HYDROTHERMAL ELECTRIC POWER MARKET ESTIMATES

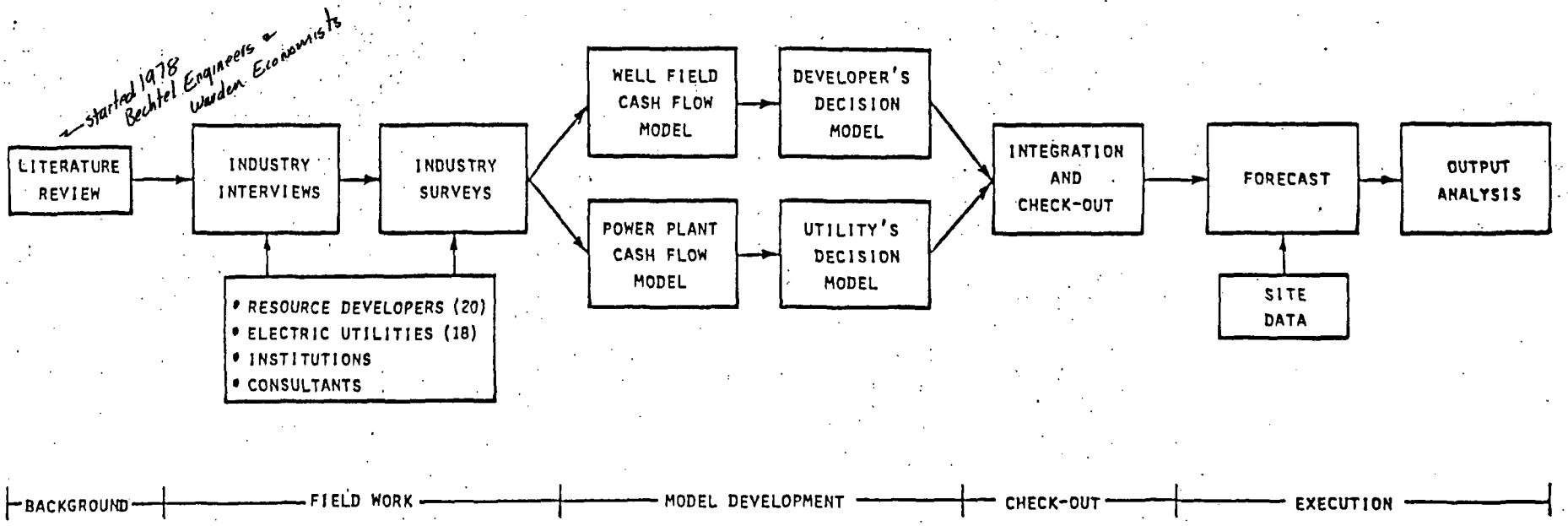
- CONFIRMED AND PROJECTED RESOURCES
- MEGAWATTS ON-LINE OVER TWENTY YEARS
- U.S. DOE PROGRAM IMPACTS

GL00706

8-19-80

presented @ EPRI

HYDROTHERMAL ELECTRIC POWER MARKET ESTIMATES PROJECT



INDUSTRY PARTICIPANTS

ELECTRIC UTILITIES

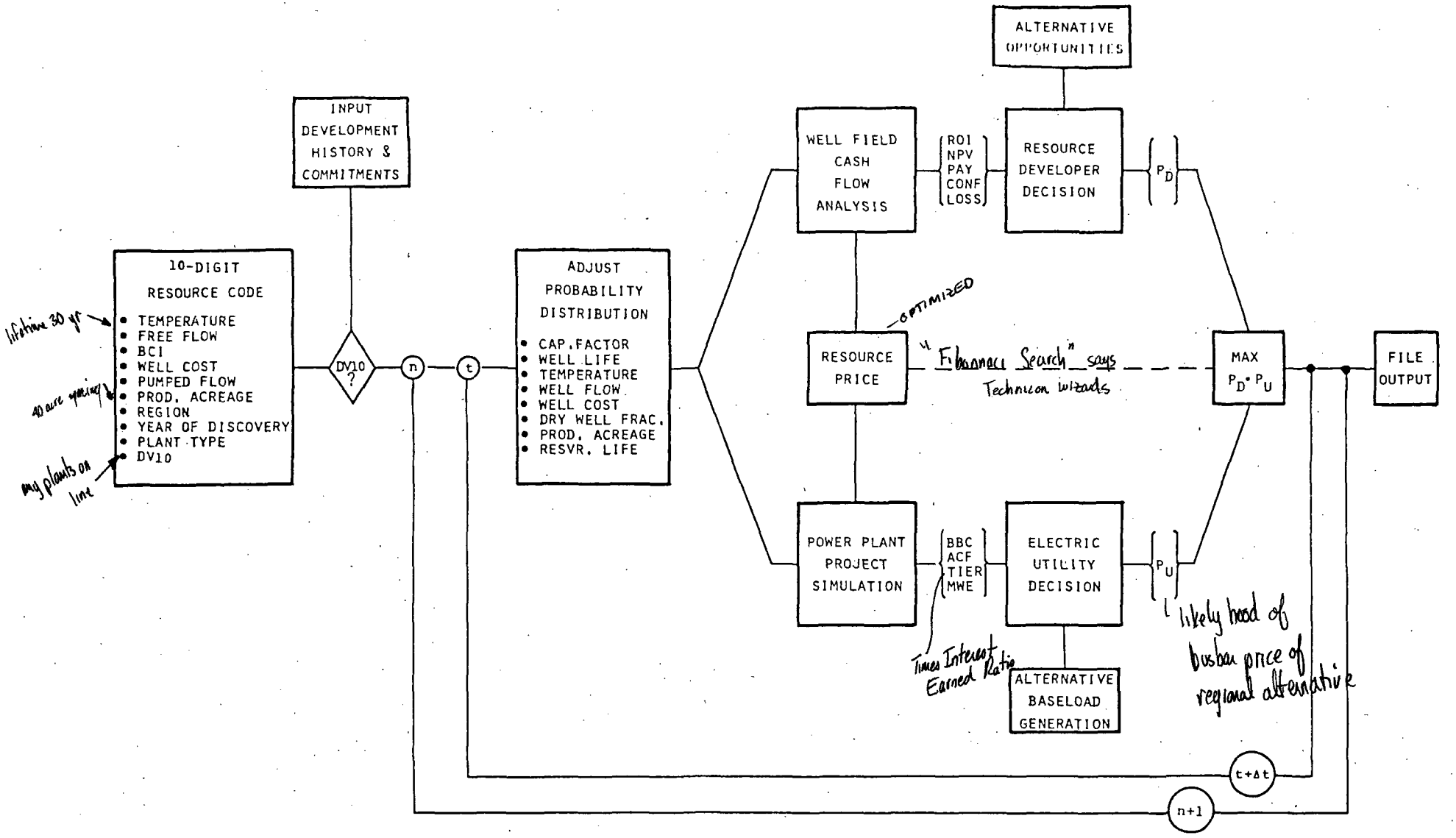
ARIZONA PUBLIC SERVICE
BOUNTIFUL POWER AUTHORITY
BURBANK PUBLIC SERVICE DEPARTMENT
CALIFORNIA WATER RESOURCES CONTROL BOARD
LOS ANGELES DEPARTMENT OF WATER AND POWER
NEVADA POWER COMPANY
NEW MEXICO, PUBLIC SERVICE OF
NORTHERN CALIFORNIA POWER AGENCY
PACIFIC GAS AND ELECTRIC COMPANY
PACIFIC POWER AND LIGHT
PHILADELPHIA ELECTRIC COMPANY
PORTLAND GENERAL ELECTRIC
PROVO CITY UTILITIES
SACRAMENTO MUNICIPAL UTILITY DISTRICT
SAN DIEGO GAS AND ELECTRIC COMPANY
SIERRA PACIFIC POWER COMPANY
SOUTHERN CALIFORNIA EDISON
UTAH POWER AND LIGHT COMPANY

RESOURCE DEVELOPERS

AMAX
AMINOIL USA
AMOCO PRODUCTION COMPANY
CHEVRON RESOURCES COMPANY
GEOTHERMAL KINETICS INC
GETTY OIL COMPANY
GULF OIL COMPANY
INTERCONTINENTAL ENERGY COMPANY
MAGMA POWER COMPANY
MCCULLOCH OIL COMPANY
OBRIEN RESOURCES COMPANY
OCCIDENTAL PETROLEUM COMPANY
PACIFIC ENERGY COMPANY
PHILLIPS PETROLEUM COMPANY
REPUBLIC GEOTHERMAL INC
SHELL OIL COMPANY
TEXAS OIL AND GAS COMPANY
THERMAL POWER COMPANY
THERMOGENICS (HUGHES)
UNION OIL COMPANY OF CALIFORNIA

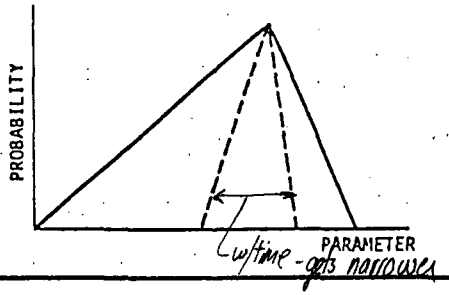
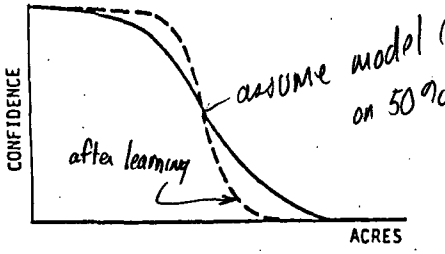
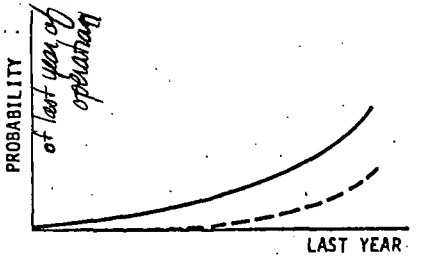
CONSULTANTS/INSTITUTIONS

ARTHUR ANDERSEN AND COMPANY - Utility Accounting Models
BANK OF AMERICA
BANK OF MONTREAL > how bankable are geoth projs.
CASCADIA EXPLORATION COMPANY (w/ Republic - on reservoir confidence)
EG&G IDAHO, INC
LOEB RHOADES HORNBLOWER
PENNSYLVANIA PUBLIC UTILITY COMMISSION
STANDARD AND POOR'S CORPORATION
STANFORD UNIVERSITY (DR. S. SUNYAL)
UURI/ESL
UTAH DIVISION OF WATER RIGHTS
WESTERN SYSTEM COORDINATING COUNCIL



HYDROTHERMAL POWER FORECAST MODEL (TCN3000)

HYDROTHERMAL POWER PROJECT UNCERTAINTIES

UNCERTAIN PARAMETER	DISTRIBUTION	FACTORS AFFECTING VARIANCE
• POWER PLANT CAPACITY FACTOR • WELL LIFE, INJECTORS • WELL LIFE, PRODUCERS • RESERVOIR TEMPERATURE • WELL FLOW RATE • WELL COST • DRY WELL FRACTION		• ON-SITE PRODUCTION TIME; ABSOLUTE TIME • ON-SITE PRODUCTION TIME; ABSOLUTE TIME • ON-SITE PRODUCTION TIME; ABSOLUTE TIME • ON-SITE PRODUCTION TIME; ABSOLUTE TIME; WELLS DRILLED • ON-SITE PRODUCTION TIME; ABSOLUTE TIME; WELLS DRILLED • ABSOLUTE TIME; WELLS DRILLED • ABSOLUTE TIME; WELLS DRILLED
• PRODUCIBLE ACREAGE		• ACREAGE IN PRODUCTION
• ECONOMIC RESERVOIR LIFE		• ON-SITE PRODUCTION TIME; ABSOLUTE TIME

ECONOMIC & FINANCIAL PARAMETERS

ALTERNATIVE PLANT COMMON STOCK COST
ALTERNATIVE PLANT COMMON STOCK FRACTION
ALTERNATIVE PLANT LONG TERM DEBT COST
ALTERNATIVE PLANT LONG TERM DEBT FRACTION
ALTERNATIVE PLANT PREFERRED STOCK COST
ALTERNATIVE PLANT PREFERRED STOCK FRACTION
ELECTRIC UTILITY DEBT OBLIGATIONS
ELECTRIC UTILITY GROWTH RATE
ELECTRIC UTILITY NET INCOME
HYDROTHERMAL PLANT COMMON STOCK COST
HYDROTHERMAL PLANT COMMON STOCK FRACTION
HYDROTHERMAL PLANT LONG TERM DEBT COST
HYDROTHERMAL PLANT LONG TERM DEBT FRACTION
HYDROTHERMAL PLANT PREFERRED STOCK COST
HYDROTHERMAL PLANT PREFERRED STOCK FRACTION
INFLATION RATE FOR GOODS AND SERVICES
INFLATION RATE FOR POWER PLANT CONSTRUCTION
INFLATION RATE FOR POWER PLANT FUEL (REGIONAL)
RESOURCE DEVELOPER'S DISCOUNT RATE
THIRD PARTY'S DEBT INTEREST RATE
THIRD PARTY'S DISCOUNT RATE
THIRD PARTY'S EQUITY FRACTION
THIRD PARTY'S RETURN ON EQUITY

TAX PARAMETERS

FEDERAL TAX RATE FOR RESOURCE DEVELOPER
FEDERAL TAX RATE FOR ELECTRIC UTILITY ALTERNATIVE
FEDERAL TAX RATE FOR ELECTRIC UTILITY HYDROTHERMAL
FEDERAL TAX RATE FOR THIRD PARTY
INTANGIBLE FRACTION OF WELL COST
INVESTMENT TAX CREDIT FOR NON-UTILITY HYDROTHERMAL
INVESTMENT TAX CREDIT FOR ELECTRIC UTILITY ALTERNATIVE
INVESTMENT TAX CREDIT FOR ELECTRIC UTILITY HYDROTHERMAL
LOCAL TAX RATES
MINIMUM TAX RATE ON PREFERENCE ITEMS
PERCENTAGE DEPLETION ALLOWANCE SCHEDULE
STATE TAX RATE FOR ELECTRIC UTILITY ALTERNATIVE
STATE TAX RATE FOR ELECTRIC UTILITY HYDROTHERMAL
STATE TAX RATE FOR RESOURCE DEVELOPER
STATE TAX RATE FOR THIRD PARTY
TAX LIFE FOR ALTERNATIVE PLANT
TAX LIFE FOR HYDROTHERMAL PLANT
TAX LIFE FOR WELL FIELD CAPITAL

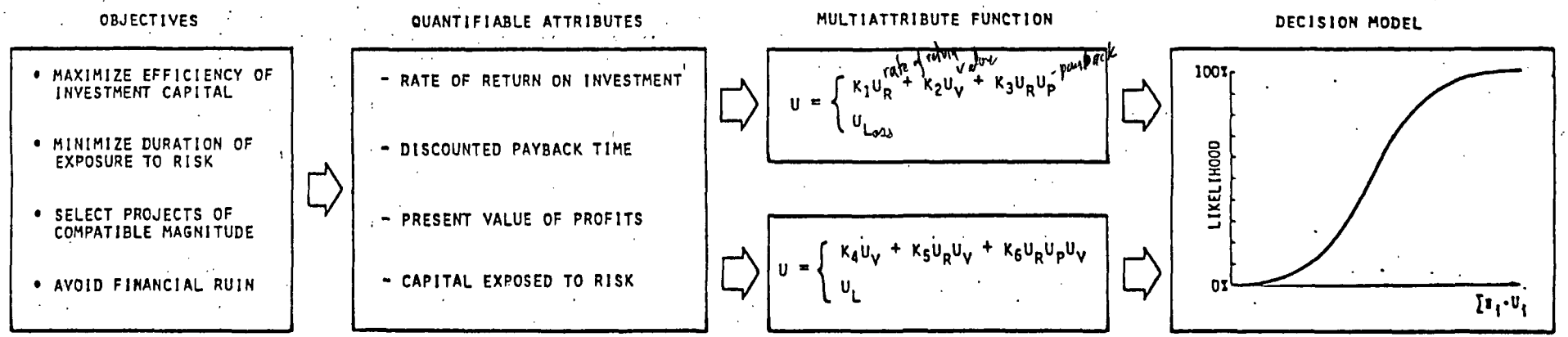
RESOURCE PARAMETERS

BRINE CONTAMINATION INDEX
CONFIRMATION WELLS REQUIRED
DEVELOPMENT COMMITMENTS TO DATE
DRY WELL COST
DRY WELL FRACTION
FINDING COST CAPITALIZED
FINDING COST EXPENSED
FIRMS IN JOINT VENTURE
FLOW TEST AND MODELING COST
LAND RENT
LEASE BONUS
OPERATION AND MAINTENANCE EXPENSE
PERMITTING EXPENSE
PRODUCER/INJECTOR RATIO
PRODUCIBLE ACREAGE AT 50% CONFIDENCE
PRODUCIBLE ACREAGE AT 99% CONFIDENCE
REDRILL COST
REDRILL FRACTION
REWORK COST
REWORK FRACTION
ROYALTY RATE
SPARE WELL FRACTION
SURFACE FACILITY COST
SURFACE PIPING COST
TEMPERATURE OF RESOURCE
TYPE OF RESOURCE DEVELOPER
WELL COST
WELL FLOW, FREE
WELL FLOW, PUMPED
WELL LIFE
WELL PUMP THRESHOLD
WELL SPACING
YEAR OF DISCOVERY

POWER PLANT PARAMETERS

BOOK LIFE OF ALTERNATIVE PLANT
BOOK LIFE OF HYDROTHERMAL PLANT
CAPACITY FACTOR OF ALTERNATIVE PLANT
CAPACITY FACTOR OF HYDROTHERMAL PLANT
CAPITAL COST OF ALTERNATIVE PLANT
CAPITAL COST OF HYDROTHERMAL PLANT
CAPITAL COST OF TRANSMISSION
EFFICIENCY OF HYDROTHERMAL PLANT - done in watt-hrs/lb of brine
FUEL PRICE OF ALTERNATIVE PLANT
INSURANCE PREMIUMS
LAST YEAR OF PROJECT OPERATION
RECURRING ANNUAL COST OF ALTERNATIVE PLANT
RECURRING ANNUAL COST OF HYDROTHERMAL PLANT
REPLACEMENT POWER COST
REPLACEMENT POWER COST ALLOWABLE
SIZE OF HYDROTHERMAL PLANT
TIME FROM DECISION TO PLANT ON-LINE
TIME INTERVAL BETWEEN PLANTS
TYPE OF PLANT (FLASH/BINARY)
TYPE OF UTILITY
WRITE-OFF PERIOD ALLOWABLE

RESOURCE DEVELOPERS



1 - for small

1 - for large

Attendance 8/19/80
EPRI et. al.

Name	Company	Phone
Evan Hughes	EPRI	(415) 855-2179
Tom Lawford	EG+G Idaho	(208) 526-1844
Duncan Foley	Earth Science Lab, Univ. Ut. Res. Inst.	(801) 581-3155
Meredith Anguin	EPRI	(415) 855-2594
Vasel Roberts	EPRI	(415) 855-2160
Tom Cassel	Technecon	(215) 561-5462
Steve Kohen	EPRI	(415) 855-2679
Rick Smith	Technecon	(415) 777-1228
Bob Edelstein	Technecon	(213) 476-8816 / (215) 561-5462

ELECTRIC UTILITIES

OBJECTIVES

- MINIMIZE BURDEN ON RATE-PAYERS
- GENERATE RELIABLE BASELOAD POWER
- MAINTAIN DESIRABLE MARGIN OF RESERVE
- PROTECT ACCESS TO CAPITAL MARKET

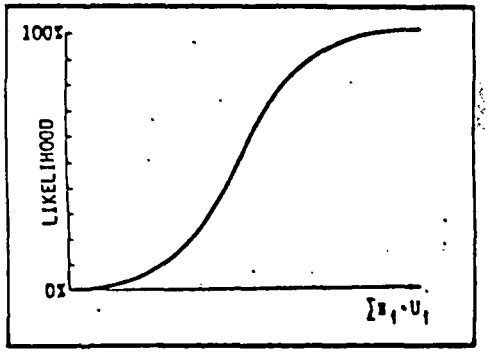
QUANTIFIABLE ATTRIBUTES

- GENERATION + TRANSMISSION COST VERSUS BEST ALTERNATIVE
- LIFETIME PLANT AVAILABILITY
- PROJECT SIZE IN MEGAWATTS
- IMPACT UPON "TIMES INTEREST EARNED RATIO"

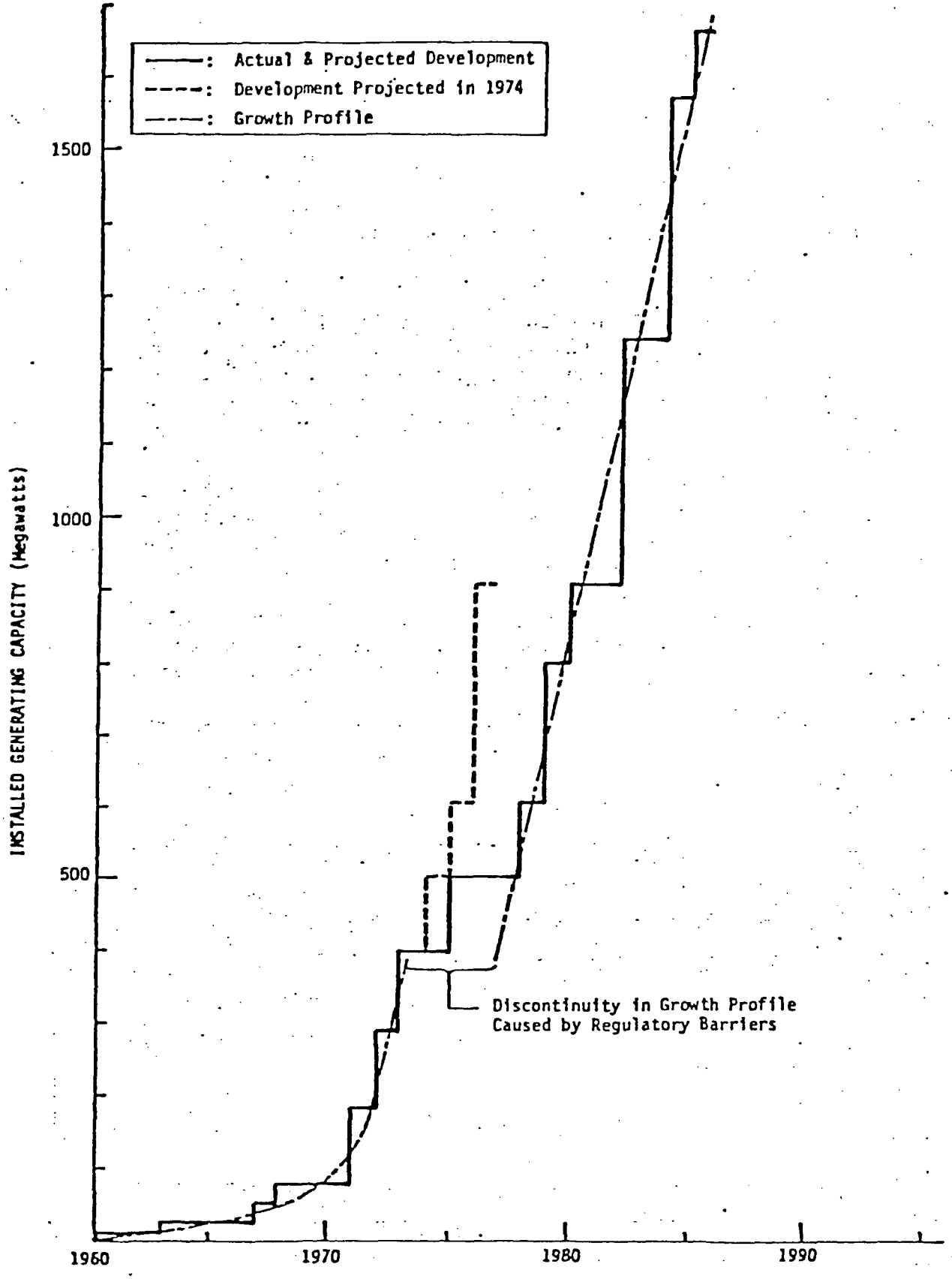
MULTIATTRIBUTE FUNCTION

$$U = K_7U_CU_A + K_8U_CU_M + K_9U_CU_T$$

DECISION MODEL

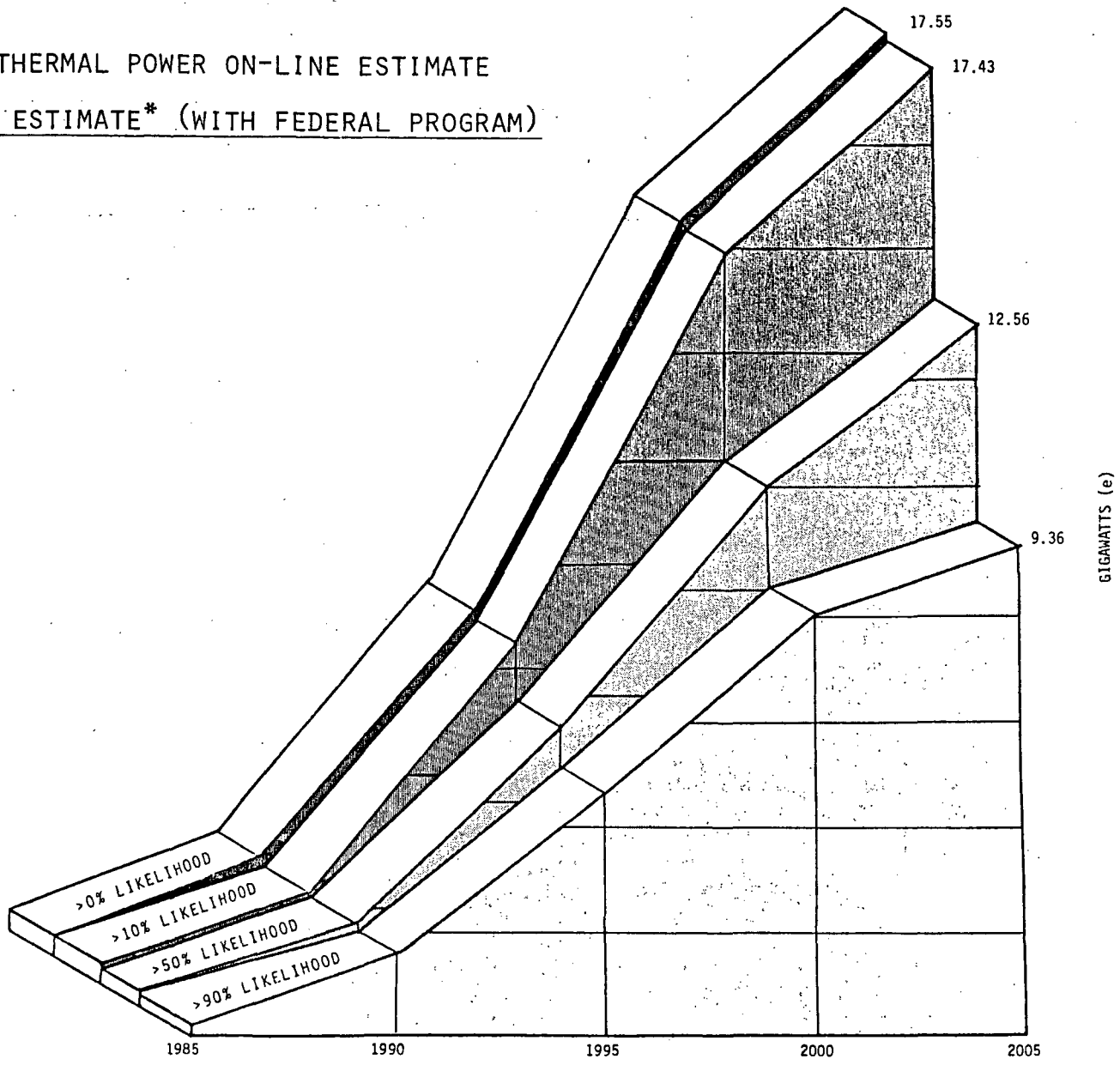


PROFILE OF DEVELOPMENT AT THE GEYSERS



HYDROTHERMAL POWER ON-LINE ESTIMATE

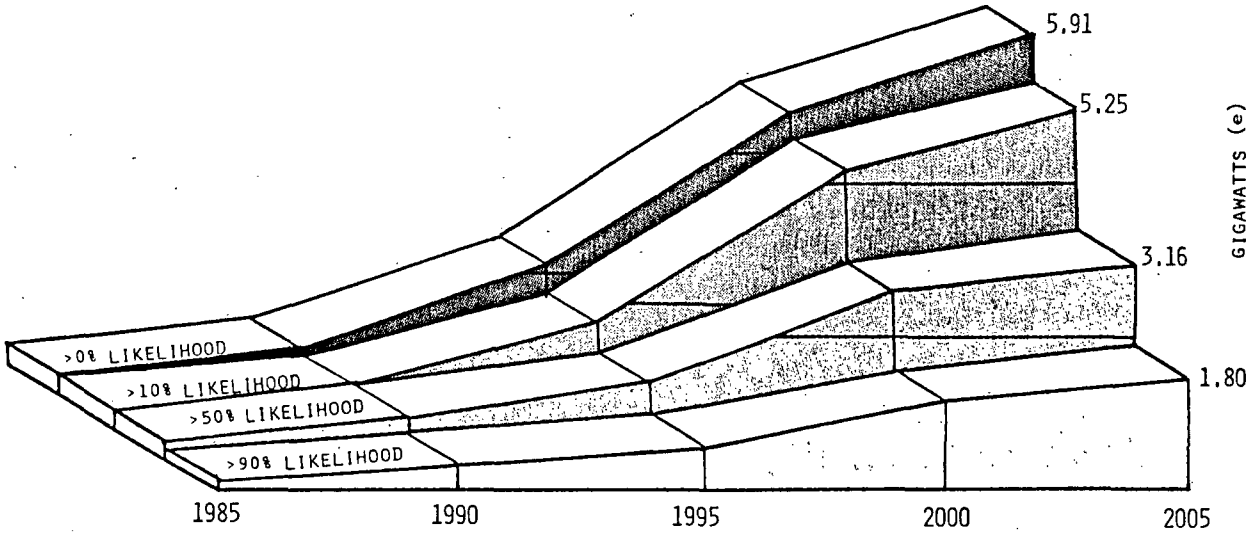
NATIONAL ESTIMATE* (WITH FEDERAL PROGRAM)



*EXCLUDES GEYSERS: 1985 (1.6GW)

HYDROTHERMAL POWER ON-LINE ESTIMATE

NATIONAL ESTIMATE* (WITHOUT FEDERAL PROGRAM)



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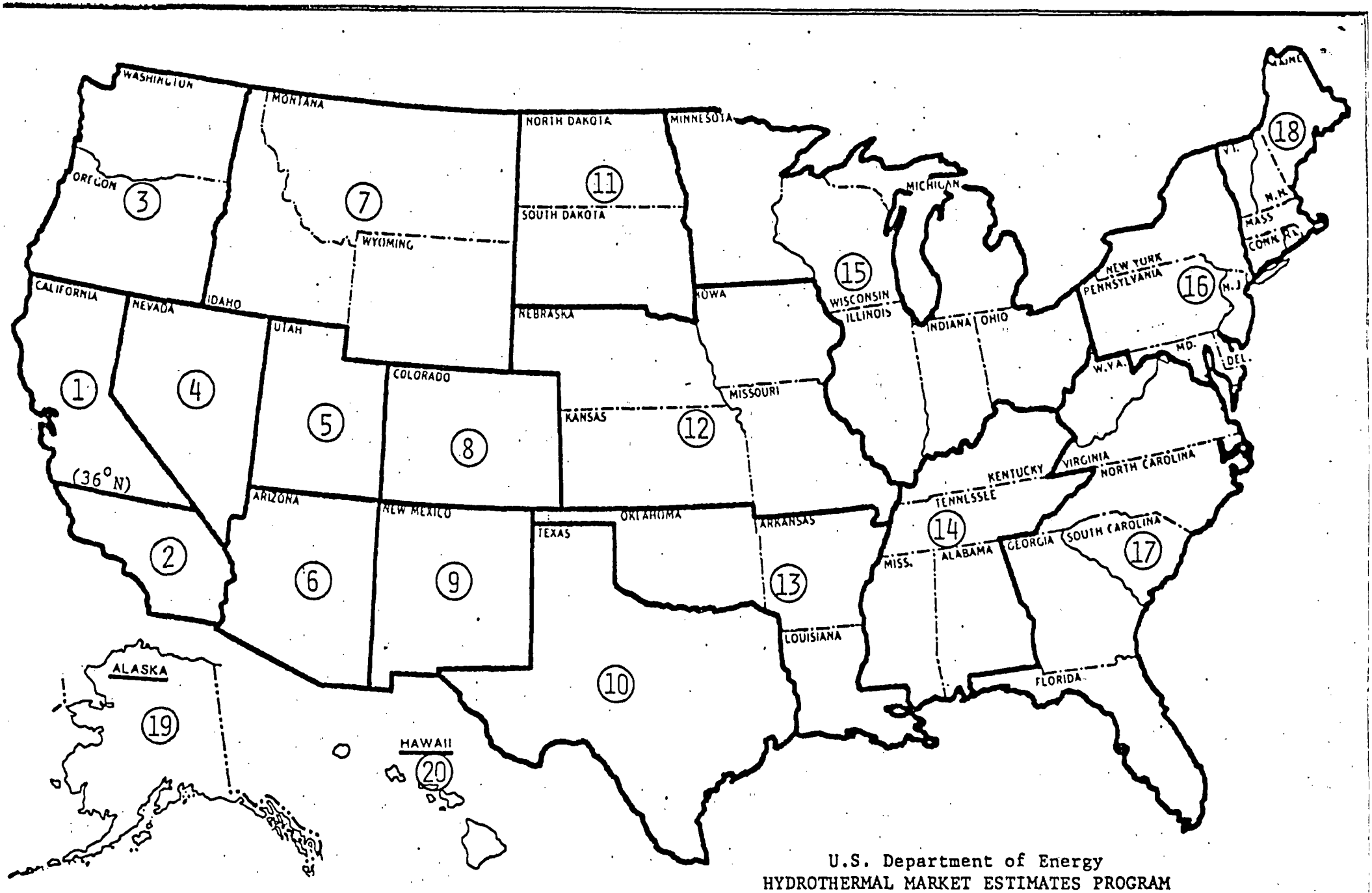
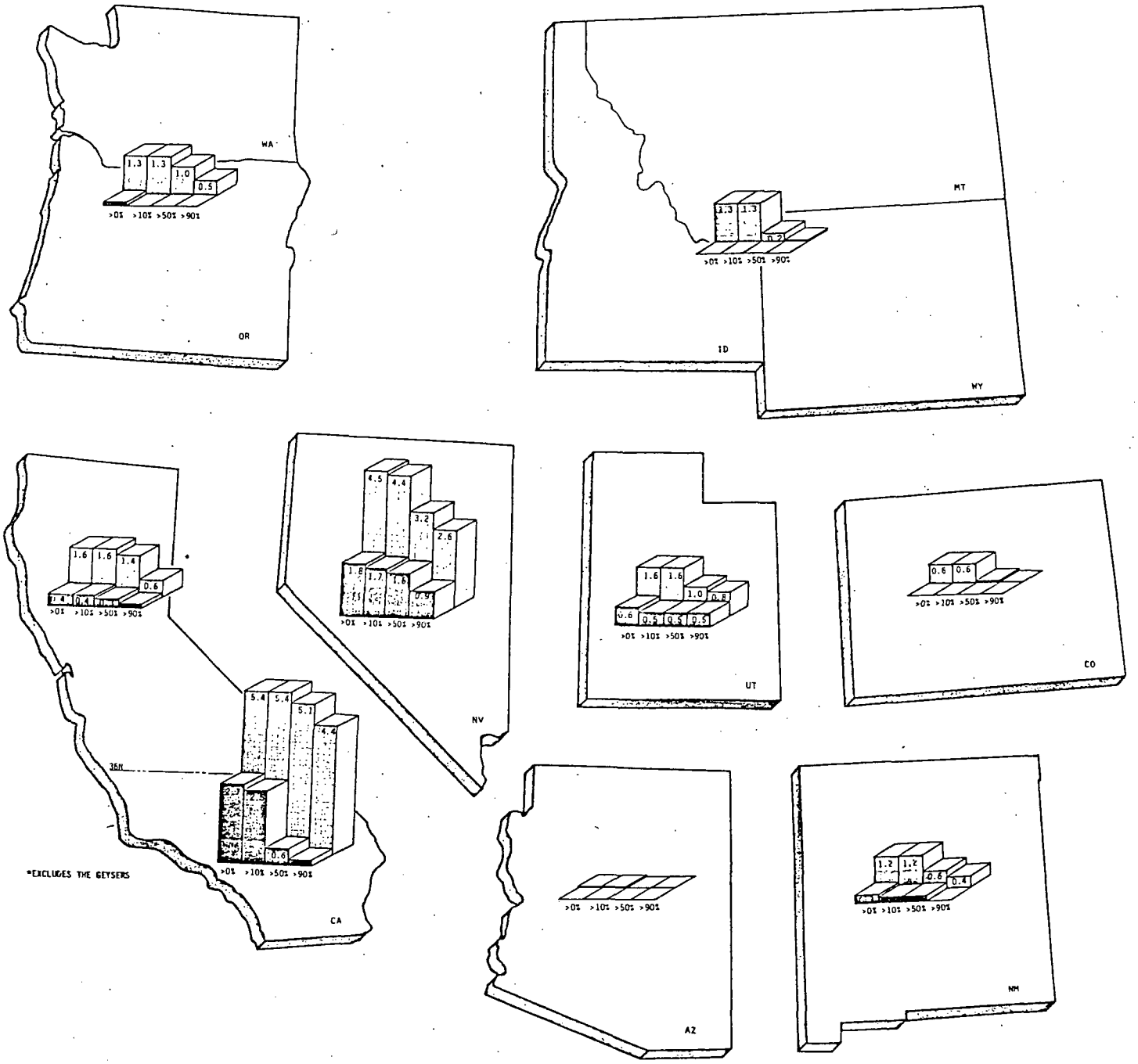


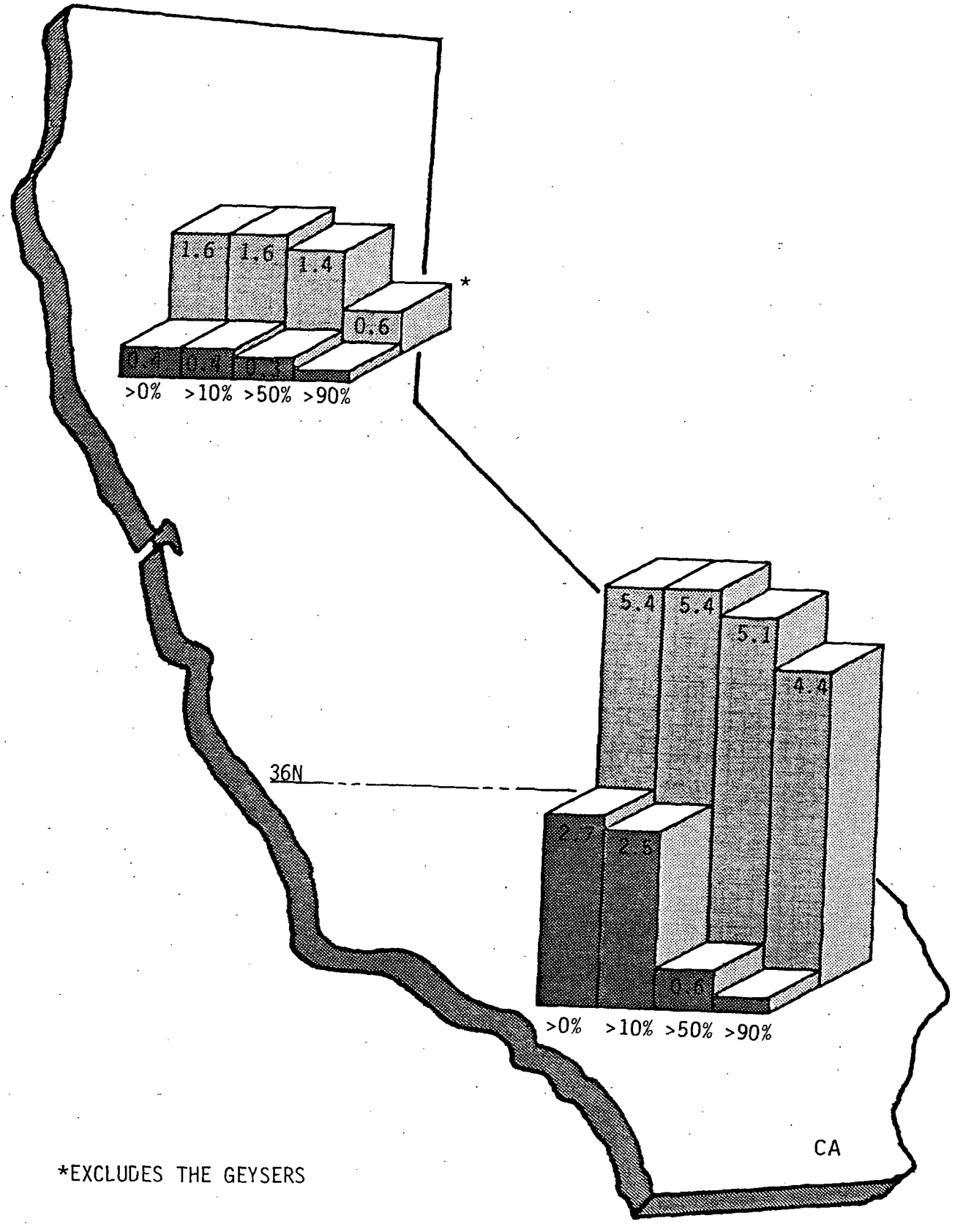
U.S. Department of Energy
HYDROTHERMAL MARKET ESTIMATES PROGRAM

Map of Regional Boundaries

HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)



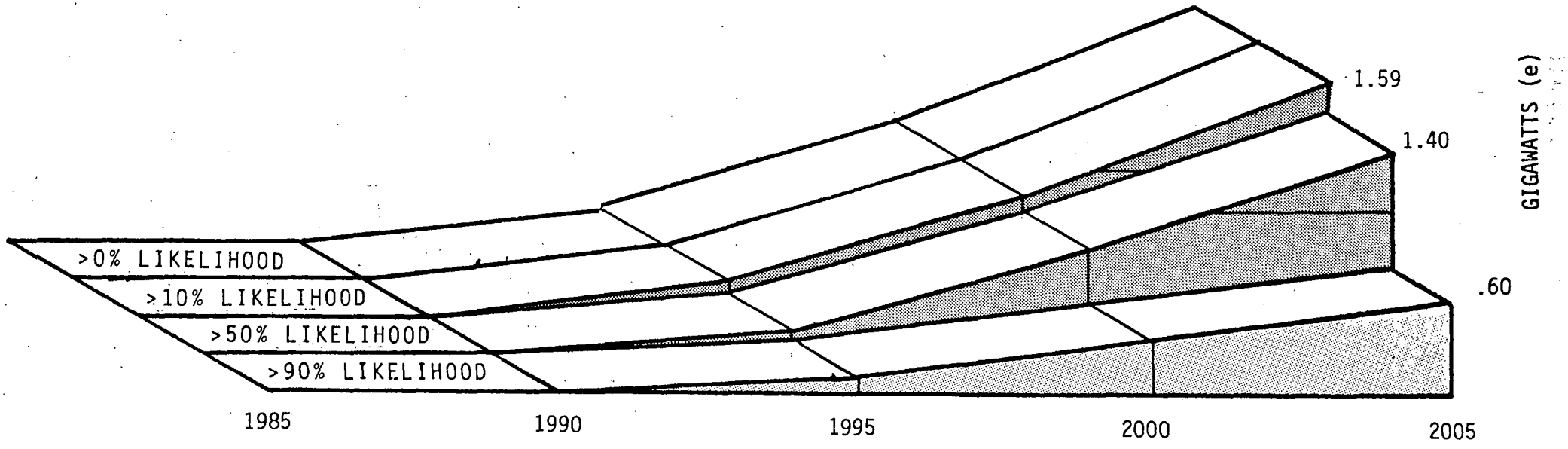
HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)



*EXCLUDES THE GEYSERS

HYDROTHERMAL POWER ON-LINE ESTIMATE

Northern California *



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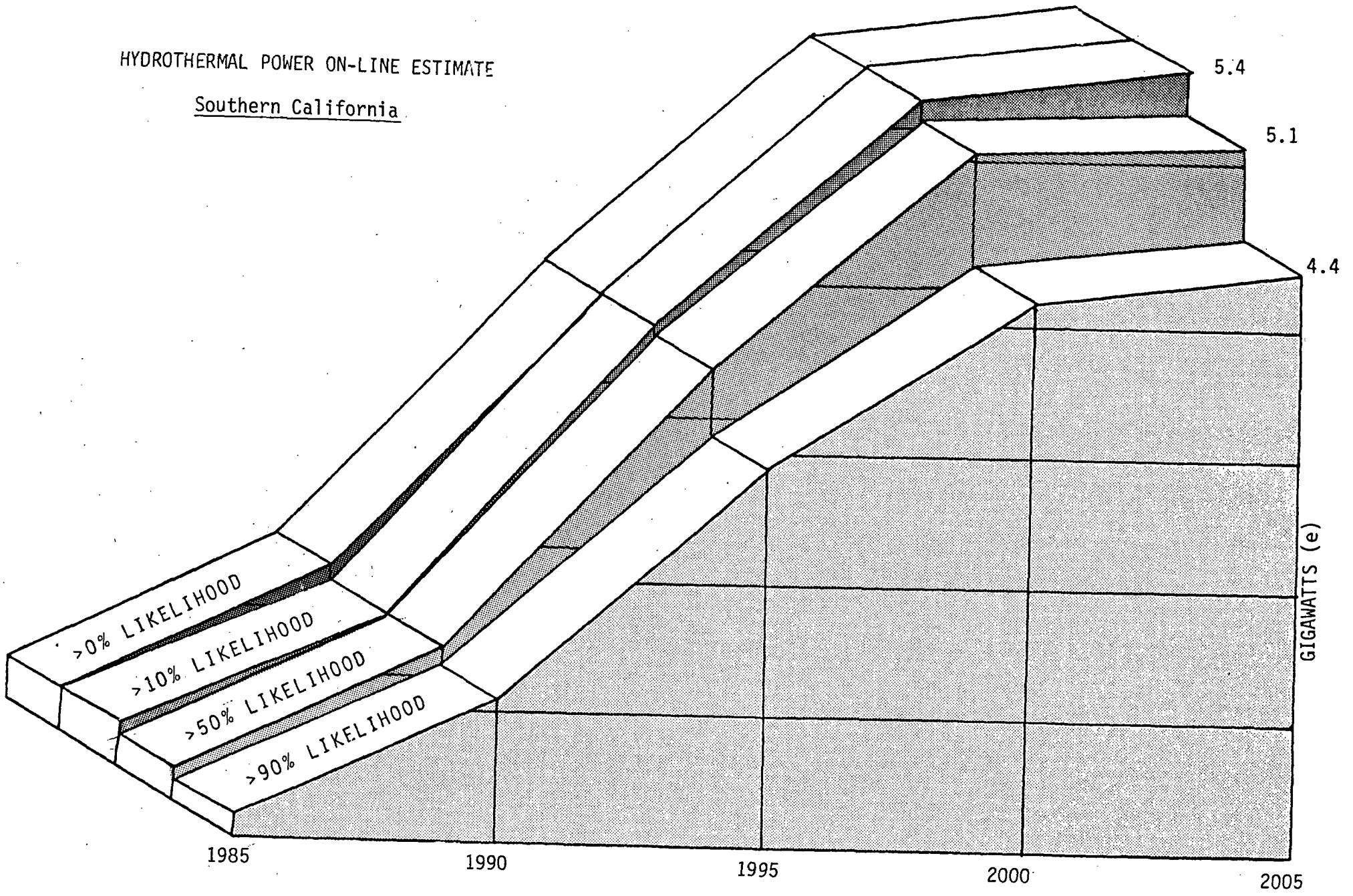
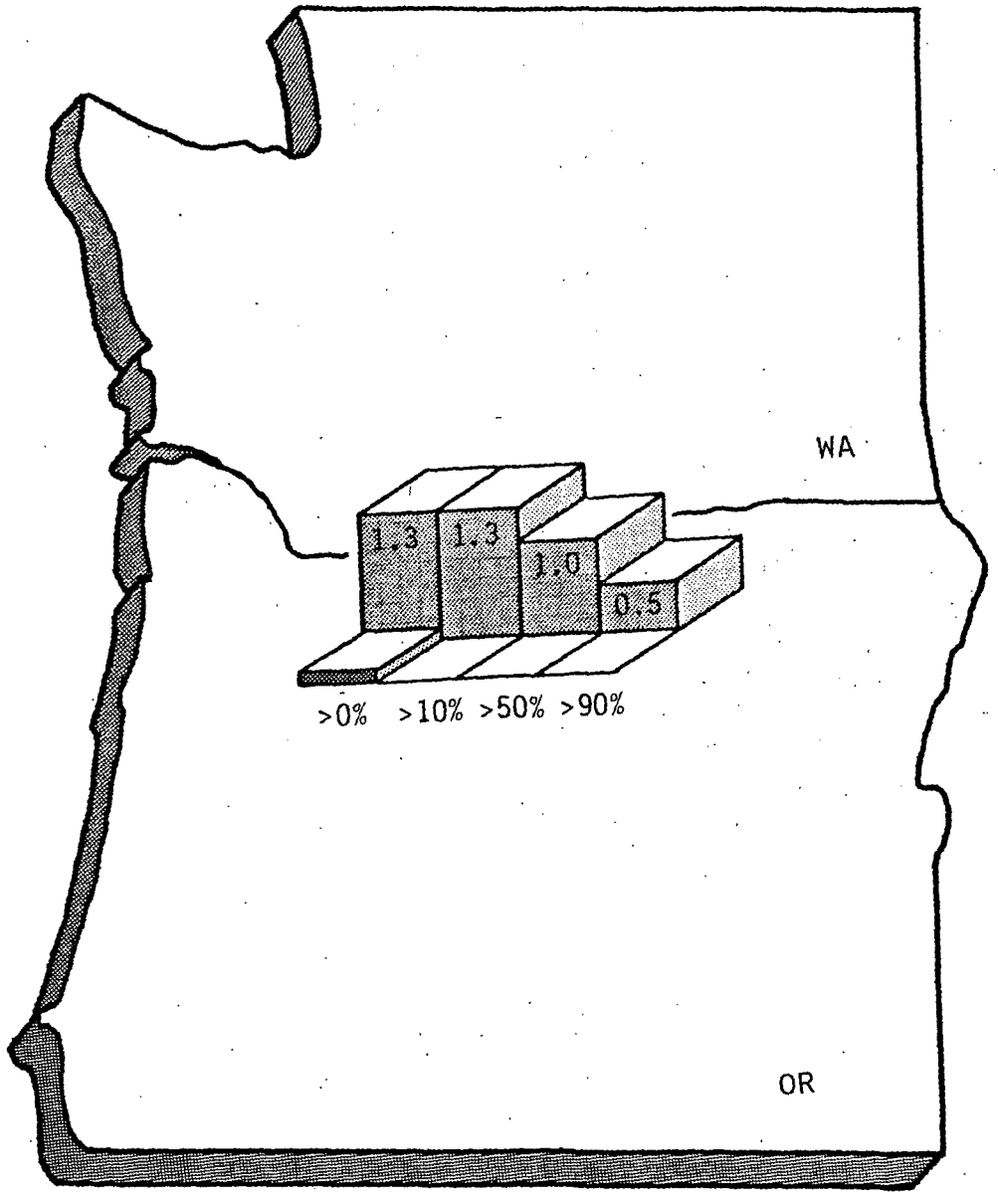
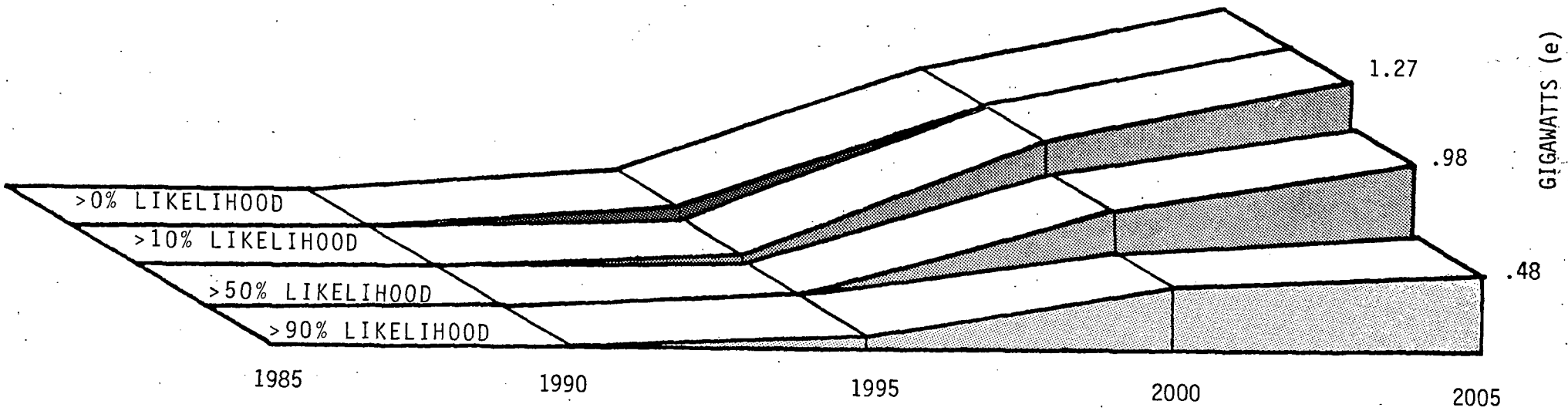

HYDROTHERMAL POWER ON-LINE ESTIMATE
Southern California
5.4
5.1
4.4
>0% LIKELIHOOD
>10% LIKELIHOOD
>50% LIKELIHOOD
>90% LIKELIHOOD
GIGAWATTS (e)
1985
1990
1995
2000
2005

HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

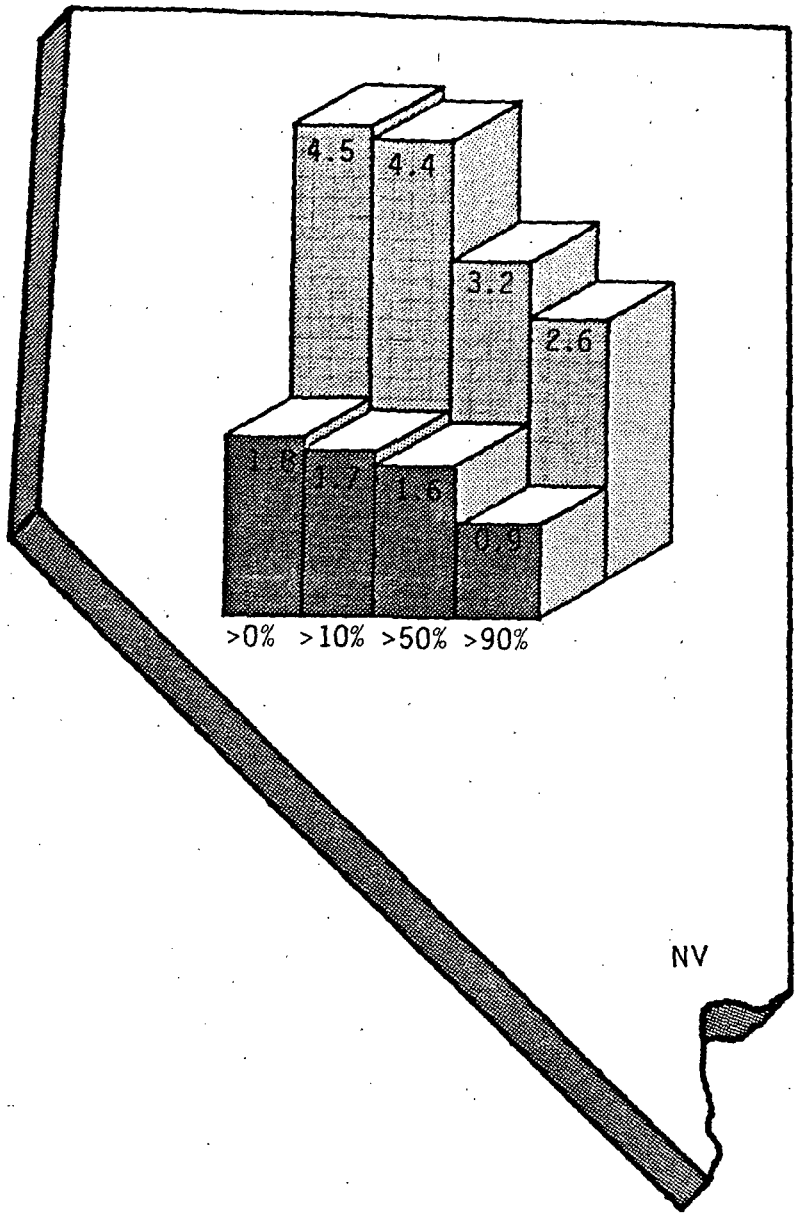


HYDROTHERMAL POWER ON-LINE ESTIMATE

Washington and Oregon

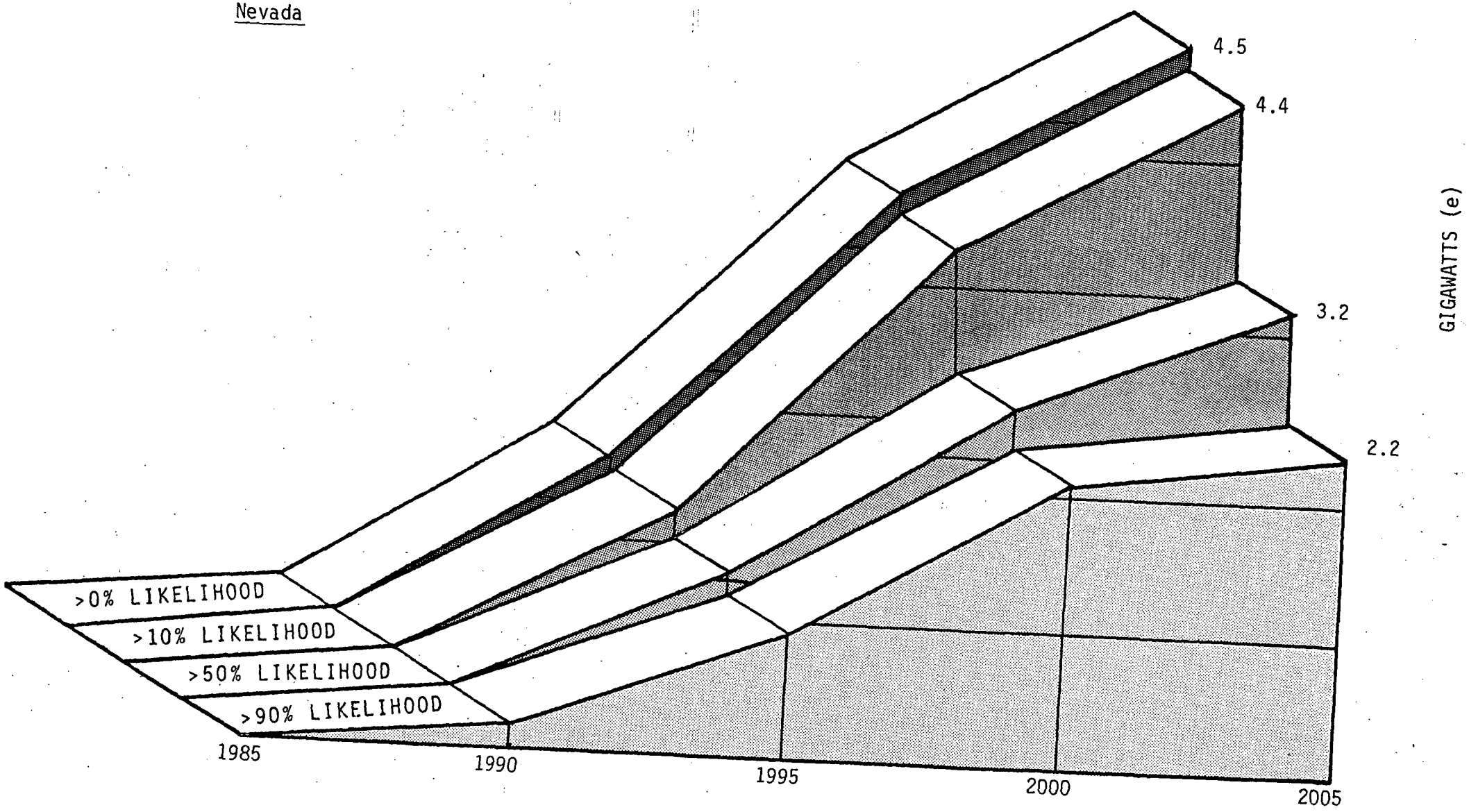


HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

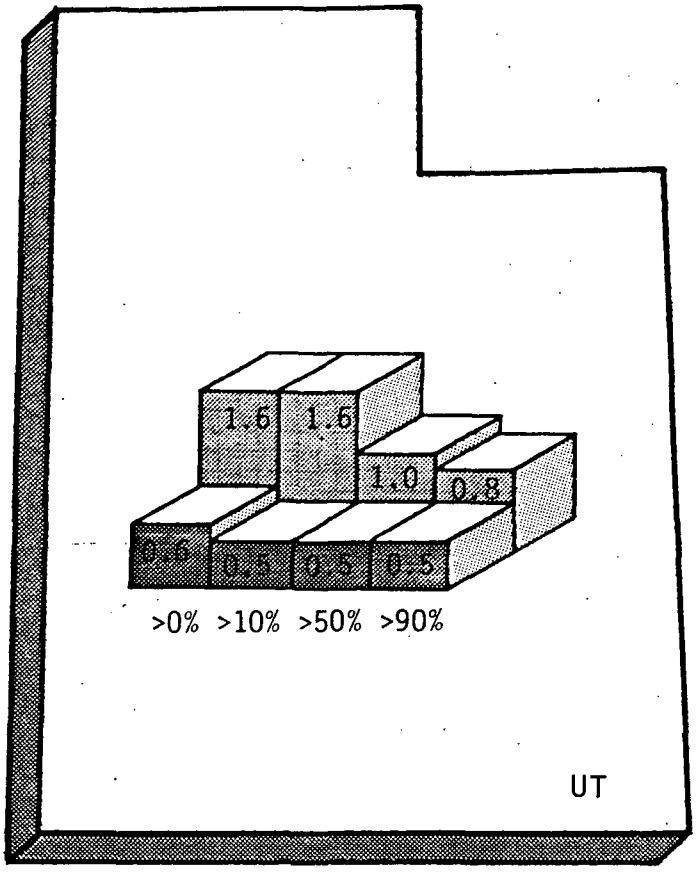


HYDROTHERMAL POWER ON-LINE ESTIMATE

Nevada

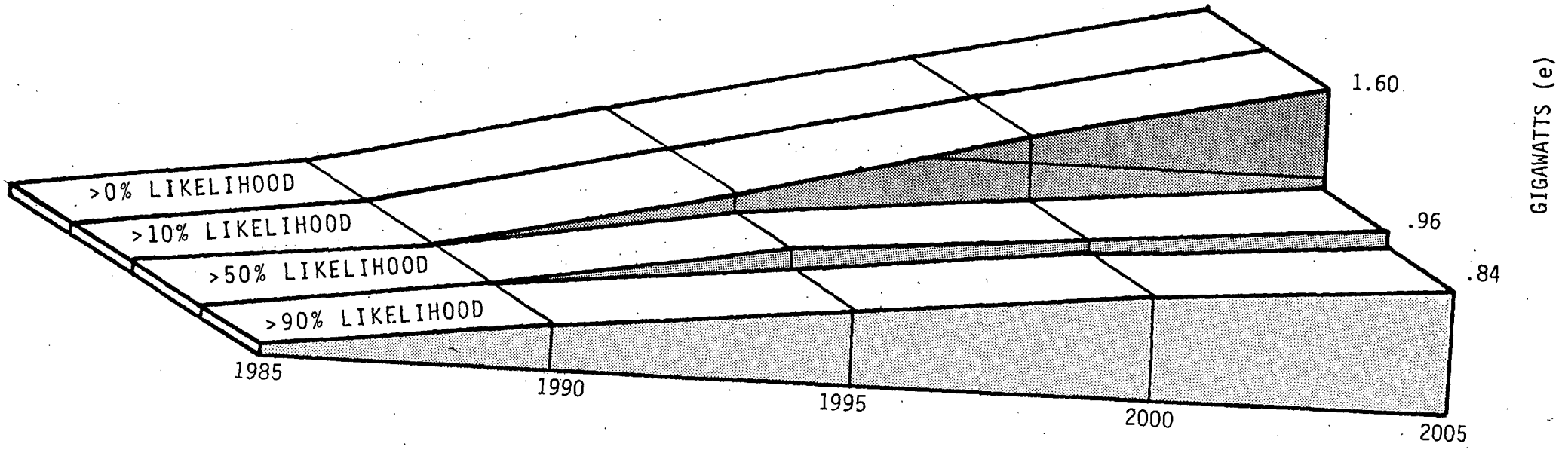


HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

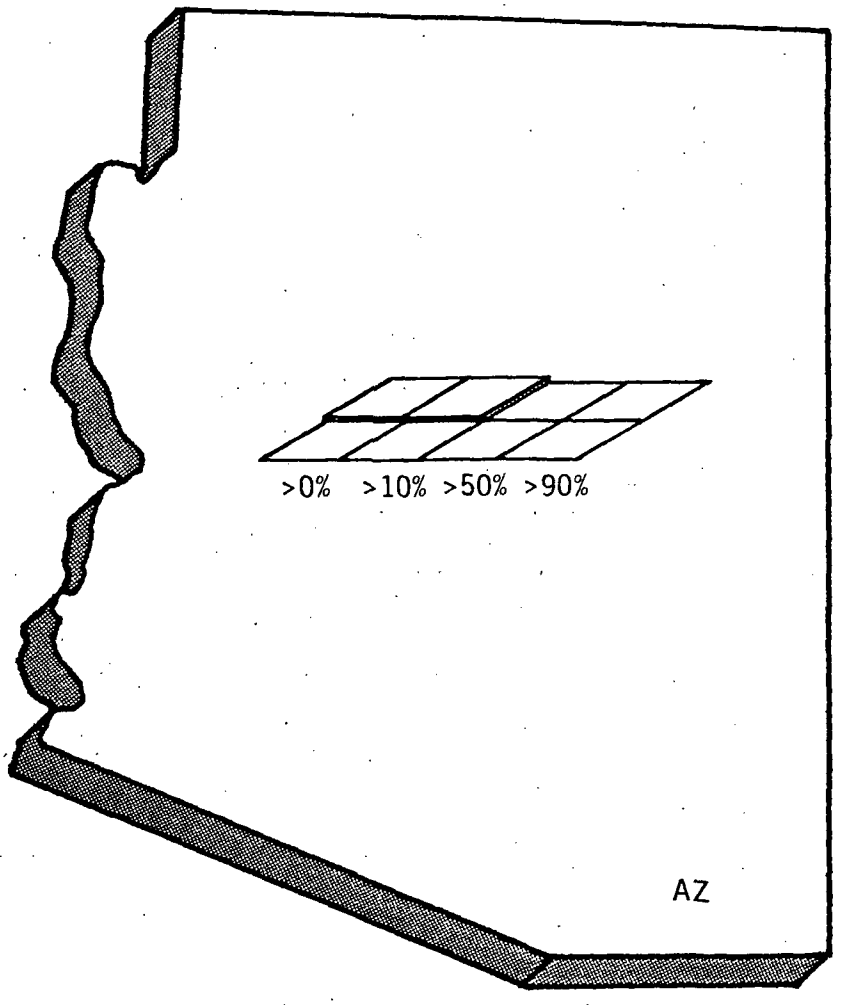


HYDROTHERMAL POWER ON-LINE ESTIMATE

Utah



HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

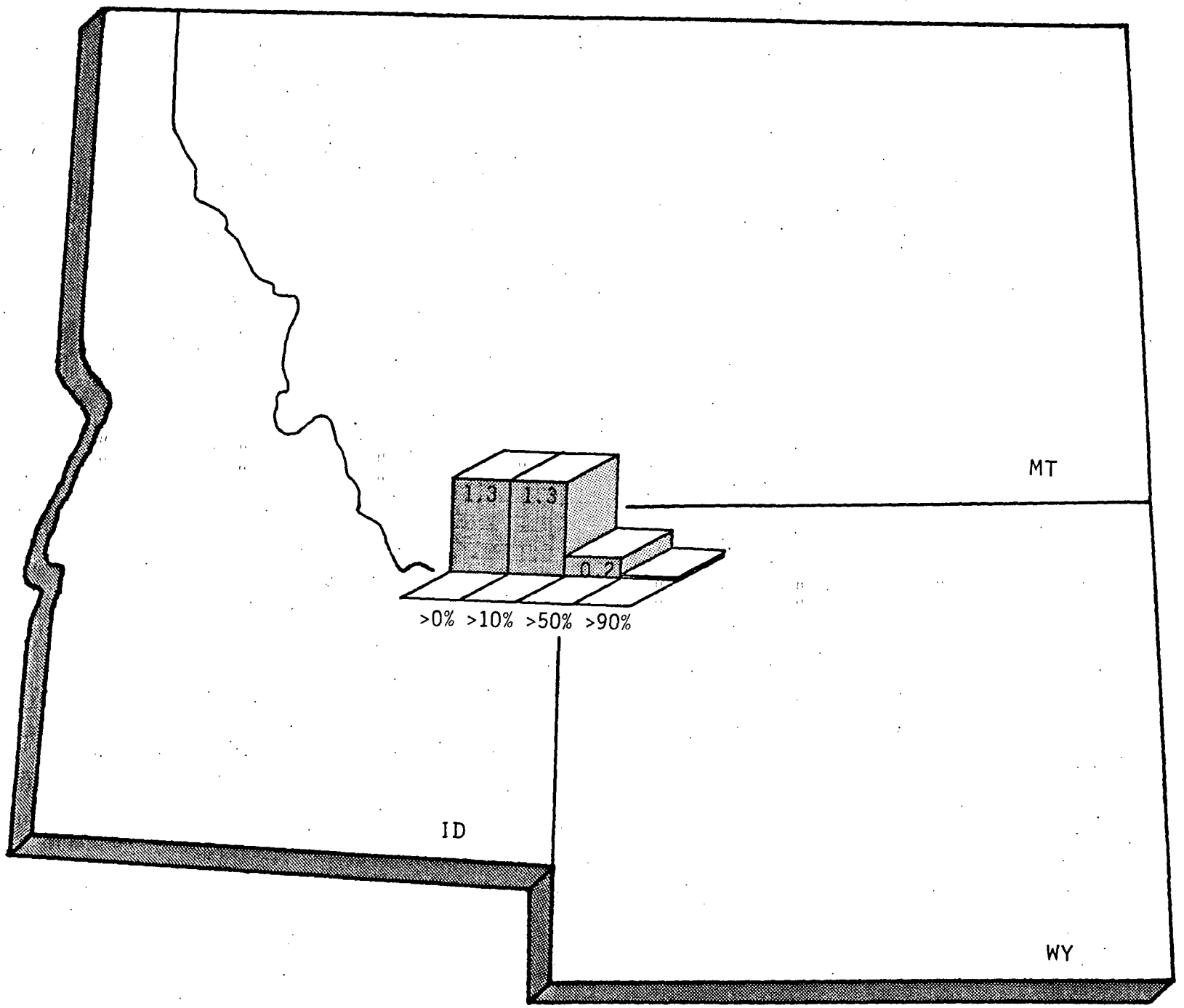


HYDROTHERMAL POWER ON-LINE ESTIMATE

Arizona

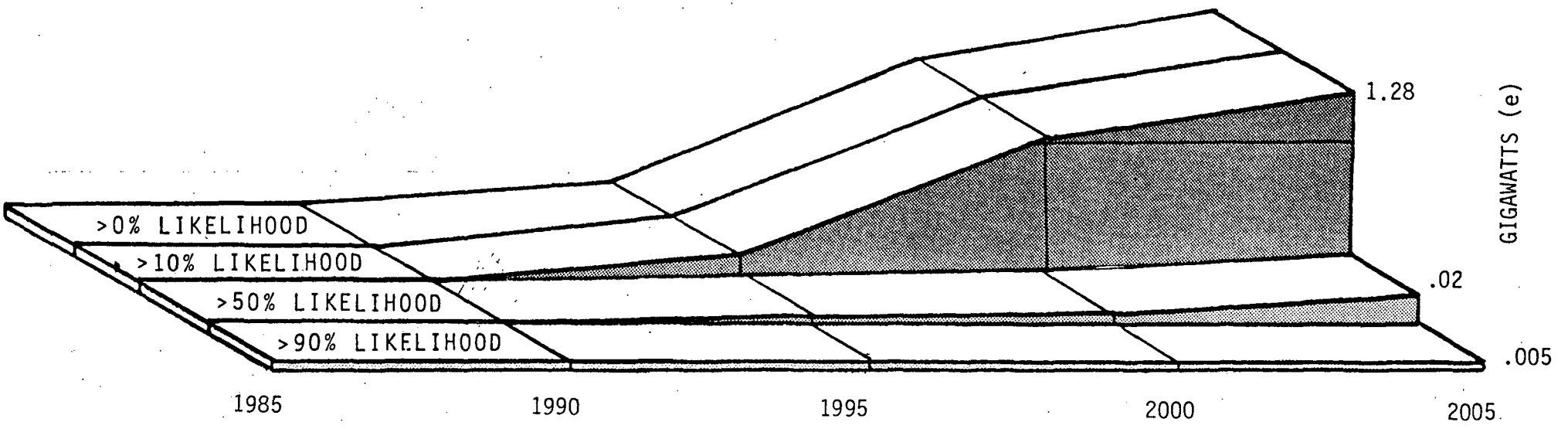
(64% LIKELIHOOD OF 20 MW IN 2005)

HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

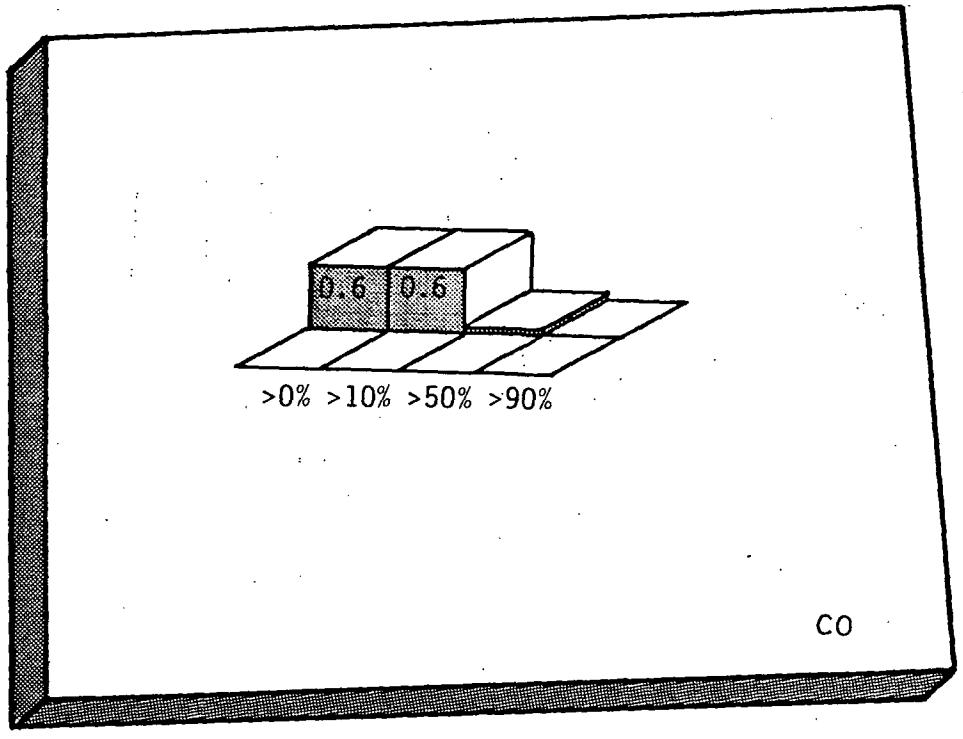


HYDROTHERMAL POWER ON-LINE ESTIMATE

Idaho, Montana, and Wyoming

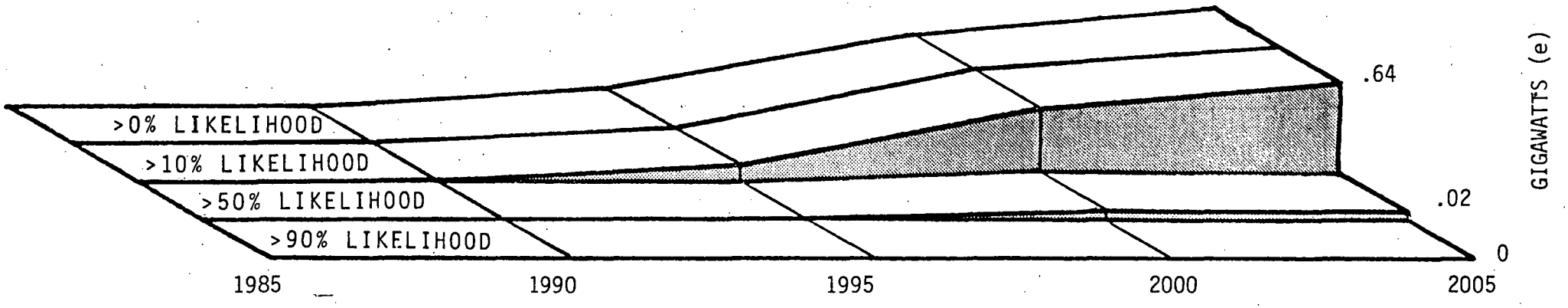


HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)

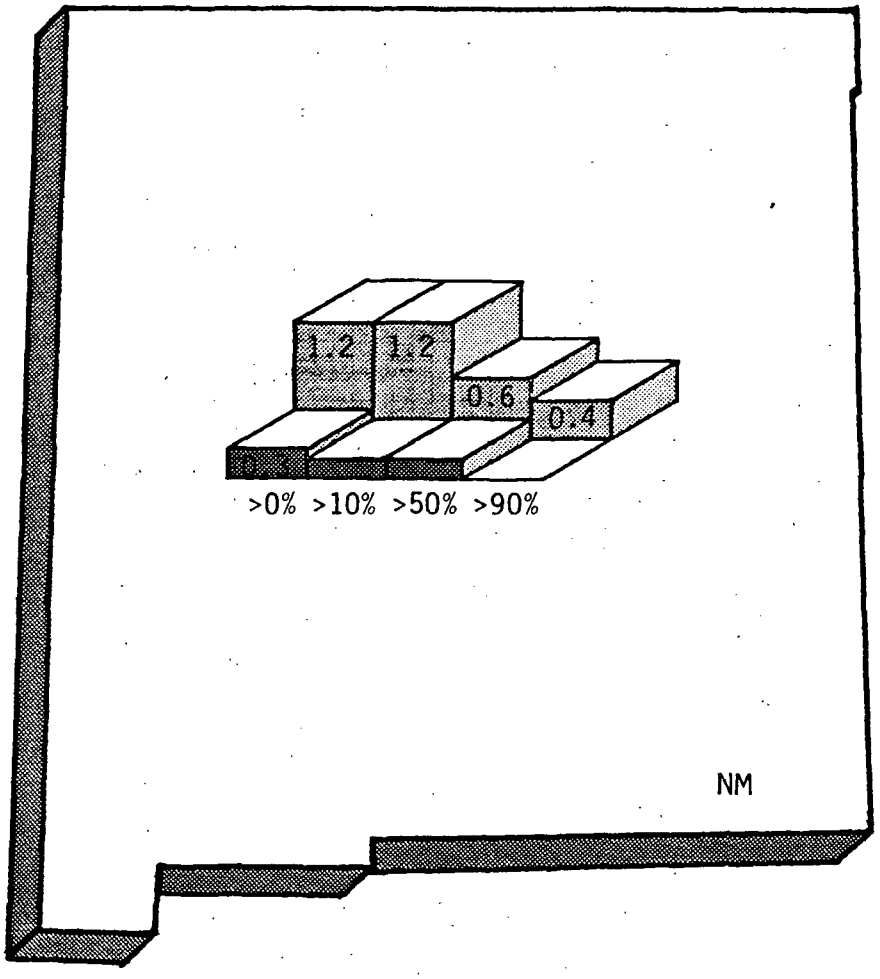


HYDROTHERMAL POWER ON-LINE ESTIMATE

Colorado

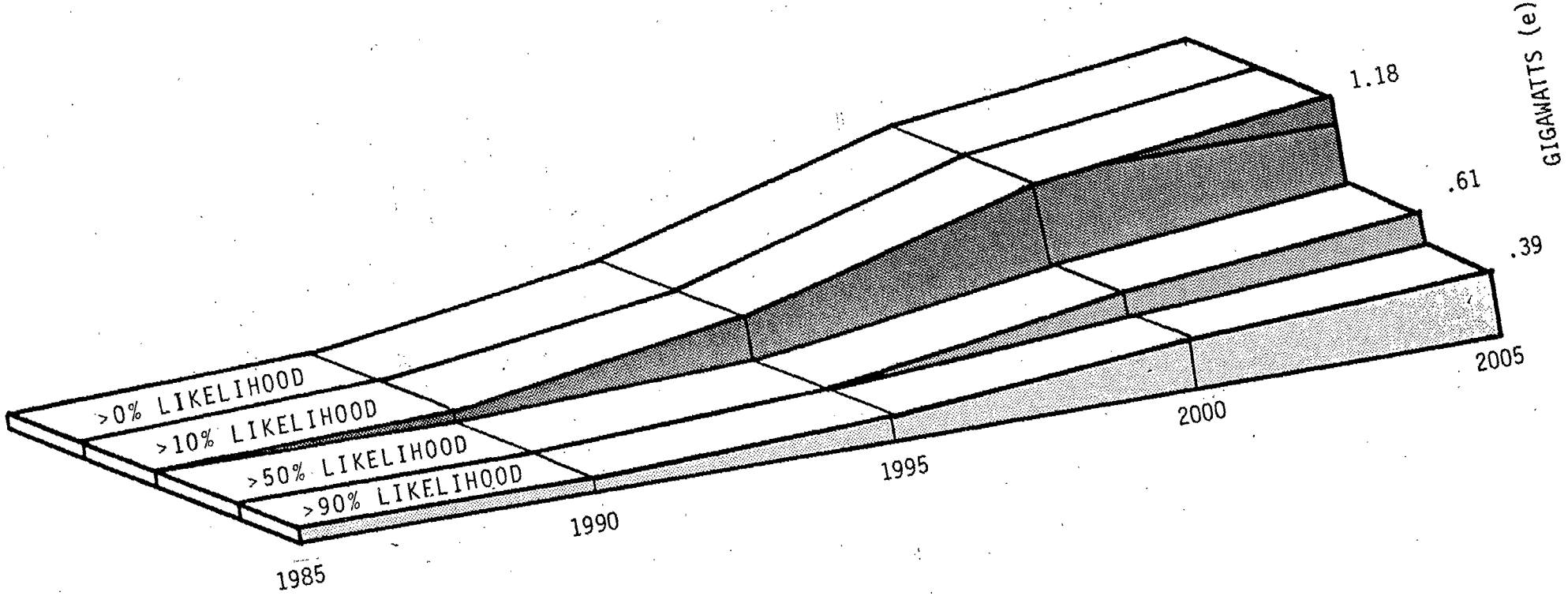


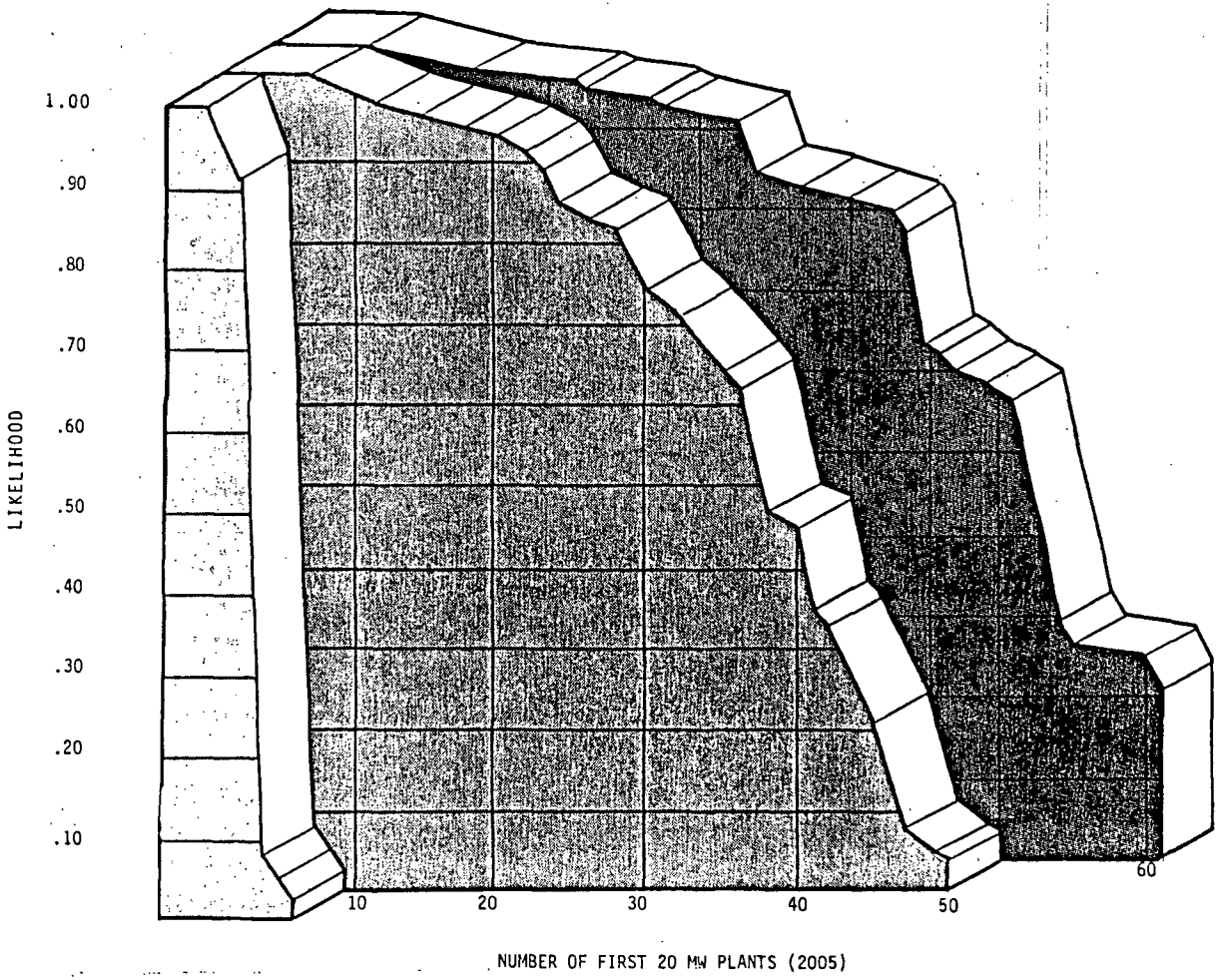
HYDROTHERMAL POWER FORECAST (GIGAWATTS BY 2005)



HYDROTHERMAL POWER ON-LINE ESTIMATE

New Mexico




1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
LIKELIHOOD
10
20
30
40
50
60
NUMBER OF FIRST 20 MW PLANTS (2005)