THE ANATOMY OF GROWTH OF PHILIPPINE GEOTHERMAL DEVELOPMENT

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ABSTRACT

The Philippines in just half a decade has emerged the second largest geothermal energy user for power generation. Its 559 MW of installed capacity in March 1982 was surpassed only by the Geysers of California with over 900 MW.

How the Philippines was able to achieve this phenomenal growth in the development of its geothermal resources was analyzed and expounded upon.

The Philippine total energy strategy, of which geothermal energy development is a major aspect, has now come to be accepted internationally as a model for developing countries in their search for relief from the energy crisis.

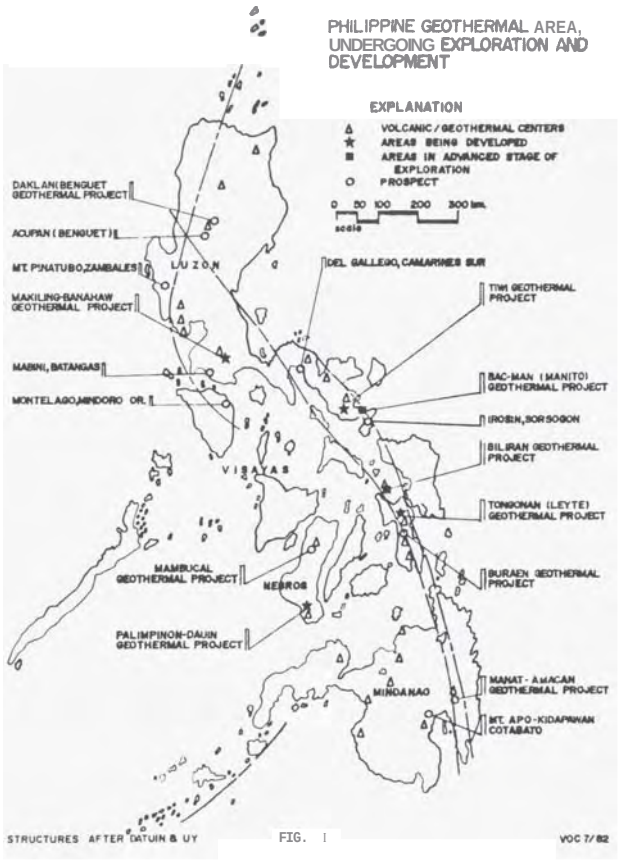
INTRODUCTION

The Philippines entered into semi-commercial utilization of geothermal energy in July 1977 with the operation of a 3MW pilot power plant in Tongonan, Leyte Island. With this small plant, the Philippines joined the exclusive international community of countries utilizing geothermal energy and was ranked ninth among them.

1979 saw the harnessing of this indigenous energy on a large scale in Tiwi, Albay province and the Makiling-Banahao (Mak-Ban) geothermal field in Laguna province, both located in the populous power-hungry large island of Luzon. Two 55-MW generation units were commissioned in each of these areas with the whole 220-MW being fed to the Luzon grid. In this year, geothermal represented 5.4% of the total (4,133 MW) installed generating capacities of the country, and displaced 2.73 million barrels-of-oil equivalent.

Additional generation units put up in Tiwi, Mak-Ban and southern Negros Island brought the total Philippine geothermal generating capacity at the end of March 1982 to 559 MW. With this amount, the Philippines ranks second only after the Geysers of California in geothermal power generation. More geothermal power plants are being built or planned for the next five years to bring the contribution of this energy source to 20-25% of the country-wide total.

With this behind us, it is perhaps worthwhile and interesting in retrospect to look into the anatomy of this successful rapid growth of geothermal development in the Philippines.



COMPELLING MOTIVES

The energy crisis of 1973 caused the Philippine economy to waver and severely affected the country's balance of payments. The Philippines then was 95 percent dependent on crude oil for its commercial energy requirements, and as the oil-importation bill increased with every oil-price spiral, the country had to devote more and more export earnings to the payment of its fuel requirements alone. From about 13 percent at the start

of the crisis, oil imports as a percentage of total imports rose to 22 percent by 1975. In absolute terms, this corresponded to a $832-million expenditure for imported oil. This figure was to exceed $1 billion by 1977.

Corollary to this overdependence on imported oil for its energy requirements, the Philippines faced the spectre of supply cuts and boycotts with the emergence of oil-based energy as an international economic and socio-political commodity. This situation would certainly pose extreme difficulties if the nation's economy is not insulated from further geo-political uncertainties in the energy market.

These therefore were compelling motives for the Philippines, that found its back to the wall, to come up with a comprehensive and practical energy policy that will not only do away with the pitfalls of past complacency and inadequate planning, but also steer it towards national socio-economic development goals. Total electrification together with dispersal of industries to depressed or underdeveloped areas were and are prime considerations of the country's growing economy.

ENERGY SELF-RELIANCE

Since the root causes of the serious Philippine energy problem were of overdependence on imported oil for energy requirements and the uncertainty of its future supply, the obvious solution was to cut this dependency to a minimum or do away with it altogether, if possible. Accordingly, the mandate to achieve a measure of self-reliance in energy was enunciated by the government.

To achieve this goal, four basic policy strategies were mapped out :

1. An accelerated diversification to alternative energy sources and the consequent reduction of dependence on oil as the primary source of energy while continuing efforts to discover and produce indigenous petroleum;

2. Diversification of geographical sourcing to minimize the sensitive geo-political concentration of imported energy supplies;

3. Conversion or development of market to use non-oil energy sources in support of fuel substitution programs; and

4. Adoption of measures to conserve and utilize energy efficiently.

As a consequence of the first strategy, the accelerated development of indigenously abundant energy resources, such as geothermal and coal, was given added impetus and all-out support by the government. Geothermal exploration and development especially became an important and large component of the national energy program. That the stress on it was well-placed and justified is now borne out this early by results already attained.

PRIMARY ENERGY SOURCE MIX
(In Million Barrels-of-Oil Equivalent, MMBOE)

	1977	1981	1982	1987
Oil - Imported (%)	94.70	78.00	69.07	39.24
Domestic (%)	-	1.59	4.86	4.99
Nuclear - Imported (%)	-		-	4.76
Coal - Imported (%)	-		0.84	6.67
Domestic (%	1.00	1.05	3.28	11.84
Hydro (%)	4.30	7.46	8.63	12.37
Geothermal (%)	-	5.52	6.64	13.97
Non-Conventional (%)		0.39	0.70	1.52
Bagasse (%)		5.99	5.98	4.64
TOTAL	100.00	100.00	100.00	100.00
TOTAL MMBOE	82.90	86.10	89.50	127.38

FIG. 2

CONCEPTUAL STAGE OF GEOTHERMAL DEVELOPMENT

Geothermal studies in the Philippines were initiated in 1962 by the Comnission on Volcanology, a government research agency. With funds granted by the National Science Development Board, the Commission undertook geoscientific investigations of the Tiwi, Albay geothermal area. Later, the studies were extended to cover the thermal manifestations found in the provinces of Laguna, Leyte and southern Negros.

Besides the research funding granted for these early studies, two situations helped facilitate their implementation. First was the availability of local manpower broadly conversant with volcano-geology, geophysics and geochemistry from the Commission on Volcanology to carry out the studies. In geothermal exploration, this is important due to the close relation of geothermal energy to vulcanism.

Second was the passage of a geothermal law by the Philippine legislature as early as 1967. The law RA 5092, provided that natural gases and geothermal energy belong to the State, and set the guidelines for their exploration, development and utilization. Thus, under this law, access to prospect areas was facilitated and enabled the government to set aside by Presidential Proclamation known geothermal resource areas as geothermal reservations.

Some impetus to carry out geothermal explorations in the Philippines also came from a United Nations study entitled "Pre-Investment Study on Power, Including Nuclear Power in Luzon". The study evaluated the resource potential in Luzon Is-

land of hydro, coal, geothermal, oil and gas vis-a-vis the possible need for nuclear power. The final report recomnended the continuation of geothermal studies already started in Tiwi, though it held geothermal energy will only be of local significance in the total power generation in Luzon.

In 1970, the government, recognizing the benefits that can be obtained from geothermal energy and realizing that the exploration work in Tiwi had reached the stage for comnercial power development, gave the National Power Corporation or NPC the task to develop and exploit the field. The following year, NPC engaged Union Oil of California through its subsidiary, the Philippine Geothermal, Inc. (PGI), to develop the steam field while NPC put up the necessary generating plant. Meanwhile, instructions were given to continue exploration studies being carried out on the geothermal prospects in Laguna, Leyte and southern Negros.

Upon conclusion of a Service Contract with PGI and the laying down clearly of a policy decision on the exploitation of geothermal energy, it may be said that the formative years in the exploration and development of the country's geothermal resources came to an end and ushered in the beginning of the period of its commercial utilization. Thus, two full years before the energy crisis reared its head in 1973, the Philippines had laid down the groundwork for the comnercial development of its geothermal resource potential.

PERFORMANCE INDICATORS IN THE GEOTHERMAL SECTOR

YEAR	Cumulative Numbn of Fields	Number of Wells	Footage	Proven Additional Field Capacity (MW)	Cumulative Power Production (MW)
1973	1	4	23,834	10.4	
1974	2	4	22,203	17.3	
1975	2	8	48,556	283	-
1976	3	18	91,116	120.7	
1977	3	24	143,948	131.5	3
1978	3	34	183.156	191.6	58
1979	4	58	317.496	315.0	223
1980	4	59	336,625	385.0	446
1981	6	56	454,686	501.0	446
TOTAL	6	265	1,621,620	1,701.0	446
Average (1973-1976)	2	9	46,427	44.0	
Average (1977-1981)	4	46	287,182	305.0	

FIB. 3

PROGRAM INITIATION

The energy development policy that was conceived basically as a reaction to the 1973 energy crisis crystallized into a more meaningful strategy for national development. Geothermal development became one of the crash diversification programs to meet a measure of energy self-reliance. The emergency nature of the situation highlighted the imperative to rush up serious estimation exercises in order to generate a truly crisis-responsive program as political and economic pressures prevailing then did not allow any compromise to the element of time.

The strategy in the development of Philippine geothermal fields was, therefore, tailored to avoid any delay by eliminating time-consuming activities and accelerating critical operations where possible. An important ingredient of the scheme was the accessing of outside expertise and sophisticated technology through assistance programs and participation of technically and financially qualified foreign companies. At the same time, however, a rigorous training of Filipino scientists and technicians in the energy exploration sciences was pursued.

POLICY DECISION-MAKING APPARATUS

In the Philippines, the energy problems are approached through different policy-making procedures and government structures with strategies determined to a large degree by decisions at the highest level of government.

Philippine National Oil Company. Thus, having set energy self-reliance as the goal of all energy plans, the government decided in 1973 to establish a state-owned oil company, the Philippine National Oil Company (PNOC), as a meaningful step toward insulating the country from adverse external developments related to the worldwide energy crisis.

By 1976, operations of PNOC were sufficiently capable of fueling the country's social and economic development programs. Having thus fulfilled its initial mandate, PNOC was converted by Presidential Decree into a total energy company with the added responsibility of accelerating the exploration and development of indigenous energy resources.

PNOC Energy Development Corporation. In accordance with this new role, PNOC formed a subsidiary, the Energy Development Corporation or EDC, to undertake development of non-oil resources, namely, geothermal and coal. This move allowed more risk-capital to be accessed for this purpose. Geothermal exploration and development activities, exclusive of Tiwi and Mak-Ban which were well on stream then, were spinned-off from the National Power Corporation to the newly created PNOC-EDC agency. Thus, PNOC-EDC became the executingg agency for the Philippines in connection with the New Zealand-Philippine assistance program on geothermal energy. It also provided the proper institutional framework from where efforts to create a pool of nationals ready to man energy development programs and effect transfer of technology could be further accelerated.

Ministry of Energy. In response to the critical need to further rationalize the country's energy-resource development plans in order to accelerate its self-reliance and conservation postures

relative to energy resources on an integrated and comprehensive basis, the government created in 1977 a Ministry of Energy. The Ministry was charged, among others, with the formulation and implementation of the government's policies, plans and programs on energy-resource development.

One of the two Bureaus of the Ministry is the Bureau of Energy Development or BED, which administers a national program for the encouragement, guidance and regulation of activities relating to development and exploitation of energy resources. With technical assistance from the Italian government, BED has undertaken an updated inventory of Philippine geothermal resources.

The Ministry of Energy since its creation five years ago have evolved total energy programs for the short, medium, and long terms. These programs have undergone several reviews and modifications to facilitate the entry of capital and technology to get the program going, and to take in encouraging results of studies and surveys to determine exactly the country's indigenous resource base. It is gratifying that the Philippine total energy strategy has now come to be accepted internationally as a model for developing countries.

DEVELOPMENT STRATEGIES

With the government's all-out support to geothermal development and the institution of the proper legal and administrative machinery to implement its program, the Philippines has indeed made impressive progress toward becoming a leader in geothermal energy utilization. However, certain development strategies also helped bring this about.

Premium on Time. The Philippines has achieved this phenomenal growth in the utilization of its geothermal resources because the government took an unorthodox and bold approach to develop them in the shortest time possible. The economic value of time was, in other words, given much weight in the planning and decision-making processes. This aggressive stand, of course, meant putting in a little more risk capital than what would have been needed by an orthodox and conservative approach.

Casing Program. Exploration wells were drilled to be production wells so that if successful, the time to bring the field into the exploitation stage would be shortened. As soon as two or three producing wells were drilled and pertinent data on steam characteristics obtained, the National Power Corporation, on advice of the field developer, then proceeded to design, bid out, and order the generating units.

Drilling Program. The drilling program was also so planned as to compliment this bold approach. After a deep well is drilled and it is a steam producer, then subsequent wells were drilled as a cluster around it rather than give priority to delineation wells. This way, the decision to put up a power plant came sooner although, of course, the potential of the field was still just better than a guess. It was a gamble, but perhaps the end justified the means.

Delineation drilling, however, was not altogether put off; rather it was just given secondary importance. Some delineation and exploratory drillholes were also drilled interspersed with production drilling to allow subsequent commitment toward additional generation units if needed.

Foreign Expertise. The government also engaged the services of foreign experts so that it could avoid much of the problems of adopting new technologies. It sought technical assistance from the four leading countries in geothermal energy utilization : New Zealand, Italy, Japan and the United States. From these countries, the Philippines availed much of what it must know about geothermy; it learned from their experiences and avoided costly mistakes.

Manpower Development. However, if efforts in geothermal development were to be primarily Filipino in the long term, an extensive manpower development in the energy field had to be pursued. This was done at every opportunity and venue. By working with foreign experts in a scheme of on-the-job technology transfer, complemented with training abroad on specialized activities, a pool of nationals ready to man energy-development programs when foreign expertise is phased out is fast building up. The training of geothermal project managers was also given equal, if not greater importance, since such highly trained persons would have a broad perspective and be able to most effectively use project resources.

CONCERN ABOUT FAST DEVELOPMENT

Two decades ago, it was more or less the general impression among geothermal circles that the maximum development that a field could sustain for an appreciable time period is about 200 MW. This was perhaps because Wairakei was developed to 192 MW and Lardarello a little over 200 MW at the time. However, the reservoir engineers would quickly counter that such a notion is without sound technical basis. They will point out that the productivity of a geothermal field depends on several parameters besides reservoir size and stored heat. Much of the helpful data that is necessary to evaluate field life under exploitation can only be gathered after some years of actual production.

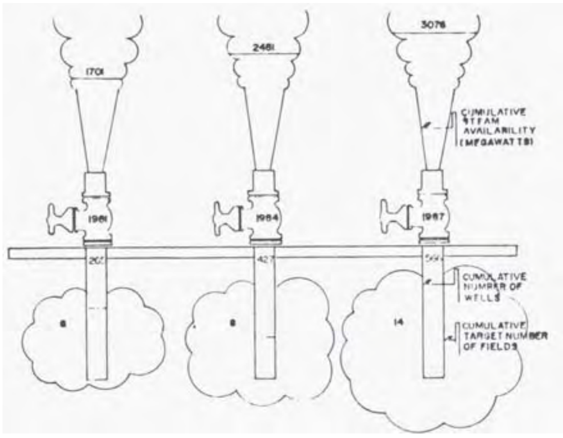
The rapid development of the Philippine geothermal fields can pose some serious problems later if proper resource management is not observed. Aware of this concern, the Philippines, after reaching its present position as a prominent geothermal energy user, is now giving equal emphasis on this important aspect of geothermal exploitation. Before committing to the installation of additional units in its already producing fields, the services of a reliable and established geothermal engineering firm are contracted to undertake reservoir assessment and simulation studies from production data so far available. Only when such studies would show that the field could sustain further production without impairing its viable

life would additions be effected.

In this connection, the Philippines is receiving from the United Nations Development Program (UNDP) assistance on geothermal reservoir assessment. A comprehensive training program to develop in-house capability in this important discipline is under implementation.

Much of the planned increases in installed geothermal generation capacities will come from new fields under development like Bacon-Manito of Luzon, Biliran and Burauen of Leyte, Baslay-Dauin of Negros, and from a fuller utilization of the large potential of Tongonan, also in Leyte.

GEOTMERMAL EXPLORATION/DEVELOPMENT PROGRAM



GEOTHERMAL EXPWRATION

YEAR			FOOTAGE (F.T.)	ADDITIONAL STEAM AVAILABILITY (MW)
1982	7	59	358,900	210
[illegible]	8	59	[illegible]	285
	10	56	[illegible]	[illegible]
1985	14	55	448,000	[illegible]
[illegible]	14	28	419,000	215
			210,000	120
			2,420,000	1,375

FIG. 4

SUMMARY

Perhaps as a summation of the analysis and evaluation of the various factors and aspects of the growth of Philippine geothermal development, we can cite the conclusions reached by Louis S. Goodman and Ralph N. Love on their work on "Policies of Geothermal Development". The study(1) centered on case histories of three important geothermal projects in New Zealand, the United States, and the Philippines.

The case history for the Philippines(2) highlighted the following important issues and observations :

1. There was a compelling need to develop indigenous energy resources. In the Philippines, the need to develop indigenous energy resources was recognized before the oil crisis of 1973. This was significant in the light of the fact that the geothermal fields were explored and developed and producing electricity during the 1970s.

2. Top administrative support ensured the success of the projects. Because of the support of the country's President, the geothermal projects cut through much red tape and was able to proceed at a relatively efficient rate. The President, for example, realized the need to set aside the geothermal fields as government reservations to facilitate the work of exploration and commercial development.

3. Coordination of energy-related government agencies was important. A number of government entities played a significant role in the planning and implementation of the different energy projects. Their efforts became centralized when a Ministry of Energy was created to integrate all energy programs.

4. Manpower development in the energy field has been constant. Philippine scientists and professionals have been trained constantly both locally and abroad. The government drew on the knowledge and experience of countries in the world that have commercially exploited geothermal energy - the United States, New Zealand, Italy, and Japan. Whether consultants are brought into the country, or local scientists go for studies and training in a foreign country, the process of technology transfer has been on-going.

5. Leadership in early geothermal development was a vital element. The Philippine experience indicated that it was essential to have a single person responsible for the coordination of all phases of geothermal development. Cloaked with overall authority, he must mediate among the geologists, geophysicists, geochemists, engineers, and social scientists; and then he must make key decisions.

6. Administration by proper government agencies was effective. The National Power Corporation, in assuming responsibility for commercial power generation, has proven its ability to orchestrate the tremendous job of power plant construction. On the other hand, the PNOC Energy Development Corporation has shown its capability to coordinate all field activities and handle smoothly the diverse interdisciplinary nature of geothermal projects.

7. Continual evaluation of project effectiveness is necessary. With a number of geothermal fields in various stages of exploration and development, it is important that the status of the projects be continuously evaluated to ensure that the overall energy program is not impaired and cost effectiveness is attained.

These then are the factors and aspects of the geothermal energy program which, together with strategies that put a premium on time, constitute the anatomy of the phenomenal growth of geothermal development in the Philippines.

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(2) Aquino, R. and Aquino S. with Alcaraz, A. P. (technical assistance), "Tiwi Geothermal Project : The Philippines", Geothermal Energy Projects, Pergamon Press, 1980, pp.168-205.