GEOTHERMAL ENERGY POTENTIAL IN THE NORTHERN SUMATRA, BY THE YEAR 2000

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SUMMARY - North Sumatra is a region of Indonesia with excellent potential of energy resources. There are many oil and gas fields which have supported the national income and increased its GNP. In the past few decades, the depletion of proven oil and gas resources have caused a problem for the long tern National energy supply. The remaining oil and gas resources to be exploited up to the end of the **1990s** are about **230** MMBOE. On the other hand, there are at least **17** high temperature geothermal systems in Northern Sumatra with a total potential of about 2200 **MWe**. This gives a very strong incentive for the development of geothermal energy by the year 2000 in **North Sumatra.**

INTRODUCTION

Indonesia has large energy resources. The greatest potential energy is in oil and gas, which have been exploited over the past **107** years. The first oil and gas well was drilled in the region of Telaga Said, which is is located on the north-eastern part of Sumatra.

The hydrocarbon resources of North Sumatra have been exploited by more than **18** international oil companies including Pertamina, the national oil company of Indonesia. As a result of oil resource depletion in Indonesia, a more recent policy of the Indonesian Government requires the use of alternative energies, i.e. hydro, coal and geothermal.

This paper briefly reviews the present and future potential energy of oil and gas resources in North Sumatra. The future requirements of North Sumatra's energy will be discussed, and the possibility of using geothermal energy **as** a resource will be highlighted.

PRESENT-DAY ENERGY POTENTIAL OF NORTHERN SUMATRA

The Northern Sumatra energy resources occur in three areas of its northern half, from Pekan Baru in the south to Banda Aceh in the North. This area covers the provinces of D.I Aceh, North Sumatra and West Sumatra.

Oil is the main potential energy in the Northem Sumatra which contributes to about 50 % of the nation's oil production, at around **7007000** BOPD (barrel oil per day). Pertamina produces about 8,000 BOPD. Coal, hydro, gas and geothermal resources are also found in this area.

Oil and Gas Resources

The total amount of known hydrocarbon (oil and gas) resources in Northern Sumatra is about **342** MMBO with recoverable reserves of about 85.5 MMBO. This total amount does not include reserves in the central Sumatra, currently exploited by PT. Caltex P. I., that supply about 50 % of the Indonesia's oil production.

The total amount of gas reserves is **14.56** TCF (trillion cubic feet) which is **15.91 %** of the total **gas** reserves of Indonesia **(Rahayu, 1990).** This total amount does not include the gas resources in Natuna (South China Sea) which are estimated to be about **37.81** TCF **(41.43 %** of total reserves). The remaining resources of oil and **gas** that can be exploited up to the year **2000** are about **230** MMBOE. Total oil and **gas** production in the last few years **has steadily** decreased due to depletion of reserves.

Alternative Energy Resources

As the economy grows rapidly, electricity demand in Northern Sumatra has increased from **14** to **18.4 %** of total energy demand, requiring an alternative energy supply. In addition to the **gas** resources, the hydropower resources in Northern Sumatra has a potential of **15,600** MW (Rahardjo, **1990)** which is about **20** % of Indonesia's total hydropower potential of 75,000 MW. However, the actual hydropower utilisation is still low (in **1969** it was only **567 MW**).

The total amount of coal reserves in Northern Sumatra is about **4.9** MM tons (Johannes, **1990)** which is **12 %** of the total Indonesian reserves. However, the main problem in using coal is transportation, **as** the deposits are mainly located in rural areas. up to **100 km** from the coast. Other deposits are located in the Barisan Range at elevations of about 700 m a.s.l.

The Indonesian Government's encourages energy diversification for the Indonesia's electricity sector. In the past, oil provided 80% of the energy in Indonesia, but this has decreased sharply to 40%. Non-oil energy increased to **45%** in 1988/1989 and **47%** in 1989/1990.

It is estimated that it will increase to 58.2% in 1992/1993 (Zuhal and Sudjanadi, 1990).

These data show that there is a great incentive to use alternative energy resources, including geothermal, to fulfil future electricity demands.

Northern

There are at least 17 geothennal prospects in North Sumatra, some of them are shown in Fig. 1. Thirteen of these prospects are high temperature systems and the others are warm and hot spring prospects (Hochstein, 1991).

A total of 5 prospects have been explored by standard geological, geochemical and geophysical methods. The status of the prospects areas is shown in Table 1.

Energy Demand

In order to achieve optimum energy supply, an energy supply model, called MARKAL (Market Allocation), and Energy Demand Model, DEMI (Demand Energy Model for Indonesia) were used.

This paper uses MARKAL for assessing the optimum energy supply in the provinces of D.I. Aceh, North Sumatra and West Sumatra.

1. D.I. Aceh Province

Demand for electricity up to the year 2000 is expected to be 177.3 GWh with an average growth of 14.5%/year. The installed capacity in 1989/1990 was 151 MW (PLN, 1990) and this is being extended by using hydropower to about 781 MW.

2. North Sumatra Province

Projected energy demand for the North Sumatra Province is 8251.5 GWh with an installed capacity estimated at about 2.052 MW by the year 2000 (PLN, 1990). This does not include the installed capacity of the Asahan hydropower project. The installed capacity in 1990/1991 was 626.2 MW.

3. West Sumatra Province

The total demand for energy up to the year 2000 is estimated to be about 2116 GWh.

Electricity Scenario Supply

The economic growth and energy demands in North Sumatra will continuously increase at a fast rate, at least up to the first decade after the year 2000.

PLN, the national electricity company of Indonesia, would supply about 40 % of the demand from energy generated by hydro power, and the remaining 60 % from energy generated using coal, gas, oil and geothermal (Akuanbatin, 1992). At least 280 MWe is expected to be installed from geothennal prospects by the year 2000 (Table 3), in order to help to satisfy the energy demand. Because of the decrease in oil and gas production. exploration and exploitation of the geothemal energy prospects in North Sumatra will increase in the near future.

GEOTHERMAL PROSPECTS TO BE DEVELOPED

Although not all the geothermal prospects in Northern Sumatra have been explored in detail, 5 of the 13 high temperature prospects are highly recommended. These are: Seulawah in Aceh; Sibayak, Sarulla and Sibualbuali in North Sumatra; and Muara Laboh West Sumatra. In addition, Gunung Talang prospect in West Sumatra is situated close to the industrial region of West Sumatra. These prospects are located on the route of the planned electricity transmission line of the Northern Sumatra grid.

Seulawah Prospect

The Seulawah prospect lids 35 km to the south-west of Banda Aceh, the capital city of Aceh Province. Seulawah is a volcanic geothennal system, and is inferred to have a potential of 200 MWe (speculative) as suggested by a reconnaissance survey conducted in 1989. Since Aceh is designated by the government to be a centre of industrial development, the Seulawah geothermal prospect could be an important additional energy resource to those of gas and hydropower.

Sibayak Prospect

This prospect is located about 50 km southwest of Medan, the capital city of North Sumatra province. This geothennal field was identified in 1989 as a volcanic, water dominated system. The prospect is now being explored and drilled. Two exploration wells were drilled and it is proposed to drill two other exploration wells soon. The probable reserve is estimated to be at least 140 MW. The reservoir comprises sandstone and limestone. This prospect is likely to be the first geothermal prospect to be developed in Sumatra, which will involve a small scale project of 2 MWe.

Sarulla Prospect

The Sarulla prospect consists of the North Sarulla and South Sarulla fields. They are located about 300 km south-east of Medan. They lie in the Sarulla Graben which is a part of the Sumatra Fault system. The reservoir temperatures are in the range of 230-270°C. The system is extensive within the Sarulla Graben, and is believed to have a potential of about 750 MWe.

Sibualbuali Prospect

This prospect contains, in the Sipal pal Aek Nabara, the biggest steam vent yet found in Sumatra. The fumarole temperatures range from 133 °C in the east to boiling point in the north. The fumaroles cover an area of about 5 km^2 surrounding the Sibualbuali Mountain.

The Sibualbuali system is liquid-dominated with a temperature estimated to be around 300°C in the reservoir. The potential of the prospect is estimated to be 380 MW.

Muaralaboh Prospect

This is located about 100 km to the south-east of Padang, the capital city of West Sumatra Province. The system has a liquid-dominated reservoir. The prospect looks promising and is in a setting similar to that of the Sarulla prospects (graben) in North Sumatra. An intensive geothermal exploration survey is being conducted which could indicate a potential of at least 200 MW.

G. Talang Prospect

This prospect, which extends 25 km north from a volcano, lies 35 km east of Padang. It is an attractive prospect because the area is close to the industrial region of West Sumatra. However, little are known about the details of this prospect.

The existence of these geothermal prospects shows that development of geothermal energy in North Sumatra is an attractive proposition.

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Note by editors:

This paper has been edited. We apologise to the authors if we changed any of their intended meaning, because they have not had time to respond to our changes.

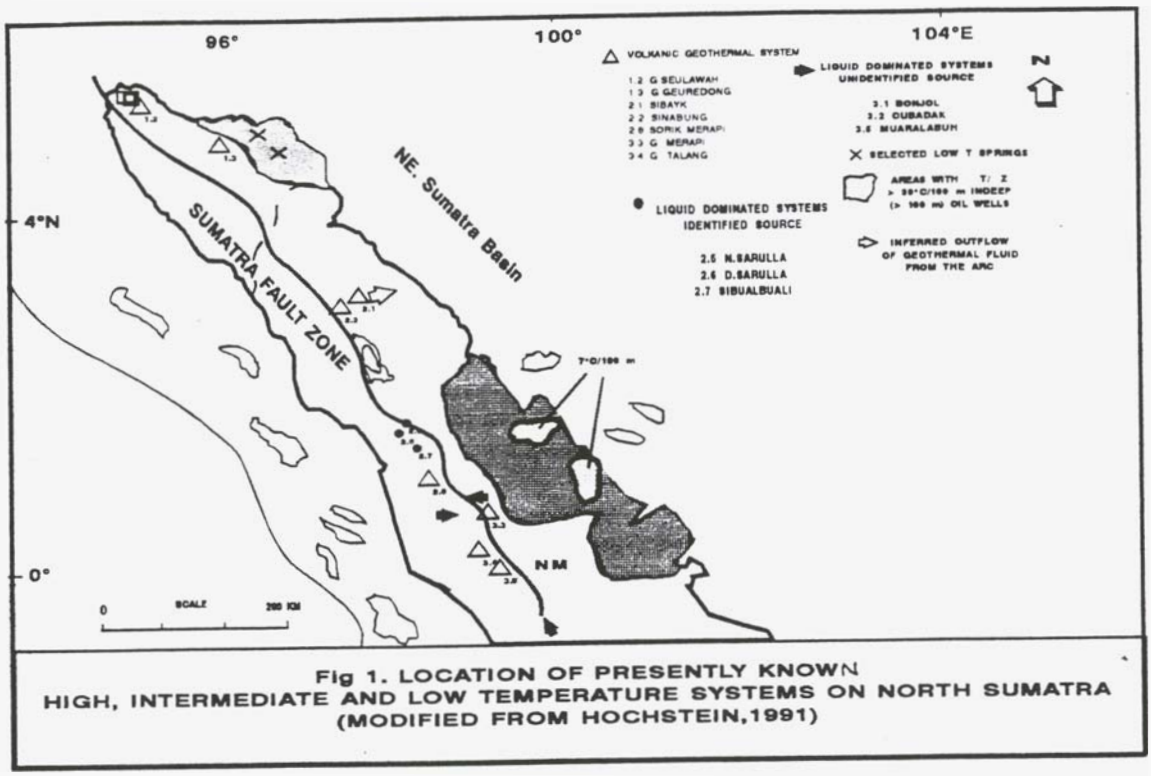

Fig 1. LOCATION OF PRESENTLY KNOWN HIGH, INTERMEDIATE AND LOW TEMPERATURE SYSTEMS ON NORTH SUMATRA (MODIFIED FROM HOCHSTEIN,1991)

Table 1 : North Sumatra Geothermal Potential Prospect Ranking and Its Status

Num.	Location of Province	Prospect	Status (June, 1993)
1.	Aceh	1. Seulawah	Rec. and Reg. survey
		2. Takengon	Rec.
		3. Kutacane	Rec.
		4. Sabang	Rec.
2.	North Sumatra	1. Sibayak	3 Exploration wells
		2. Sibualbuali	Detail Expl. Survey
		3. Sarulla	Detail Expl. Survey
		4. Sorik Merapi	Detail Expl. survey
		5. Tarutung	Rec.
		6. Pusuk Bukit	Detail survey
		7. Sinabung	Hazard and Detail
		8. Namora Ilangit	Expl. Survey
3.	West Sumatra	1. North Muaralabuh	Detail Expl. Survey
		2. South Muaralabuh	Detail Expl. Survey
		3. G. Talang	Detail Expl. Survey
		4. Bonjol	Rec.
		5. Panti	Rec.

Explanation :
Rec = Reconaissance
Reg = Regional
Expl = Exploration

Table 2 : The potential of Northern Sumatra Geothermal resources

	Prospect location	Potential Category			
		Resource Speculative (MW)	Possible Reserves (MW)	Probable Reserves (MW)	Proven Reserves (MW)
Num.		(1)	(2)	(3)	(4)
1.	D.I Aceh Province	2161*	200		-
2.	North Sumatra Province	1960	1770	150	40
3.	West Sumatra province	2339*	240	23	-
	Total :	6450	2210	173	40

* From : Takhyan, I.A : (1991)

(1) Calculation based on regional exploration survey (speculative)
(2) Calculated based on detailed exploration survey
(3) Calculation based on 1 exploration well
(4) Calculation based on production and delineation well test

Table 3 : Geothermal scenario supply by the year 2000 in Northern Sumatra, Indonesia

Geothermal pospect	Scenario supply (in Mwe)						Capacity
	95/96	96/97	97/98	98/99	9912000	2000/2001	
Seulawah (D.I Aceh)					20	20	20
Sibayak (N.Sumatra)	2	2	2	22	22	22	22
Sarulla\Sibualbuali (N.Sumatra)	20			110	110	220	220
G. Talang (W. Sumatra)	-	-	-	-		20	20
Total	2	2	2	132	152	282	282