERTY TAX
   $6,554,000   $2,256,000    $2,733,000          $690,000               $0   $2,249,000
NET SAVINGS THROUGH YEAR:       1990            2000            2020
                           $499,000   $10,704,000  $36,366,000
PRICE OF GEO:    $3.94     PRICE OF ALT FUEL:    $2.80     YEAR ON LINE:  1990

PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.226

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
      FED TAX    TAX CREDIT      ROYALTY          STATE TAX ST SALES TAX  PROPERTY TAX
   $8,166,000   $2,790,000    $3,460,000          $860,000               $0   $2,801,000
NET SAVINGS THROUGH YEAR:       1990            2000            2020
                         $2,042,000   $17,270,000  $55,536,000
PRICE OF GEO:    $3.94     PRICE OF ALT FUEL:    $2.80     YEAR ON LINE:  1988

PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.226

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
      FED TAX    TAX CREDIT      ROYALTY          STATE TAX ST SALES TAX  PROPERTY TAX
   $8,166,000   $2,790,000    $3,460,000          $860,000               $0   $2,801,000
NET SAVINGS THROUGH YEAR:       1990            2000            2020
                         $3,133,000   $24,049,000  $76,450,000
PRICE OF GEO:    $3.94     PRICE OF ALT FUEL:    $2.80     YEAR ON LINE:  1988
```

Physical Science Laboratory

6. Syn (Synthetic Price Limit)

The price competetiveness of synfuels is highly dependent upon the price of oil. Speculations indicate that when the price of oil reaches $50 per barrel then the synfuel will become economically competitive and hence on line. The model B-THERM makes provision for the introduction of synfuels into current energy markets and assumes that whatever value that a particular user desires as a "synfuel limit" thereafter the savings growth rate ceases for geothermal users. Also, at the interception in time of the price growth rate of oil and the assumed price floor where synfuels become competitive, retrofitting and conversion to utilize geothermal energy will cease.

Savings 2020 ($000)

	Syn			
RI	10	20	30	40
.03	4,795	5,407	5,410	5,410
.04	5,095	6,346	6,508	6,510
.05	5,305	7,203	7,676	7,820
.06	5,456	7,958	8,799	9,179

```
RUN
THE DATE IS  20  DEC   1979,  TIME  10:25
ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...SYN+10 20 30 40
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...EASTMILLCREEK
...PALT+7.12
...
PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.123

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
       FED TAX    TAX CREDIT      ROYALTY        STATE TAX ST SALES TAX  PROPERTY TAX
  $34,840,000  $11,075,000   $7,584,000   $2,905,000   $8,039,000  $11,583,000
NET SAVINGS THROUGH YEAR:       1990          2000          2020
                         $19,130,000  $32,696,000  $40,293,000
PRICE OF GEO:   $8.21    PRICE OF ALT FUEL:    $7.12    YEAR ON LINE:  1984


PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.123

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
       FED TAX    TAX CREDIT      ROYALTY        STATE TAX ST SALES TAX  PROPERTY TAX
  $34,840,000  $11,075,000   $7,584,000   $2,905,000   $8,039,000  $11,583,000
NET SAVINGS THROUGH YEAR:       1990          2000          2020
                         $59,078,000 $148,042,000 $198,056,000
PRICE OF GEO:   $8.21    PRICE OF ALT FUEL:    $7.12    YEAR ON LINE:  1984


PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.123

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
       FED TAX    TAX CREDIT      ROYALTY        STATE TAX ST SALES TAX  PROPERTY TAX
  $34,840,000  $11,075,000   $7,584,000   $2,905,000   $8,039,000  $11,583,000
NET SAVINGS THROUGH YEAR:       1990          2000          2020
                         $59,078,000 $185,209,000 $277,640,000
PRICE OF GEO:   $8.21    PRICE OF ALT FUEL:    $7.12    YEAR ON LINE:  1984


PENALTY FACTOR FOR LOW TEMPERATURE IS:     1.123

COST AND BENEFIT SUMMARY (1980 - 2020), DISCOUNTED AT COST OF CAPITAL.
       FED TAX    TAX CREDIT      ROYALTY        STATE TAX ST SALES TAX  PROPERTY TAX
  $34,840,000  $11,075,000   $7,584,000   $2,905,000   $8,039,000  $11,583,000
NET SAVINGS THROUGH YEAR:       1990          2000          2020
                         $59,078,000 $189,591,000 $322,426,000
PRICE OF GEO:   $8.21    PRICE OF ALT FUEL:    $7.12    YEAR ON LINE:  1984
```

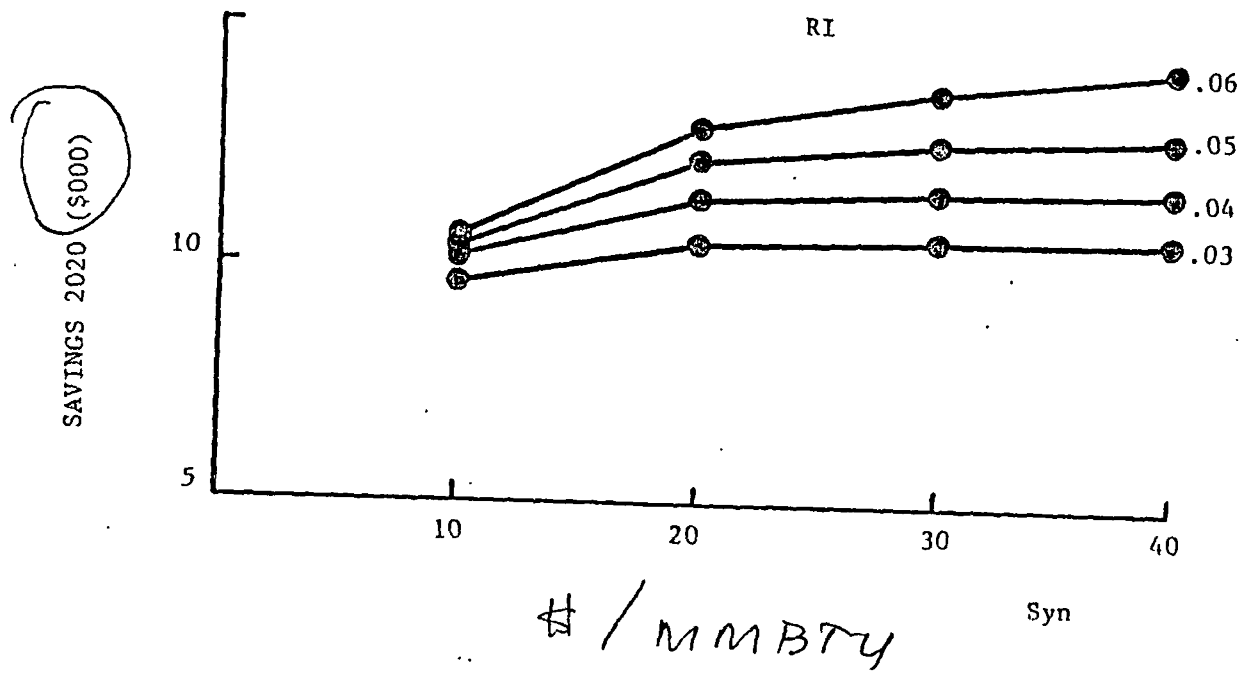
7. 2020 SAVINGS, RI Versus Syn

Given a very high real growth rate in the price of conventional fuels the savings to consumers of geothermal energy will also be very high. These savings however will be checked by the introduction of synfuels into energy markets. Savings being equal to

$$\text{Savings} = P \times Q_{(Alt,\ t)} - P \times Q_{(GEO,\ t)}$$

and $P \times Q_{(Alt,\ t)} = P \times Q_{(Alt,\ o)} \times (1 + RI)^{t}$

where Alt is the conventional or alternate fuel. The simplifying assumption is made that Q is relatively inelastic with respect to P. At some point in time after PALT is grown at some real rate a less expensive synfuel may enter the market. At this point savings to geothermal users are assumed to cease.



RI
.06
.05
.04
.03
SAVINGS 2020 ($000)
10
5
10
20
30
40
Syn
#/MMBTU

FINANCIAL FACTORS

ACIW = Required acreage for injection well

ACPW = Required acreage for production well

AHD = Average heat demand, residential and commercial

AHE = Area of heat exhanger (Ft^2)

AMOR = Amount of principal repaid in year t (amortization schedule)

BR = bond rate (interest rate on borrowed money)

CBA = Cost and Benefit summary (taxes, credits, consumer savings)

CC = Total Conversion Costs

CCC = Commercial conversion costs

CCPCF = Commercial conversion cost per firm (used for pure commercial application only)

CCRED = Commercial credit (20% of total geo-conversion costs)

CHE = Cost of heat exchanger

CITY = A combination of parameters used to show city developed geothemal energy

CON = Construction time (years)

CPIPF = Industrial hookup costs (per inch diameter per foot)

CRHUC = Commercial ratio for hookup costs

CRRFC = Commercial ratio for retrofit costs

CSM = Citys share of money, i.e. not loan or grant

DEPAMT = Amount of depreciation claimed in year t

DEPRD = Depreciation schedule

DES = Percent of investment for design costs

DEV = Factor to allow selection of city developer or private developer

D = Period of depreciation for drilling investment

DINV = Distribution investment

DF = Discounting Factor (Set to zero to get nominal values, otherwise cost of capital)

DK = Debt portion of capital investment

DNV = Drilling investment

DPAC = Leasing cost per acre (dollars)

DVP = Development time (years)

ELECQ = Electricity quantity per year, Kwh
EK = Percent of equity financing
EXP = Exploration time (years)

FTXRT = Federal tax rate (currently 46% minimum)

GEOCRED = Geothermal (energy) tax credit rate (terminates by 1986)
GR = Growth rate of geothermal price

HEC = Heat exchanger coefficient
HUC = Hookup cost to bring hot water from street into building
HUCC = Total commercial hookup cost
HUCI = Industrial hookup costs
HUCPA = Hookup cost per apartment
HUCPH = Hookup cost per home
HUCR = Total residential hookup cost

ICRED = Total investment tax credit
IDE = Intangible drilling expense in year t
INV = Equity portion of total project investment
ITRNV = Intercept of transmission investment curve
INTP = Interest costs per year
IWCOST = Injection well cost (function of production well cost)

LAMDA = Royalty rate (percent of gross income)
LNV = Leasing investment

MC = Factor to compute management fee for city development as a function of investment
MFC = Multiplication factor for hookup and retrofit costs (scaling factor)
MFCCC = Multiplication factor for commercial conversion cost
MFCCPCF = Multiplication factor for commercial conversion cost per commercial firm (used only for pure commercial application)
MFCHE = Multiplication factor for cost of heat exhanger
MFDINV = Scaling factor DINV
MFRNV = Multiplication factor for research investment
MFSAVE = Multiplication for savings

NEGFEE = Negotiable fee as a percentage of ROI

NG = New growth flag, NG = 1 for new growth only, NG = 0 for all population

NPVCB = Net present value of investment, discounted at capital cost

OCE = Percent of drilling costs which constitute operating expenses

OCP = Percent of drilling and plant costs which constitute operating expenses

OCTAX1 = Other taxes during period T1

OXTAX2 = Other taxes during period T2

PALT = Price of cheapest available conventional fuel

PC = Base year percentage of operating cost as a function of investment

PCD = Operating costs as a percent of drilling investment

PCI = Operating costs as a percent of total industrial investment

PCOC = Percent operating cost (function of TNV)

PDCRED = Private developer credit

PFFLT = Penalty factor for low temperature resource

PIWCR = Production injection well cost ratio

PLV = Plant investment (does not include drilling)

POPG1 = Population growth for the period of T1

POPG2 = Population growth for the period of T2

POPGIT = Multiplier for population growth

POPI = Estimated industrial growth/year

PPKWH = Price per kilowatt hour

PPY = Preproduction years

PREG = Price of regulated fuel

PRINP = Principal payments per year (loan repayment)

PRIV = Private developer

PR1 = Price based on R1 } P is based on

PR2 = Price based on R2 } weighted average

PTX = Property taxes

PTXR = Property tax rate

R1 = Rate of return required by developer for first 15 years

R2 = Rate of return required by developer for remaining years

RC = Gross revenue

REALG = Growth rate for investments

REGCRED = Regular tax credit rate

RESCRED = Credit amount per dwelling

RFC = Total retrofit costs

RFCC = Commercial retrofit costs

RFCI = Retrofit cost for industry

RFCR = Residential retrofit costs

RFCMI = Multiplication factor for industrial retrofit

RG = Real growth rate in investment and operating costs per year

RFCPA = Retrofit cost for apartment

RFCPH = Retrofit cost for home

RI = Escalation of energy price over time (real price growth)

RNV = Research investment

ROI = Return on investment (divided into R1 and R2 time periods)

ROY = Amount of royalty paid per annum (Divided into R1 and R2 time periods)

SKP = Number of years between heating districts

SPECCRED = Special tax credit (residential and commercial property owners)

SSTXR = State sales tax rate

STK = Heating district inclusion flag, STK = 1 do include heating district, STK = 0 no heating district

ST1 = State tax paid under R1

ST2 = State tax paid under R2

STRNV = Slope of transmission investment curve

STXRT = State tax rate

SYN = Synfuel price ceiling

T = Project life in years

TAX = Income tax total (Divided into TAX1 and TAX2 time periods)

TCB = Tax cost base for calculating depreciation amount and allowable depletion amount

TNV = Total investments

TRNV = Transmission investment

TSPOPI = Multiplier for industrial growth

TVC = Variable costs (maintenance, tax depreiation etc.)

T1 = Number of years to apply POPG1

T2 = Number of years to apply POPG2

VARG = REALG as a vector of multipliers

VARI = RI as a vector of multipliers

WCOST = Production well cost

Y = Tangible investment percentage

YEAR = Year in which PLV occurs (user input, otherwise PPY-1)

Z = Depletion allowance rate

ENERGY AND HOT WATER REQUIREMENT

CDR = Commercial demand

CF = Commercial factor for ratio between commercial and residential energy consumption derived separately for each city

CRHWD = Percent factor for commercial hot water demand, fraction of commercial space heating demand as simplifying assumption

DEGD = Degree days heating required of the community

DEPTH = Depth to hot water resource

DDDEPTH = Drawdown depth during well operation

DESF = Engineering factor, to provide for safety margins

DIST = Distance from resource to use point in decimal miles

DT = Difference between ambient inside temperature (65°F) and LT, lowest mean outside temperature

E = Correction factor for fraction of steam available

FR = Flow rate of each production well (lbs/hr)

HADD = Heat demand for apartments (BYU's/hr/Δ°F)

HDS = Heating district size

HHDD = Heat demand for home (BTU's/hr/Δ°F)

HWD = Total hot water demand, residential plus commercial

HWDC = Hot water demand commercial (lbs/hr)

HWDR = Hot water demand residentail (lbs/hr)

HWLBH = Hot water (lbs/hr) needed at given temperature

HWLBHI = Industrial hot water demand (lbs/hr)

ISS = Injection well success ratio

ITD = Intercept temperature drop

ITPD = Intercept of transmission pipe diameter (inch)

LF = Load factor (percent of time system used)

LT = Mean low temperature (for specific site)

MFTPD = Multiplication factor for transmission pipe diameter

NHRS = Hours of operation per annum (Industrial only)
NIW = Number of new injection wells
NPW = Number of new production wells

PA = Percent of population in apartments as opposed to homes
PCRHW = Per capita residential hot water demand (lbs/hr)
PDROP = Percent drop in temperature per mile of transmission
PH = Percent of population in homes as opposed to apartments
PHD = Peak space heating demand for residential and commercial sector
PHDC = Peak commercial space heating demand
PHDI = Industrial heat demand BTU's/year
PIR = Ratio of production to injection wells
POP = Population of area to be served
PPD = People per dwelling
PPHD = Peak residential space heating demand (BTU's/hr)
PSD = Plant to street distance in feet
PSS = Production well success ratio

RIW = Required injection wells
RPW = Required production wells

SF = Steam fraction
STD = Slope of temperature drop
STPD = Slope of transmission pipe diameter (inch)

TD = Usable temperature drop
TE = Effective temperature
TEMP = Temperature of the resource
TG = Thermal gradient of site (°F/100 ft)
THD = Total average heat demand
TPD = Transmission pipe diameter (inch)
TPHWD = Total peak hot water demand

UTD = Difference between ground water temperature and required temperature

WL = Well life

```
RUN
THE DATE IS  17  JAN   1980,  TIME  16:40
ENTER THE MULTIVALUED VARIABLE AND ITS VALUES
...
ENTER ANY CHANGES TO THE BASE CASES DESIRED
...TAMM
...BR←.12×MFRNV←.5×R1←R2←.3×DEV←DPQ←1×GR←.025×PCRHW←30
...
PENALTY FACTOR FOR LOW TEMPERATURE IS:    1.035

PRICE OF ALTERNATE FUEL  $10.00
                     INVESTMENT COSTS
      CATEGORY                    NET PRESENT VALUE
                              DISCOUNTED AT COST OF CAPITAL
    ------------             ------------------------------

    RESEARCH INVESTMENT       $          420,148
    DESIGN                                26,440
    MANAGMENT FEE                              0
    WELLS                                103,181
    TRANSMISSION                         114,211
    DISTRIBUTION:
       RESIDENTIAL RETROFIT               32,927
       RESIDENTIAL HOOKUP                 11,525
       COMMERCIAL CONVERSION                   0
       INDUSTRIAL CONVERSION                   0
       HEAT EXCHANGERS                    15,490
       CENTRAL SYSTEM                     32,561

                 TOTAL        $          756,483

PRICE PER MILLION BTU:    $9.55

 × TEMP←60 × DEPTH←1750 × DIST←2 × PA←1 × PH←0 × POP←750 × POPG1←.1 ×
 POPG2←.03 × T←D←20 × PHDI←CF←0 × MFC←.25 × MFDINV←.075 × FCRHW←40 ×
 DEGD←8300 × LT←10 ×  × BR←.12 × MFRNV←.5 × R1←R2←.3 × DEV←DPQ←1 ×
 GR←.025 × PCRHW←30
```