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ANCILLARY BENEFITS OF GEOTHERMAL DEVELOPMENTS

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ABSTRACT

This paper presents estimated real values of ancillary benefits of geothermal development. Several independent sources of information will be quoted including efforts to quantify such benefits in monetary terms. This paper deals exclusively with benefits that are not directly accountable or not immediately accepted and included in the price paid for the resource. Geothermal development is here treated as meaning any utilization of geothermal heat be it for electric power, process heat, comfort heating, air conditioning, or other energy purpose.

INTRODUCTION

What's wrong with the system that won't allow the geothermal industry to go forward in new areas when there is so much anticipation in geothermal development and when the recognition of the need for new energy sources is so widespread? The future of geothermal power has become tied up in a controversy over how to share the costs and the benefits. It has therefore become important for us in the geothermal industry to establish the ancillary or indirect benefits of geothermal energy as well as cost and performance projections. This paper will present identifications and evaluations of the ancillary benefits. To do so, we have had input from many sources making this part of the effort easy. However, the hard part is that we also have to ask why it is necessary to go through such an exercise. We need to get out from under the yoke of short-term political decisions so that long-term and intangible benefits can be considered. But that will not come easily. The industry will have to prepare the ground by providing the proper information and by mustering political support. We will discuss this issue and offer some suggestions on what can be done.

DISCUSSION

This presentation on ancillary benefits of geothermal energy is based on input from four sources. First is the application to the

California Public Utilities Commission for approval of the Heber Flash Power Plant submitted by Southern California Edison Company. Next is an assessment of the Heber Binary Power Plant by San Diego Gas & Electric Company. The book entitled, ENERGY FUTURE-REPORT OF THE ENERGY PROJECT AT THE HARVARD BUSINESS SCHOOL, edited by Robert Stobaugh and Daniel Yergin provides a general evaluation. Finally, we will quote some statements issued by the California Energy Commission. This shows an impressive breadth of input.

Southern California Edison has presented the indirect benefits from development of geothermal energy to the PUC as follows:

1. Reduced oil consumption
2. Decreased air emissions
3. Development of California's natural resources
4. Meeting State's objective to protect the environment while promoting a sound economy
5. Lessen impact on rate payers from fuel cost increases
6. Reduced demand on capital.

Other benefits from geothermal projects may be very important such as: employment benefits; diversification of power generation; the learning and experience; increased competition among energy sources and development of by-product minerals to reduce strategic dependency on foreign sources. It would be a major undertaking to discuss all these benefits in detail or to try to quantify the benefits and costs. Fortunately, a couple of examples can be used to gain a quick understanding of the magnitude of all these benefits.

San Diego Gas & Electric Company has assessed the external benefits of its Heber Binary Project on a request by the CPUC. Regional Economic Research performed that study with the following specific objectives of general interest:

- to identify the primary intangible benefits and costs related to the Heber Project;

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- . to devise a series of conceptual framework within which these efforts can be analyzed;
- . to estimate dollar values for the most important intangible benefits and costs for the period in question.

The major conclusions of the study list

- . employment benefits
- . net public revenues
- . environmental benefits primarily from enhanced air quality
- . expected learning and experience benefits.

The report points out that "the external

effects, by their very nature, are often difficult to value in dollar terms. Indeed, they are sometimes characterized as 'non-quantifiable' effects." While the report makes no claim to possess the capability to measure the dollar values of these effects directly, it suggests that their values can be estimated within reasonable limits through a variety of means.

The study summarizes San Diego County Net External Benefits at 1.74¢ per kwh probable in 1985; the Imperial County Net External Benefits at 1.21¢ per kwh probable also in 1985. The figures rise to 8.30¢ in 1997 in San Diego County and 2.56¢ in Imperial County. The results are shown on Figures 1 and 2.

Figure 1 San Diego County Net External Benefits  
(in ¢ per kwhr)

Year	Net Employment Benefits	Fiscal Benefits	Environmental Benefits		Field O&M Learning		Plant Construction Learning		Total Benefits	
			Probable Minimum	Probable Minimum	Probable Minimum	Probable Minimum	Probable Minimum	Probable Minimum		
1985	.03¢	.01¢	.48¢	.30¢	1.22¢	1.89¢	-	-	1.74¢	1.56¢
1986	.01	.00	.55	.34	2.1	2.2	-	-	2.66	2.45
1987	.02	.00	.63	.39	2.4	2.6	-	-	3.05	2.81
1988	.02	.00	.59	.36	2.6	2.9	-	-	3.21	2.98
1989	.02	.00	.64	.40	2.8	3.4	-	-	3.46	3.22
1990	.03	.00	.71	.44	3.1	3.8	-	-	3.84	3.57
1991	.03	.00	.78	.48	3.5	4.2	-	-	4.31	4.01
1992	.03	.00	.85	.53	3.8	4.7	1.3¢	.5	5.98	4.86
1993	.03	.00	.94	.58	4.1	5.2	1.3	.5	6.37	5.21
1994	.04	.00	1.03	.64	4.4	5.6	1.3	.5	6.77	5.58
1995	.04	.00	1.12	.69	4.8	6.2	1.3	.5	7.26	6.03
1996	.04	.00	1.23	.76	5.2	6.8	1.3	.5	7.77	6.50
1997	.05	.00	1.35	.83	5.6	7.3	1.3	.5	8.30	6.98

Figure 2 Imperial County Net External Benefits and Costs  
(in ¢ per kwhr)

	Net Employment Benefits	Fiscal Benefits	Environmental Costs		Net Benefits	
			Probable	Minimum	Probable	Minimum
1985	1.03¢	.28¢	.10¢	.40¢	1.21¢	.91¢
1986	.86	.19	.05	.17	1.00	.88
1987	.85	.37	.04	.15	1.18	1.07
1988	.92	.64	.05	.16	1.51	1.40
1989	1.00	.65	.05	.17	1.60	1.48
1990	1.08	.66	.06	.18	1.68	1.56
1991	1.17	.67	.06	.19	1.78	1.65
1992	1.27	.69	.07	.20	1.89	1.76
1993	1.38	.70	.07	.22	2.01	1.86
1994	1.49	.72	.08	.23	2.13	1.98
1995	1.62	.73	.08	.25	2.27	2.10
1996	1.76	.75	.09	.27	2.42	2.24
1997	1.90	.76	.10	.28	2.56	2.38

The study has no doubt played an important role in convincing the PUC to approve the Geothermal Sales Contract for the Heber Binary Project as stated in their decision No. 83 05 047. During the hearings on the application by San Diego Gas & Electric a PUC staff witness testified to that fact.

Robert Stobaugh and Daniel Yergin, in their book, ENERGY FUTURE-REPORT OF THE ENERGY PROJECT AT THE HARVARD BUSINESS SCHOOL, have estimated the "real" cost of a barrel of imported oil. To compute a price for incremental amounts of imported oil, they established a total "social cost" - that is, market price plus the cost to the society of future price hikes and economic disruptions that might result from increasing demand. Although in this calculation they did not include the political and the more dire economic consequences, the best estimate of the cost still came out at \$65 to \$100 a barrel during the second oil shock. To be conservative, they settled for \$65 a barrel or about twice the average price paid in the early 1980's for imported oil. The economics of geothermal would look very good in a comparison with oil at this price.

The California Public Utilities Commission recognizes in general that alternate energy sources offer indirect ancillary benefits that justify the promotion of such alternate energy. This was expressed in a decision in January, 1982. The decision lists the following advantages that apply to geothermal power:

- . Diversification of the utilities' resource plan
- . Minimization of dependence on any single source of generation
- . Independence from foreign fuel sources. The use of domestic fuels is important for reasons of international economics and politics
- . Development of many small power plants contributes to system reliability
- . Lead time is less than for large central plants allowing for more flexibility.

Putting this evidence together, we find first that everybody recognizes that geothermal power specifically and alternate energy in general carry intangible benefits of considerable value. Several methods to calculate these values

have produced different results. We are therefore faced with a dilemma as to what values to use. The numbers developed by San Diego Gas & Electric and by Stogaugh and Yergin are of such magnitude that they could swing many marginal projects over to clearly justified projects. The numbers cannot be ignored.

Why isn't the evidence presented here enough? One answer is that quantified values are based on assumptions, not historical facts. Another answer is that the long term perspective isn't understood or appreciated by the public and therefore generally not supported by legislators and political appointees.

What happens if we fail to act on this evidence? Eventually the effects on power costs will show up on the rate payers' bills. The effects in Energy Future evaluated by Stogaugh and Yergin affect all of us. It is an interest of the rate payers and those who set the rates to make the long-term benefits available. Energy Future is everybody's concern.

How can we accomplish these goals? It is hardly possible to expect the developers, investors and financial institutions to justify projects on indirect benefits to rate payers and the public. Concrete recognition of the long-term values is required. The indirect benefits have to be converted into dollar amounts to attract investment capital. So it remains to all of us in the geothermal industry to impress the public, the legislators, and the PUC. That objective cannot be accomplished if we only talk to each other. The message must be carried to the news media, to the legislators and to the decision makers. For the public the message must be simple and forceful. To the legislators the message should be backed by voter and election support. To the decision makers the facts must be presented in clear language.

The geothermal power industry has come a long way towards maturity. The technological status is excellent. The organizations are in place to take off. Commercialization keeps getting stalled by political hurdles. The time has come to tackle that last obstacle.

#### ACKNOWLEDGEMENTS

We would like to acknowledge the cooperation and assistance from Thomas R. Sparks of Southern California Edison Company and Robert G. Lacy of San Diego Gas & Electric Company.

#### REFERENCES

California Public Utilities records pertaining to:

Application No. 61167 filed  
December 31, 1981, by:  
John R. Bury  
Tom P. Gilroy  
Philip Walsh  
Lucina Lea Williams  
Attorneys for Applicant  
Southern California Edison Company

California Public Utilities records pertaining to:

Decision 83 05 047, San Diego  
Gas & Electric Company for approval of  
Geothermal Sales Contract, Heber Binary  
Project  
Assessment of the External Benefits of the  
Heber Binary Project, prepared by Regional  
Economic Research.

Stogaugh, Robert and Yergin, Daniel, 1983.

ENERGY FUTURE, REPORT OF THE ENERGY PROJECT  
AT THE HARVARD BUSINESS SCHOOL.