

## **Alternative Electric Power Plant that Environmental Friendliness at Indonesia**

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**ABSTRACT:** Requirement of energy electrical increasing, is estimated by a growth will reach 7,1% each year till year 2012 with the electrification ratio 60%. Condition of like this at one side seethe with excitement, but other; dissimilar side will give the impact concerning from environment aspect, because 89,5% power plant in Indonesia use the energy fossil. Affect the use of energi fossil one of them is menghasilkan of gas emission throw away big enough, suppose each; every kWh energi electrical produced by energi fossil yield the polutan thrown into the air 974 gr CO<sub>2</sub>, 962 mg SO<sub>2</sub> dan 700 mg Nox. At year 2012 is estimated by production of energy electrical in Indonesia reach 192,590 GWh, means 172,360 GWh electrical produced to use the energy fossil. Sum up this result happened by release 168 juta ton CO<sub>2</sub>, 159,6 thousand ton SO<sub>2</sub> with 120,7 thousand ton Nox into the air. Starting from the impact, require to be done/conducted by a more study of comprihensive and comparability of concerning generating which is in using in Indonesia. This study is done/conducted by pursuant to evaluate from various information upon which reference, to later; then to yield the recommendation of concerning appropriate generating to be used in Indonesia. As for variable to be weared by as indicator evaluate is economic aspect, ecological and technical or is environmental. Than the variable, hence relevant generating for the context of Indonesia is power station of heating power of earth and power station nuclear energy.

**KEY WORD:** *energy, ecology, economy*

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### **I. ANTECEDENT**

Modern Society life depend on availability of source energy especially energy electrical. Requirement to electrical of is same as fundamental requirement of other human being. Exploiting of energy electrical have influenced and form the human being civilization this decade, cause of quality of human life own the correlation to exploiting of energy electrical in everyday life. Crisis energy of effect of decreasing it the availability of source of energy of world primary, marked with its stomach is oil price in world marketing become the American 130 dollar each;

every barel have triggered the social and economic crisis in various state of is inclusive of in Indonesia. Governmental policy of Indonesia for the increase of price of substance of fuel oil by the reason of general revenues and expenditure budget saving trigger the increase of price of most of all commodity needed by a society in Indonesia. This matter is poverty increased and people life progressively wickedness. Various society element of is inclusive of student submit the objection of through/passing demonstration refuse this policy is happened by most of all fatherland angle. Difficult choice which must be taken by government by various consequence which must be shouldered. This fact is pointed that crisis energy can trigger the crisis multidimension in global direction and also in state of each.

Use fuel oil redundantly not even trigger the global economic crisis and also each; every state, but more concerning is trigger the global environmental crisis. Global environmental crisis marked with the phenomenon of air contamination, land; ground and irrigate the. The crisis, effect of exploitation of resource energy of up to its exploiting to various requirement of human life in various sector of like electrical power, transportation, domestic and industrial.

One of environment phenomenon menacing world mankind life is global or global warm-up of warming. One of the matter cause global warm-up is use of energy fossil namely petroleum, gas and petrify the coals. combustion of Energy fossil cause to increase it concentration of glasshouse gas in atmosphere. existing Glasshouse gas is atmosphere of like carbondioksida (CO<sub>2</sub>), dinitro oxide (N<sub>2</sub>O),

methane (CH<sub>4</sub>), sulfurheksaflorida (SF<sub>6</sub>), PERFLOROKARBON (PFCS) and hidroflokarbon (HFCs) of abundant glasshouse gas concentration will double the sunlight so that earth temperature progressively go up the. Temperature increase will trigger the environmental imbalance is namely happened by the climate change [1]. Affect from climate change touch all sector especially agricultural sector that line, various disaster that happened this last is frequently related to by a global warm-up phenomenon.

Sector of electrical power give the biggest contribution increase it concentration of glasshouse gas in atmosfir namely equal to 40% and the rest of transportation sector 27%, industrial sector 21%, domestic sector 15% and also other; dissimilar sector - other; dissimilar 1% [2]. This data is valid enough because most power station in Indonesia namely 89,5% using fossil fuel with the electrification ratio newly reach 56%, conceiving if electrification ratio increasing while depending of power station still at fossil fuel. As illustration of each; every kWh energy electrical produced by use of energy fossil yield the glasshouse gas of equal to 974 gr CO<sub>2</sub>, 962 mg SO<sub>2</sub> and 700 mg Nox. [3]

## II. METHODOLOGY

Method weared in this study is use the book study namely collect various related/relevant information with the sole energy specially energy electrical related to by factor environment or ecology. Data obtained from various source of like reference book, erudite journal, popular erudite article, and others will be analysed to use the technical approach, ecological and economic or environment. Analyse is only limited for the power station of have big scale to.

## III. RESULT AND SOLUTION

### Potency Energy in Indonesia

Natural factor of Indonesia State very supporting of development of energy sector in Indonesia especially in electricity sector. Geographically rich Indoneia of resource of energy. The resource for example which can be innovated and which cannot be innovated the. the Potency energy existence gone the round of to flatten the totality region Nusantara. Potency of pure energy oil fossil 86.9 milliard barel of while which reserve only equal to 9 milliard barel or 10,36% while ability to be exploited still be pertained to by lower namely only 5.56% each year (tables 1).[3].

Matter which require to be paid attention to that the potency do not go along way or will used up after have exploitation without effort exploration of like petroleum will used up 18 years later; then, same thing for the gas of 61 years and petrify the coals 147 years. Rare of this have been felt in this time namely Indonesia have do not fulfill quota as state of explored oil determined by organization of nations of export oil (OPEK). This Fact is pointed that depending to fossil fuel need is immediately lessened step by step look into its existence is finite, because earning used up if continuous have exploitation.

Natural by Crisis fuel oil of Indonesia in this time represent the governmental disability evidence for the prediction of requirement fuel oil as a result in this time Indonesia State which before now export in this time become the import. Its consequence is increase of price of world oil influence the resilience of economics of state and sector of electrical power experience of the economic impact is which enough concern because most power station is use fuel oil.

Tabel 1 Energy Potency Fossil National

Fossil Energy	Resource	Reserve	Production (each year)	Ratio Res/ Prod (without exploration year)
Oil	86.9 mil barel	9 mil barel	500 Jt barel	18
Gas	384.7 TSCF	182 TSCF	3.0 TSCF	61
Coal	57 miliar ton	19.3 mil barel	130 Jt ton	147

Crisis of global environmental Energy crisis and represent the opportunity which require to be exploited for the maximal of exploiting of potency energy of non fossil which character newly. Potency energy of non plenty of fossil and useful not yet maximal (tables 2)[4]. Biggest Potecy is at water power namely 846,00 MILLION BOE or 75,67 GW and is newly exploited by equal to 4.2 GW or 5,55%. Same thing for the heat of earth, hot potency of earth in Indonesia represent biggest in world assure 40% from hot reserve of world earth, but in Indonesia its exploiting still be very low namely 3.1%.

Exploiting of potency energy of is non fossil which still be very low caused by because some consideration for example high invesment expense, new price energy not yet earned to vie with the price of energy fossil, ability of human resource relative lower the, for the energy of new is which not yet commercial and service ability and industrial of energy less support [5].

The weakness can be overcome by if government own the policy to give the amenity and incentive of so that/ to be new exploiting energy can be maximized. But that way this matter is not happened by because from governmental policy hit the composition of use energy (mix energy) until year 2025 namely petroleum 26,2%, coal 32,7% earth gas 30,6%, earth heat 3,8% and the rest is energy alternative / new energy newly 4,4% consisted of the: PLTS 0,02%, PLT Wind 0,028%, Biomasa 0,766%, Biofuel 1,335%, nuclear 1,993% ( picture 1).

Tabel 2. Potensi Energi Terbarukan Nasional

ENERGI TERBARUKAN	SUMBER DAYA	PEMANFAATAN	KAPASITAS TERPASANG
Tenaga Air	75,67 GW	6.851,00 GWh	4.200,00 MW
Panas Bumi	27,00 GW	2.593,50 GWh	800,00 MW
Mini Micro hydro	468,75 GW		84,00 MW
Bio massa	49,81 GW		302,40 MW
Tenaga Surya	4,80 kWh/m2/hari		8,00 MW
Tenaga Angin	9,29 GW		0,50 MW
Tenaga Nuklir	24.112 TON = 3 GW		

Pursuant to RKAP PLN year 2007, *energi mix* produce the energy electrical obtained from Coal 44%, energi irrigate 8,6%, oil fuel 23,7, earth heat 3,1% and natural gas 20,05 %

Thereby from governmental side of galore new potency energy still not yet become the goals which can be pledged to overcome the crisis of energy and ecology crisis in Indonesia.

### Prediction of Requirement of National Electrical

Electrification Ratio in Indonesia still be pertained to by lower namely equal to 56%, because weakness from state to develop the system electrical in national capable to fulfill the requirement of entire/all people. fast Development growth is industrial area and construction trigger the request input of electrical power and hitherto PLN not yet able to fulfill all. This matter is seen from electrical crisis that happened in various area which must do/conduct the extinction have innings. Growth of big enough electrical energy request namely about 7% every year ( tabel-3).[4].

Table 3. Requirement of Energy Electrical in Indonesia

Description	2004	2005	2006	2007	2008	2009	2010	2011	2012
Energy Sales (GWh)	99,012	104,985	111,858	119,222	127,194	135,691	144,763	154,448	164,794
Growth Rate (%)	-	6.03	6.55	6.58	6.69	6.68	6.69	6.69	6.70
Production (GWh)	115,116	122,692	130,714	139,332	148,649	158,579	169,182	180,500	192,590
Peak Demand (MW)	21,902	23,343	24,869	26,509	28,282	30,171	32,188	34,342	36,642
Installed Capacity	27,503	28,356	29,356	30,529	31,578	31,601	31,608	31,566	31,380

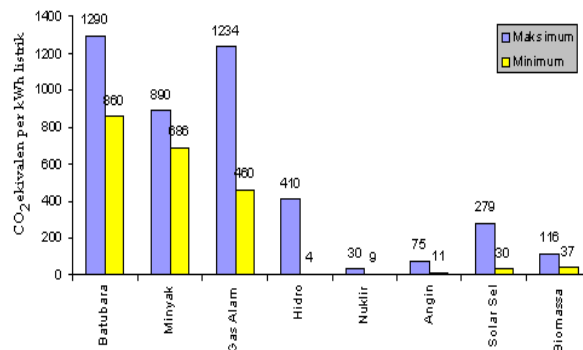
Fact that request of energy electrical non-stoped expand, hence require to be strived for the development of in electricity sector of through/passing new rebuild generating, at one blow maximize there is and also do/conduct the efficiency in operation. Thereby leave open the opportunity to exploit the new energy as generating.

**Power station and Environmental problem**

From inferential above description that potency of energy fossil limited and have potency to menace or trigger the ecology crisis, while development energy is newly opened by opportunity of because its potency is friendly adequate and also to environment Challenge faced by is how to find the power station which have high capacities, owning economic value at one blow remain to guarantee the environmental continuity. Generating technology weared for all generating of not many differing, giving difference is energy weared for the evocation of. In general power plant work principally is electromagnetic namely intersection of magnetic field of effect of magnetic pole movement (rotor) in magnetic pole remain to (stator) will yield the tension current. Process this happened in electrical generator namely electrical engine converting energy mechanic or move to become the energy electrical. To awaken the energy electrical, generator moved by various energy of generally three faction namely first energy of energy fossil: oil, coal, and natural gas, second of new energy, like: hydro, sun / diesel fuel, wind , and earth heat, last of nuclear energy.

Fact that in the year 2004 consumption of energy primary predominated by energy fossil of equal to 93% consisted of the: petroleum 53%, gas 19% and coal 21%, energy irrigate equal to 4%, and geothermal [of] equal to 3%. Produce the Indonesia electrical in the year 2003 stemming from energy fossil of equal to 80% consisted of by the coal: 52%, BBM 5%, gas 23%, 9% and earth heat 9% with the electrical capacities attached by about 25.681 MWe consisted of by 22.231 MWe or 86,6 % produced by PLN and 3.450 MWe or 13,4 % produced by company of private sector electrical. While source energy for the power station of. [6].

From data obtained by that pollution yielded by generating at most coming from at generating which used of fossil fuel namely petrify the coals, petroleum or diesel fuel and natural gas (picture 3) [6].



Picture the 1. Contribution of Improvement of CO<sub>2</sub> power station.

Pursuant to data PLN in the year 2012 estimated by production of energy electrical in Indonesia reach 192,590 GWh, meaning 172,360 GWh electrical produced to use the energi fossil. Sum up this result happened by the release 168 million ton CO<sub>2</sub>, 159,6 thousand ton SO<sub>2</sub> and also 120,7 thousand ton N<sub>ox</sub>.

This condition indicate that the depending of power station in Indonesia to big enough energi fossil and this matter have triggered the economic crisis in Indonesia at one blow cause the ecology crisis. Ecology crisis enabled by because each; every use fuel oil will yield the gas emission throw away which significant enough.

Thereby one of solution to lessen the global environment crisis cause is correction in electricity sector of through/passing effort of exploiting of environmental friendly source energy electrical as well as economically give the advantage so that is easy to reached by lower most economic circle.

Alterantif which can on the market which can be executed in Indonesia in context in this time is hot use energi development of earth and nuclear energy use. other New Energy to short-range not yet earned exploited maximally pursuant to efficiency consideration or economic. Both types of this energi own the excellence compared to by energy fossil from economic and environmental aspect.

**Earth heat of as alternative**

Hot Energy of earth represent the hot energy is secretory the than earth stomach which can be exploited to turn around the turbine of generating generator. Hot use energy of earth in Indonesia have taken a long time, but its growth is tardy relative.

Hot potency energy of earth in Indonesia big relative because representing biggest potency in world, namely 40% hot reserve of earth in all the world there are in Indonesia. This spreading energy is relatiive flatten the totality Indonesia, because Indonesia state geographically reside in the region of trajectory of mount have fire. (*ring of fire*) Totalize the hot potency energy of earth in Indonesia reach 27.487 MW which is there are almost entire/all area in Indonesia namely island Sumatra, Java, Sulawesi island, Nusa South-East, Island of Kalimantan and Papua ( tabel-4). Piquancy from hot potency energy of earth from geographical spreading facet is 18.183 MW or 66,15% there are outside Java. But that way its exploiting exactly concentration in Java, though outside depending Java to fossil fuel very high.

Table 4. Hot Potency Energi [of] Earth in Indonesia

No	Derah Potensi	Kapasitas (MW)
1.	Sumatera	13.773
2.	Jawa	9.304
3.	Sulawesi	2.105
4.	Nusa Tenggara	1.681
5.	Maluku	524
6.	Papua	50
7.	Kalimantan	50
	Jumlah Kesuluruhannya	27.487

From environmental aspect of PLTPB give the very positive impact for environmental balance, because yielding gas emission throw away the very low CO<sub>2</sub> (tables of 5) [4], namely 10,48 times is lower the than stone smolder, 9,85 times is lower the than petroleum and 6,61 times is lower the than natural gas. Matter striking is at emission SO<sub>2</sub> that is 315,4 slimmer times compared to with the stone smolder and 34,29 times is slimmer the than petroleum. Thereby gracious use PLTPB to environment.

From economic aspect of development PLTPB own the excellence (tables 6) [7]. Cause, do not need the fuel so that can yield the energy electrical at the price of which cheap relative and its continuity well guaranted because do not it depends on the weather, so that own the high capacities factor namely 95% operational time.

Table 5. Gas emission from various power station. Emisi

No.	Pembangkit	Aspek Lingkungan/Emisi gas (lbs/mWh)		
		CO <sub>2</sub>	SO <sub>2</sub>	NOx
1.	Panas Bumi	0,20	0,35	0
2.	Gas Alam	1,321	0,22	2,96
3.	Minyak Bumi	1,969	12	4
4.	Batu Bara	2,095	110,39	4,31

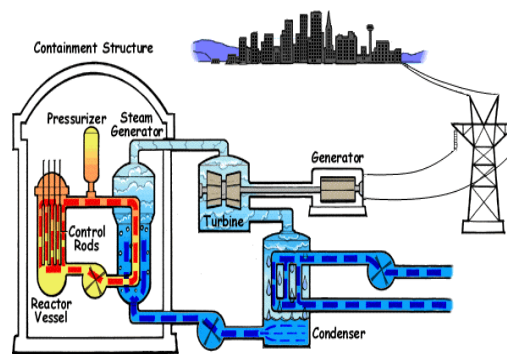
Investment expense of early high enough but low conservancy so that in the long term very beneficial. Even though weakness from PLTPB is its location is which is far from burden center make the expense of transmission and high electrical power distribution enough, but in the long term remain to promise economically.

Table 6 . Economic factor of PLTPB.

No	Pembangkit	Perkiraan Biaya		
		Modal (US \$/kWh)	Pemeliharaan (US cents/kWh)	Produksi Rata-Rata (US cents/kWh)
1.	Panas Bumi	1150-3000	0,4-1,4	1,5-7,0
2.	Air	735 - 4778	0,7	0,5-2,4
3.	Batu Bara	1070-1410	0,46	2,0-5,0
4.	Nuklir	1500-4000	1,9	1,5-3,0

### Nuclear Energy Alternately

Principle work the PLTN is aqueous vapour to turn around the turbine yielded by heat from process of nuclear fission react the uranium in reactor (draw 2) [8]



Picture 2. Principal Scheme work PLTN.

React the nuclear fission of uranium happened in reactor. In the reaction reactor happened by related to at the time of nucleus; core from uranium in this case apart U-235 or U-233 react with the neutron to yield various other element during very quickly, process this will generate the new and neutron-neutron heat. Heat coming from reactor nucleus; core poured into by system of primary cooler, to is later; then overcome at hot appliance change and hot here in after thrown to environment of through/passing system of cooler secondary [ 9].

Operation PLTN very clean because do not yield the gas emission throw away so that do not contaminate the environment and from economic facet of big enough invesment, but in the long term enough own prospect. Factors which require to be paid attention to in handling PLTN [is] security. In the event of reactor leakage cause fatal because, radio-activity will be brought by air and can reach the areal which wide enough and it will menace life in the areal. Various disaster of failure of nuclear reactor of like one of them is in Chernobyl - Russia still leave the 'still remember' among world society of is inclusive of in Indonesia.

Others, issue of like generated radiasi, radioactive waste processing, social impact and proliferasi, [is] issue which require to get the attention in order to development PLTN in Indonesia. For that strive to prepare the society psychologically, look after the participance of society give the support and make-up of quality and also discipline of past master wrestling PLTN represent a belief for attendance PLTN in Indonesia.

#### **IV. CONCLUSION**

Pursuant to data and analyse above can be embraced by several things for example:

- 1) Global crisis Energi of effect of depending to energy fossil affect at crisis energy in Indonesia triggered the social and economic crisis in Indonesia
- 2) Energy sector of electrical represent the biggest contributor namely 40 % for memory of konsentrasi of glasshouse gas in atmosphere causing global warm-up.
- 3) Pollution yielded by generating at most coming from at generating using fossil fuel namely using stone smolder the, petroleum and natural gas.
- 4) Alternative which can on the market be achieved in Indonesia in context in this time to overcome the crisis of energy and environment problem is hot use energi development of earth and nuclear energy use. the circumstance energi proven by the economic and environmental friendliness.
- 5) Exploiting of nuclear energy in electricity sector require to consider the psychological aspect of society which still 'still remember' to nuclear accident radisi the settlement of disposal and also polifersi.

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