GEOTHERMAL RESOURCES AND DEVELOPMENT IN INDONESIA

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outline

- Introduction
- Geothermal energy potential
- Survey activities
- Geothermal Law

DISTRIBUTION OF GEOTHERMAL AREAS IN INDONESIA

Total : 251 locations

1. Aceh : 17 lcs	10. Banten : 7 lcs	19. Gorontalo : 2 lcs
2. North Sumatra : 16 lcs	11. West Java : 38 lcs	20. Central Sulawesi : 14 lcs
3. West Sumatra : 16 lks	12. Central Java : 14 lcs	21. South Sulawesi : 16 lcs
4. Riau : 1 lcs	13. Yogyakarta : 1 lcs	22. S-E Sulawesi : 13 lcs
5. Jambi : 8 lcs	14 East Java : 11 lcs	23. Maluku : 6 lcs
6. South Sumatra : 5 lcs	15. Bali : 5 lcs	24. North Maluku : 9 lcs
7. Bengkulu : 5 lcs	16. West N. Tenggara : 3 lcs	25. Papua : 2 lcs
8. Lampung : 13 lcs	17. East N. Tenggara : 18 lcs	26. West Kalimantan : 3 lcs
9. Bangka Belitung : 3 lcs	18. North Sulawesi : 5 lcs	

GEOTHERMAL ENERGY POTENTIAL OF INDONESIA

LOCATION	RESOURCES (MWe)		RESERVE (MWe)			INSTALLED CAPACITY
	SPECULATIVE	HYPOTETIC	POSSIBLE	PROBABLE	PROVEN	
SUMATRA	5,705	2,433	5,419	15	499	2
JAVA - BALI	2,300	1,611	3,088	603	1,727	785
NUSA TENGGARA	150	438	631	-	14	
SULAWESI	1,000	125	632	110	65	20
MALUKU / IRIAN	325	117	142	-	-	
KALIMANTAN	50	-	-	-	-	
Total 251 locations	9,530	4,714	9,912	728	2,305	Total 807 MWe
	14,244		12,945			
	Total : 27,189					

GEOTHERMAL ENERGY POTENTIAL OF SUMATERA ISLAND, INDONESIA

LOCATION	RESOURCES (MWe)		RESERVE (MWe)			INSTALLED CAPACITY
	SPECULATIVE	HYPOTETIC	POSSIBLE	PROBABLE	PROVEN	
ACEH	630	398	282	-	-	
NORTH SUMATERA	1.500	170	1.627	-	329	
WEST SUMATERA	925	153	686	-	-	2
BENGKULU	450	223	600	-	-	
SOUTH SUMATERA	725	392	794	-	-	
LAMPUNG	925	838	1.072	-	20	
BANGKA BELITUNG	75	-	-	-	-	
JAMBI	375	-	358	15	40	
RIAU	25	259	-	-	-	
Total 85 locations	5.630	2.433	5.808	15	399	Total 2 MWe
	8.063		6.222			
	Total : 14.285					

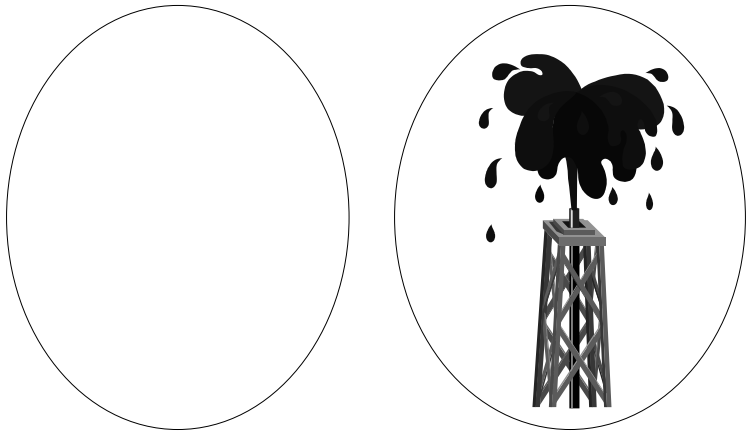
GEOTHERMAL ENERGY POTENTIAL
OF JAVA, BALI AND NUSA TENGGARA ISLAND, INDONESIA

LOCATION	RESOURCES (MWe)		RESERVE (MWe)			INSTALLED CAPACITY
	SPECULATIVE	HYPOTETIC	POSSIBLE	PROBABLE	PROVEN	
BANTEN	450	100	285	-	-	
WEST JAVA	1.500	784	1.297	488	1.557	725
CENTRAL JAVA	275	342	614	115	280	60
YOGYAKARTA	12.5	-	-	-	-	
EAST JAVA	137.5	365	654	-	-	
BALI	75	-	226	-	-	
NTT	125	374	542	-	14	
NTB	-	74	70	-	-	
Total 97 locations	2.575	2.039	4.291	603	1.851	Total 785 MWe
	4.614		6.745			
	Total : 11.359					

GEOTHERMAL ENERGY POTENTIAL
OF SULAWESI, MALUKU, PAPUA, KALIMANTAN ISLAND, INDONESIA

LOCATION	RESOURCES (MWe)		RESERVE (MWe)			INSTALLED CAPACITY
	SPECULATIVE	HYPOTETIC	POSSIBLE	PROBABLE	PROVEN	
NORTH SULAWESI	25	125	540	110	65	20
GORONTALO	22	-	15	-	-	
CENTRAL SULAWESI	325	-	8	-	-	
SOUTH SULAWESI	325	-	49	-	-	
S-E SULAWESI	250	-	51	-	-	
NORTH MALUKU	150	117	42	-	-	
MALUKU	125	-	100	-	-	
PAPUA	50	-	-	-	-	
WEST KALIMANTAN	50	-	-	-	-	
Total 70 locations	1.322	242	805	110	65	Total 20 MWe
	1.564		980			
	Total : 2.544					

Geothermal VS Oil



27 GWe for 30 years ≅ 11 Billion barrels

GEOTHERMAL DIVISION ACTIVITIES

1. GEOTHERMAL SURVEYS:

- 11 GEOTHERMAL AREAS HAVE BEEN INCREASED FOR THEIR STATUS OF SURVEY FROM RESOURCES TO POSSIBLE RESERVE
- ONE GEOTHERMAL FIELD HAS BEEN DRILLED (PRODUCING STEAM OF 1,5 MW (MT-2, MATALOKO)
- DRILLING 2 SEMI PRODUCTION WELL (MT-3 AND MT-4, MATALOKO) IN PROGRESS

2. STANDARDISATION:

1. Classification of Geothermal Energy Potential
2. Parameter Method In Estimating Geothermal Energy Potential
3. Parameter Constant In Estimating Geothermal Energy Potential
4. Procedure In Conducting And Reporting For Preliminary Geothermal Survey
5. Procedure In Conducting And Reporting For Detail Geothermal Survey
6. Flow Test Method For Geothermal Well
7. Procedure In Flow Test For Geothermal Well
8. Apparatus Criteria In Flow Test For Geothermal Well
9. Electrical Energy Conversion For Geothermal Well Flow Test
10. Reporting In Flow Test For Geothermal Well

3. GEOTHERMAL DATABASE

- DIGITATION OF GEOTHERMAL MAPS : 12 AREAS DONE; 6 AREAS IN PROGRESS
- UPDATING OF GEOTHERMAL DATABASE : 12 AREAS DONE; 6 AREAS IN PROGRESS

4. OTHERS

- BOOK OF INDONESIAN GEOTHERMAL POTENTIAL STATUS (2002 & 2003)
- MAP OF GEOTHERMAL DISTRIBUTION AND ITS POTENTIAL IN INDONESIA (2003)
- BOOK OF PROVINCIAL GEOTHERMAL POTENTIAL SUMARRY
- BOOK OF GEOTHERMAL POTENTIAL SUMARRY IN EASTERN INDONESIAN DISTRICTS

East Nusa Tenggara

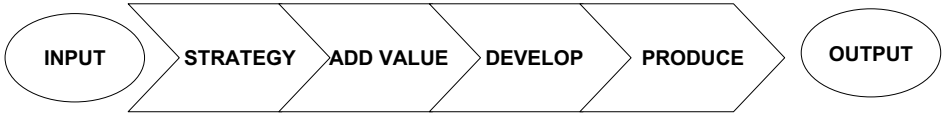
No	Area	Regency	Potency (MWe)					Proposed Utilization
			Resource (MWe)		Reserve (MWe)			
			Speculative	Hypothetic	Poss	Prob	Prov	
1	WAI SANO	Manggarai	-	90	33	-	-	B, D
2	**ULUMBU**	**Manggarai**	**-**	**-**	**187,5**	**-**	**12,5**	**B, D**
3	WAI PESI	Manggarai	-	-	54	-	-	D
4	GOU - INELIKA	Ngada	-	28	-	-	-	D
5	MENGERUDA	Ngada	-	5	-	-	-	D
6	**MATALOKO**	**Ngada**	**-**	**10**	**63,5**	**-**	**1,5**	**B, D**
7	KOMANDARU	Ende	-	11	-	-	-	D
8	NDETUSOKO	Ende	-	-	10	-	-	D
9	SUKORIA	Ende	-	145	25	-	-	B, D
10	JOPU	Ende	-	-	5	-	-	D
11	LESUGOLO	Ende	-	-	45	-	-	B, D
12	OKA	Flores Timur	-	-	6	-	-	D
13	**ATEDAI**	**Lembata**	**-**	**-**	**40**	**-**	**-**	**B, D**
14	BUKAPITING	Alor	-		27	-	-	B, D

Notes : **A = Big-scale Electric Power Generation** **C = Binary System Electric Power Generation**
B = Small-scale Electric Power Generation **D = Direct Used (heating, drying, sterilization etc) or tourism**

No	Area	Regency	Potency (MWe)					Proposed Utilization
			Resource (MWe)		Reserve (MWe)			
			Speculative	Hypothetic	Poss	Prob	Prov	
15	ROMA-UJELEWUNG	Lembata	-	16	6	-	-	D
16	OYANG BARANG	Flores Timur	-	-	37	-	-	B, D
17	SIRUNG (ISIABANG-KURIALI)	Alor	100	48	-	-	-	D
18	ADUM	Lembata	-	-	36	-	-	B, D
Total Potency = 1042 MWe			**100**	**353**	**575**		**14**	

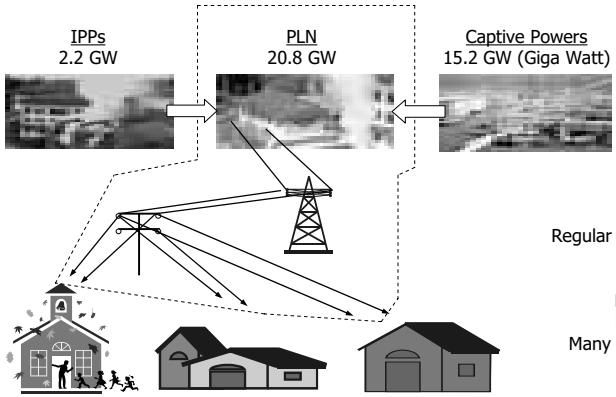
Notes :
A = Big scale Electric Power Generation
B = Small scale Electric Power Generation
C = Binary System Electric Power Generation
D = Direct Used (heating, drying, sterilization etc) or tourism.

GEOTHERMAL POSITION : INDONESIA DEVELOPMENT STRATEGY



WHERE WE ARE NOW	HOW WE WANT TO GET THERE				WHERE WE WANT TO BE
	STRATEGY	ADD VALUE	DEVELOP	PRODUCE	
• 1998 Indonesia's energy Policy promote energy mix that add value • Indonesia has 27,000 MW potential geothermal resources, 94% of these resources are untapped • Indonesia's electrical power sector as well as oil and gas sector have been restructured and reformed to meet global environment demanding for transparency, market economy, competitiveness and sensitivity to the environment. • Given the GOI subsidy for oil fuel weaken the geothermal competitive-ness • The economic downturn has reached the path for a recovery	Strategic positioning: • GOI to appreciate benefits, uniqueness and urgency of geothermal development • GOI to have strong determination in developing geothermal energy • Reform energy policy to support geothermal development • Develop legal framework for the basis of geothermal development • Promote commitment to make Indonesia the center of excellence for geothermal industry • Provide equal footing / a fair level of playing field for geothermal energy	Create competitiveness • Risk Reduction-Guaranteed Return, GOI Risk Sharing, Price Adjustment • Technology-Support R&D, Develop Human Resource Competency • Economics Parameters-Mitigate High Cost Factor, Economic of Scale, Base Load	• Quantitative analysis of Indonesia's Geothermal Energy Potential and its intrinsic benefits • Geothermal Campaign (Better Understanding and Appreciation of Indonesia Geothermal Energy Potential) • Program to Enhance HR Competency and Professionalism • Workshop to better understand the new electricity market structure (multi-buyers-multi-sellers)	• Geothermal Energy White Paper • Indonesia's Energy Policy • Indonesia Geothermal Development Master Plan (Geothermal Asset Management Process Map) • Geothermal Energy Sales or Power Purchase Agreement Model • Geothermal Law • Government Regulation	• Geothermal Resources become energy of choice in the expanding market by virtue of its natural environmental benefit and its potential opportunities to add value in support of Indonesia's sustainable national development Why Geothermal is the energy of choice : • Fossil fuel substitution effect • Renewable • Seasonal independence • Non-exportable/domestic use • Abundance • Environmentally friendly • Incremental & small scale development viability • Secondary benefits

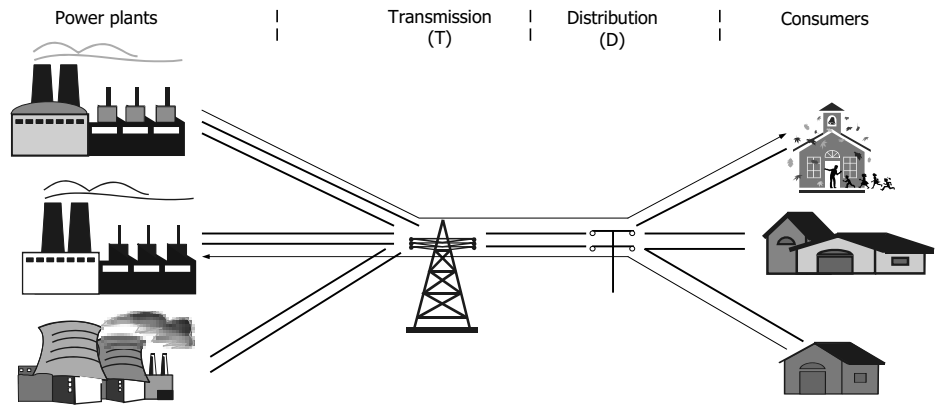
Monopoly structure, nowadays :



Result.
Regular black out and brown out (30 areas).
Limited fund to extend G, T, and D.
Unreliable supply.
Bearing the government for subsidy.
No risks for IPPs (bilateral contract).
Many people have no access for electricity
Can not promote private section participation

T (Transmission), D (Distribution), G (Generator)
IPP = Independent Power Producers, PLN = Electricity State-Owned Company

Competitive Structure

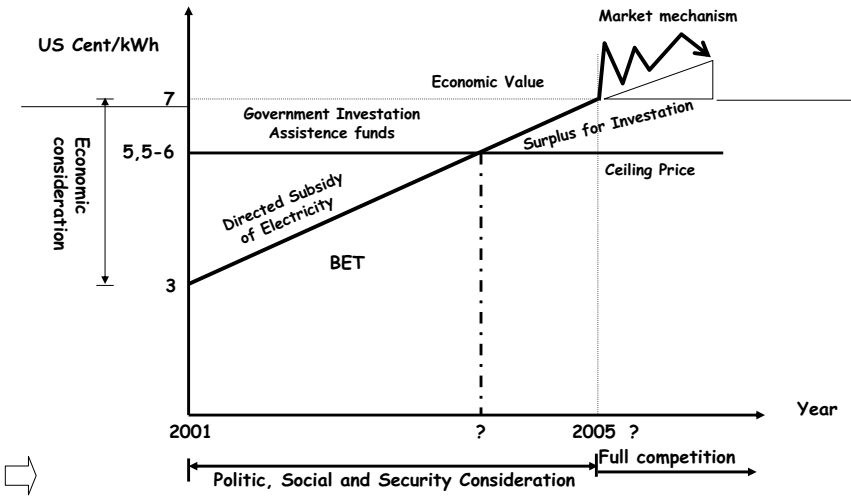


- Competition among generators (G)
- Generator has choice

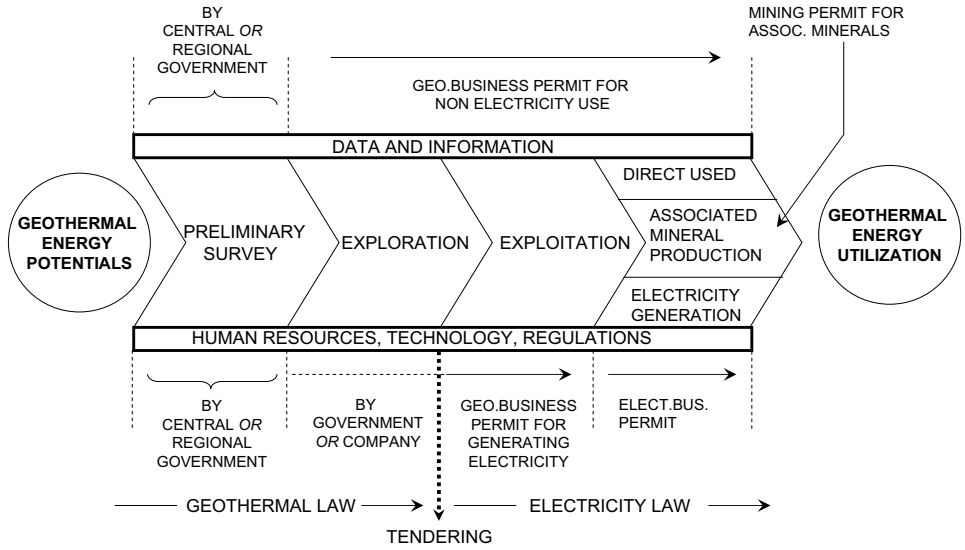
- Regulated tool fee for T and D
- Free access for all

- Consumers have choice

BASED ELECTRICITY TARIF (BET) DETERMINING POLICY



GEOTHERMAL DEVELOPMENT PROCESS



INDONESIA GEOTHERMAL LAW

The Indonesia Geothermal Law No. 27 / 2003

This Law regulate the upstream business of geothermal which consists of 15 Chapters and 44 Articles. The downstream business that engages in electric power generation shall subject to prevailing Electric Law No. 20/2002

This regulation provide certainty of law to the industry because the huge of potentials of Indonesia's geothermal resources and it vital role to ensuring Indonesia's strategic security of energy supply, and its ability to add value as an alternative energy to the fossil fuel for domestic use.

- **Mining Right**

  The government of Indonesia ("Government") carries out the execution of the mining right. In doing so, the Government may delegate its mining right to the Regional Government depending on the extent of the location of the geothermal reservoirs and the utilization of the resource. If it is contained and utilized within the region, the Regional Goverment is granted the authority to execute the geothermal mining right.

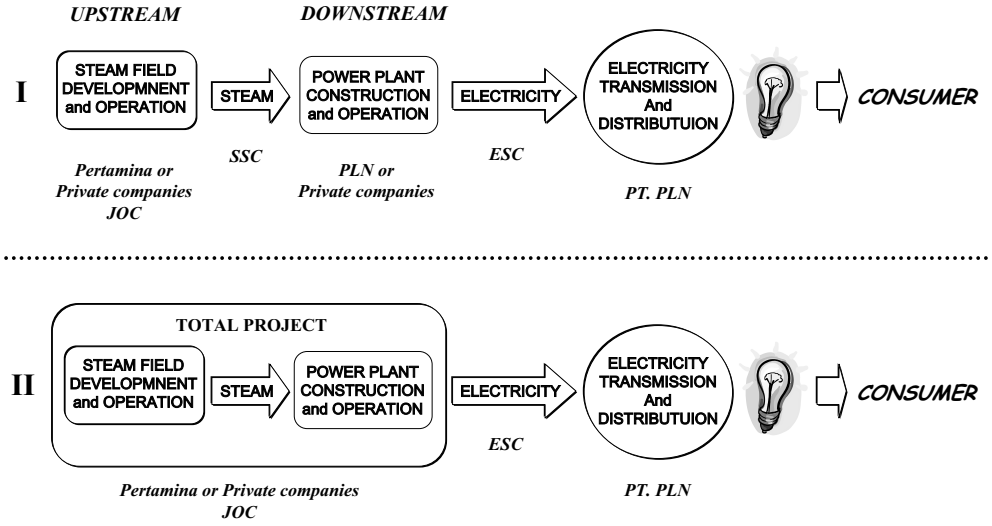
- **Operational and Economic Activities**

  The government may conduct exploration activities for gathering data and information on geothermal prospects in order to determine the Geothermal Working Area and to prepare for tendering process of the geothermal economic undertaking. It will take over a steam field development risk, hence, will give significance impacts on price.

- **Geothermal Business Permit**

  The permit is granted to the company upon winning the tendering process to conduct economic activities for exploring and exploiting geothermal energy in specific working area. The permit can be issued by Government or Regional Government, depending on the coverage area of geothermal prospect, whether it covers more than one region, and the utilization of the geothermal resources.

Geothermal Business Scheme in Indonesia



INDONESIA GEOTHERMAL DATABASE

JOINT COOPERATION IN SMALL-SCALE GEOTHERMAL FIELDS DEVELOPMENT

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outline

- Introduction
- Geothermal potency
- Exploration activities
- Joint co-operation

AUTHORITY TO ISSUE GEOTHERMAL BUSINESS PERMIT

Utilization	Geothermal Reservoir Spread		Remarks
	Within One Region	Beyond One Region	
Electric Power Generation • Grid Connected Beyond the Region • Used only within the Region	GBP : Regional Adm. EBP : Central Govt.	GBP : Central Govt. EBP : Central Govt.	GBP : Geothermal Business Permit EBP : Electricity Business Permit Accordance with Electricity Law MMP : Mineral Mining Permit in accordance with General Mining Law
	GBP : Regional Adm. EBP : Regional Adm.	GBP : Central Govt. EBP : Regional Adm.	
Direct Use (Heating Process)	Regional Adm.	Central Govt. / Regional Adm.	
Production of Assoc. Minerals	Regional Adm. MMP : Regional Adm.	GBP : Central Govt. MMP :Regional Adm.	

Database

CLASIFICATION OF INDONESIA GEOTHERMAL ENERGY POTENTIAL

RESOURCES (Unidentified resources)	Speculative Resources
	Hypothetical Resources
RESERVES (Identified resources)	Possible Reserves
	Probable Reserves
	Proven Reserves
Total Energy Potential	

Increasing degree of confidence

Position Paper on Geothermal Development in Indonesia

Before discussion on the geothermal resources and database, we would like to take this opportunity to present the position paper on geothermal development in Indonesia.

There is an urgent need to optimize the development of alternative energy in Indonesia. This is primarily driven by the fact that the country's petroleum reserves depletion and current domestic energy consumption pattern (that is heavy on oil products), has pushed Indonesia to the brink of becoming a net oil importer in the near future. This factor is combined with the increasing awareness that a clean environment is a commodity. This was suggested by the Kyoto Protocol, which included a carbon trade clause.

Geothermal is the most viable and feasible alternative energy sources in Indonesia to be developed. It possesses unique socio-economic and environmental benefits for the country, and provides the diversified long –term energy mix required by the "Kebijaksanaan Umum Bidang Energi – KUBE, 1998" energy policy.

The geothermal industry is currently stalled and will not be able to compete unless steps are taken. To date, there are about a dozen geothermal contracts signed with a targeted capacity of about 3,000 MW, however the on-line installed capacity is only less than 4 % of total Indonesia geothermal resource potential. In addition, there is currently about than US $ 2 billion of stranded investment.

To the utility geothermal is perceived to be a high priced power source. INAGA believes, however, that the total "value" of geothermal energy should be viewed from a broader perspective. The following values make geothermal energy an "energy of choice" for Indonesia

1. *The long – lived nature of geothermal resources provides low cost power in the long term.*

   Once the project investment is recorded with an acceptable return, the field can still produce reliable power at the cost of operation and maintenance only. For reference, several geothermal plants in Italy are still producing after 100 years, and there are geothermal fields in New Zealand and North America that are still producing after 50 years. This is reliable; continuous and secure

2. *Abundant in Indonesia.*

   PERTAMINA has identified at least 80 geothermal prospects and has estimated that the geothermal / electric energy potential may approach 20,000 MW. This total potential will free up the energy equivalent of nine billion barrels of oil. To date there are only less than 4 % of total Indonesia geothermal resources potential of on-line installed capacity.

3. *Non-exportable indigenous source of energy that can substitute for fossil fuels.*

   To provide the maximum value-added benefit to the country, the national energy development plan should be directed towards utilizing non tradable and non-exportable sources of indigenous energy such as geothermal, thereby optimizing export of transferable and exportable energy commodities such as coal, oil and gas.

4. *Renewable and not weather or seasonally dependent.*

   Unlike wind, solar, or even hydroelectric power, which are dependent upon favorable weather or season, geothermal energy provides highly reliable renewable energy throughout the year. Geothermal energy contributes to energy diversity.

5. *Incremental and small-scale development viability.*

   Geothermal can be developed in small increments appropriate to the growth pattern of the Indonesian electricity market. The existing surplus capacity in the Java-Bali grid resulted from excessive development of large capacity coal and combined cycle power plants. In eastern art of Indonesia, Geothermal fits to Village power to remote sites.

6. *Predictable price.*

   Unlike fossil fuels, the geothermal price is not tied to oil prices, which fluctuates with supply & demand, political and social events, and even weather and reason. This is even predictable local costs, no price shocks

7. *Environmentally friendly energy source.*

   Geothermal development can reduce the overall air NOx, SOx, and CO_2 emissions from power developments. Geothermal plants emit only 5 % of the CO_2 emissions of coal power on a per MWh basis. Other environmental problems damage can be reduced with geothermal development including crop and forest damage, deterioration of buildings, and global climate change. In addition, geothermal developments are compatible with natural habitats and require less land per installed MW compared with coal and hydro power plants.

8. *Secondary benefits.*

   Apart from its electricity conversion utilization, geothermal energy has demonstrated secondary economic benefits including mineral extraction heat recovery for agriculture industry, direct heating and tourism.

9. *Uses Little Land.*

   Geothermal power plant requires very small land for wells, pipe-line, and power plant compare to other technologies

10. *Boosts Local Economies.*

    Certainly, since the geothermal field in Indonesia is still in non-infrastructure area, geothermal development will boost local economies.

To leverage its unique and intrinsic benefits, a policy is needed to make geothermal energy competitive and to attract participation of private investors to develop Indonesia's geothermal resources. This policy should provide room for geothermal to compete by mitigating risk, advancing the technology, and establishing a level playing field for benchmarking, in addition to enhancing geothermal economic parameters. These include running geothermal plants at base load, leveraging the economy of scale, and making available certain fiscal and monetary incentives to help mitigate the risk and reduce the front-end cost of geothermal resource development.

This will require a comprehensive and quantitative understanding of the geothermal energy development, together with knowledge of international benchmarking of geothermal regulations, business practices, price structure, costs and contracts. Furthermore, INAGA believes that Geothermal resources become energy of choice in expanding market by virtue of its natural environmental benefits and its potential opportunities to add value in support of Indonesia's sustainable national development.

INDONESIA GEOTHETRMAL ENERGY POTENCY