

## The Analysis of Energy Options for Kalimantan

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### Abstract

Kalimantan - a resources rich state of Indonesia - will have a special role to play in the country's quest to achieve energy security. Kalimantan contributed 10.5% to the national GDP in 2008. Most of this contribution (7.5%) came from East Kalimantan, followed by West Kalimantan (1.2%), South Kalimantan (1.1%), and Central Kalimantan (0.8%). That year, Kalimantan contributed nearly 33.3% to the national primary energy supplies, with East Kalimantan and South Kalimantan as the major contributors (BAPPENAS 2009). Notwithstanding the resource richness of Kalimantan, the state is faced with a high degree of energy shortages. Power-offs by PLN is becoming recurrent across Kalimantan, even in East Kalimantan where all kinds of energy resources are available in abundance. It is obvious that the current energy policies adopted by the central government for the Kalimantan region are not effective. Two scenarios are developed in this research to better understand the wider consequences of strategies to meet rising demand. The first scenario is called (in this research) Business-As-Usual (BAU) which broadly corresponds with the national energy blueprint for 2025. The other scenario is Renewable (REN) with the share of renewable energy in the primary energy mix is 20% which is higher than the BAU scenario.

Analysis of these two scenarios shows that if the current policy trends (as represented by the BAU scenario) continue, by 2025, Kalimantan will need approximately 2.5 mn KL of additional oil as compared with the REN scenario. This would also require higher subsidies by the government. Further, the REN scenario will need less coal as compared with the BAU scenario, hence, it will result in lower GHG emissions.

This research argues that an increased reliance on indigenous resources could be an effective means to meet future energy demand. Gas is the most abundant energy resource, followed by coal, hydro and other renewable such as biomass, solar and wind. To utilize gas, supporting infrastructures will be required. This will obviously mean high initial costs. Therefore, increased use of coal could be beneficial because of its abundance and significant coal infrastructures are in place.

The BAU scenario also suggests that the choice of coal as the main energy to fuel power plants will result in higher GHG emissions, thus contributing to global warming. A possible solution to this problem will be offered.

This research offers some recommendations to overcome the current difficulties such as to increase the use rate of renewable energy. The solution to the consequences of this choice will be offered as well. Other recommendations are to develop energy infrastructure, pipelines for gas distribution or gas stations for gas-fuelled vehicles. Other strategies include promoting the environmental conservation, public-private partnership for infrastructure development, promotion of research and development on energy issues, design of appropriate financial and legal frameworks and emphasis on capacity building and technology transfer.

**Key words:** *Kalimantan, energy resources, renewable energy, energy scenarios, energy policies*

## 1. Introduction

In order to support the economic development of a region in an efficient way, all resources of energy it has are needed to be optimized. Since the optimum exploitation of energy resources can damage environment, one need to decide the best energy policy that can be adopted to support the increasing demand of energy as a result of higher quality of life for people and development of its industries.

As Indonesia's undeniable need of energy to provide a higher quality of life, it is unreasonable to claim that it could move immediately to a fully sustainable energy system (Brooks and Indonesia 1992). However, it is possible to attain such system in the future with important steps to be taken. One of these steps is to realize that someday the reserves of nonrenewable energy will be gone and therefore it is important to decide what policy to be adopted by Government of Indonesia (GOI), especially the Ministry of Energy and Mineral Resources (MEMR) to overcome this problem.

Kalimantan which consists of four provinces i. e. West Kalimantan, Central Kalimantan, South Kalimantan and East Kalimantan, ideally should work together in order to produce Kalimantan energy policy since it is difficult for a province to provide sufficient amount of energy for its people and its industries by relying only on its own energy resources. Today, nearly all regions in Kalimantan are suffering from lack of energy (Kurtubi 2012) due to lack of investment in electricity infrastructure as well as low exploration in new resources of energy (IEA 2008). It seems unlikely to see these problems are occurring in the energy-rich island of Kalimantan since it is long time known to export energy abroad. There should be some mistakes had happened in the energy management run by central government. This is one of several reasons why a comprehensive energy policy is needed.

Before making an energy policy, it is important to identify energy resources available not only benefit the region in particular but also the whole country in general. Kalimantan, as the main topic in this research, has an area of about 28% from total land area of Indonesia with many energy resources available waiting to be utilized. Beside East Kalimantan, Central Kalimantan for example, has a lot of energy resources from nonrenewable such as oil, coal, and natural gas, and renewable ones such as hydro, wind, solar, biogas, and biomass which are left untouched (RUEDCK 2011). West Kalimantan as the neighboring province actually has radioactive minerals (RUEDWK 2011) which then open the possibility to develop nuclear power plant in the future utilizing BATAN to deal with its research and development. Nuclear energy itself actually will not be particularly discussed in this research paper due to many debates on the danger the waste it creates despites the appropriateness of such high technology to Indonesia has been issued by IAEA in November 2009 (Sidik 2010).

This paper will first describe the current energy consumptions and future energy demand and analyze the options of energy of Kalimantan for meeting that energy demand to support not only the economic growth and population development of the Kalimantan region but also the economic growth and society development of the country.

Furthermore, it will develop some scenarios to set a light on how policy options can be formulated with the consequences they may bring. Finally, the paper will formulate some energy policy options that may be suggested to energy policy makers in order to develop a reasonable energy policy.

## 2. Current Energy Consumptions and Possible Future Demand

In order to have a better understanding on the trend of current energy consumption in the Kalimantan region, it is needed to get all required data of energy consumptions within the four provinces in Kalimantan during 2005-2010. The data is gathered mostly from Ministry of Energy and Mineral

Resources (MEMR) and Implementing Body for Oil and Gas Upstream Operations (BP Migas). The results are as follows.

Table 1 Energy consumption growth rate in four provinces in Kalimantan during 2005-2010

Province	Growth Rate % per annum				
	Electricity	Premium	Kerosene	Diesel	LPG
W. Kalimantan	9.25	8.55	-37	6	1.69
S. Kalimantan	6.02	8.55	-37	6	2.2
C. Kalimantan	10.02	8.55	-37	6	1.95
E. Kalimantan	8.02	8.55	-37	6	3.29

Source: Ministry of Energy and Mineral Resources and BP MIGAS, 2010

From the table above it can be seen that in terms of fuel consumption, in all provinces, these three types of fuels premium, diesel and kerosene has similar rate of growth during 2005 to 2010 which are 8.55%, -37% and 6% respectively. The significant drop in kerosene growth rate most likely due to conversion program from kerosene to gas applied by the central government. The LPG growth rate in all province are different with the highest in East Kalimantan (3.29% pa) and the lowest in West Kalimantan (1.69% pa).

In terms of total fuel consumptions, the share of Kalimantan region in 2010 as a proportion of national fuel consumption for premium, kerosene, diesel and LPG were 6.05%, 6.82%, 13.69%, 1.88% respectively (Migas 2010). Diesel was the most type of fuel to be consumed most likely due to many oil palm plantations have been built in the region.

In terms of electricity consumption, during 2005-2010 Central Kalimantan has the highest growth rate with 10.05%, followed by West Kalimantan, East Kalimantan, and South Kalimantan with 9.25%, 8.20% and 6.02% respectively (MEMR 2010). In terms of total rated capacity, Kalimantan region was still considered very low which only 4.9% from total national rated capacity (BAPPENAS 2009). This surely hinders the economic development in the region.

For four provinces in Kalimantan, during 2005-2010 households consumed most of the electricity energy compared to industry and commercial with more than 60% while industry consumed the least electricity with 9.75% (MEMR 2010). Compared to national consumption, the pattern was quite different. Even though households consumed most of the electricity (39%), industry consumed slightly less about 37% during the period (MEMR 2010). It can be concluded the industry in Kalimantan region needs to be developed more to level the industry development in other areas in Indonesia especially Java-Bali and Sumatra region.

To compare the consumption of energy in 2010 between provinces, a table created as follows.

Table 2 Total energy consumption between provinces in Kalimantan in 2010

No.	Province	Type of energy				
		Electricity (GWh)	Premium (KL)	Kerosene (KL)	Diesel (KL)	LPG (kg)
1	West Kalimantan	1,178.78	327,147.76	43,903.00	311,901.62	37,657,176
2	South Kalimantan	1,211.00	358,658.79	42,191.73	432,428.41	11,325,682
3	Centr. Kalimantan	515.04	179,537.66	27,981.40	170,032.03	4,183,189
4	East Kalimantan	1,750.58	521,653.99	46,124.53	857,435.98	70,342,807

	<b>TOTAL</b>	<b>4,655.40</b>	<b>1,386,998.20</b>	<b>160,200.66</b>	<b>1,771,798.04</b>	<b>70,342,807</b>
	<b>NATIONAL</b>	<b>147,297.00</b>	<b>22,934,500.00</b>	<b>2,349,510.00</b>	<b>12,944,076.00</b>	<b>3,751,000,000</b>

Source: Ministry of Energy and Mineral Resources, 2010

From the table above, it can be concluded that even though Central Kalimantan has the highest growth rate in electricity consumption, it actually has the smallest amount in terms of quantity. As economic factors play an important role in energy sector development, it is important for Central Kalimantan to increase the economic activities in the area. East Kalimantan represents the highest consumption of all type of energies which means the economic activities in this area is better compare to other areas in Kalimantan.

### Future Demand

After examining the current energy consumption, it is decided to use *Business-As-Usual* (BAU) scenario which will use historical data to forecast the future demand of energy for Kalimantan. The features of the scenario used to forecast can be seen in the table below.

Table 3 Features used to forecast future energy demand for Kalimantan

No	Province	Electricity (% pa)	Premium (% pa)	Kerosene (% pa)	Diesel (% pa)	LPG (% pa)
1.	West Kalimantan	9.25	8.55	-37	6	1.69
2.	South Kalimantan	6.02	8.55	-37	6	2.2
3.	Central Kalimantan	10.02	8.55	-37	6	1.95
4.	East Kalimantan	8.02	8.55	-37	6	3.29

The results are presented in the table below.

Table 4 Future demand of energy in Kalimantan in 2025

No	Province	Electricity (GWh)	Premium (KL)	Kerosene (KL)	Diesel (KL)	LPG (kg)
1.	West Kalimantan	4,443.80	1,112,730.81	42.91	747,490.38	48,419,629.18
2.	South Kalimantan	2,910.46	1,227,803.58	41.24	1,036,339.85	15,779,197.65
3.	Central Kalimantan	2,151.45	614,614.75	27.35	408,646.46	5,591,177.73
4.	East Kalimantan	5,568.58	1,785,788.21	45.09	2,060,718.65	114,247,135.75
	<b>Total</b>	<b>15,074.29</b>	<b>4,740,937.35</b>	<b>156.59</b>	<b>4,253,195.34</b>	<b>184,037,140.31</b>

Source: This research

From the table above it can be concluded that in 2025 the demand of energy, except for kerosene, would increase more than triple of the 2010 consumptions. Hence, comprehensive energy planning and policy should be designed carefully in order to meet those demands.

### 3. Option for Meeting Future Energy Demand

In order to meet the future energy demand in the Kalimantan region it is decided to examine the current energy system within the region and the energy options available in this region. The data gathered from various resources such as national and regional office of energy and mineral resources in each province, PLN (PLN 2010) and National Energy Blueprint 2025 (MEMR 2006).

#### Current energy development in Kalimantan

In terms of energy development, Kalimantan is still left behind compared to Java-Bali region and Sumatra region especially in electricity sector. It can be seen from the PLN planning 2010-2019 that they plan to build some 100 - 300 MW power plants for Sumatra system and 400 - 1,000 MW power plants for Java-Bali system and only 25-100 MW for Kalimantan system (PLN 2010).

In terms of energy supply for Kalimantan region, East Kalimantan currently supplies all kinds of fuels to South and Central Kalimantan. Especially for West Kalimantan, all kind of fuels is coming from South Sumatra most likely due to cheaper costs compared to fuels coming from East Kalimantan. For electricity there are three isolated system which are Khatulistiwa System to supply West Kalimantan, Barito System for South and Central Kalimantan and Mahakam System for East Kalimantan and several isolated systems across these four provinces (PLN 2012). In the future, PLN plans to connect all these three systems to increase the electricity reliability of Kalimantan region (PLN 2010).

Furthermore, East Kalimantan has actually not only supplied its neighboring provinces but also Java-Bali (especially coal) and all eastern part of Indonesia as we can see in Fig. 1.

Even though Central Kalimantan has the highest growth rate in electricity consumption, it actually has the smallest amount in terms of quantity amongst other provinces in Kalimantan. As economic factors play an important role in energy sector development, it is important for Central Kalimantan to increase the economic activities in the area. East Kalimantan, as mentioned earlier, represents the highest consumption of all type of energy which means the economic activities in this area is better compare to other areas in Kalimantan. It is not surprising since East Kalimantan endowed with a lot of natural resources such as oil, gas and coal and attracts a lot of foreign investment thus resulting in people coming from all over Indonesia to look for a better job or business.

To give better options for a decision maker to plan an energy policy, it is decided to have a good knowledge on the potential of energy resources in the Kalimantan region. The results are presented in the table 5 below.

Table 5 Potential energy resources in Kalimantan

No.	Region	Coal (MBOE)	Oil (MBOE)	Gas (MBOE)	Hydro (MBOE)	Solar (kWh/m <sup>2</sup> /day)	Biomass (MBOE)
1.	West Kalimantan	782.02	125.41	-	2,241.2	8-9	11.22
2.	South Kalimantan	7,563.03	620.60	-	58.59	4.5	0.74
3.	Central Kalimantan	6,773.12	-	176.47	284.88	4.5	21.14
4.	East Kalimantan	105,042.02	985.00	918.5x10 <sup>6</sup>	1,002.9	4.5	-
	<b>TOTAL</b>	<b>120,160.19</b>	<b>1,731.01</b>	<b>918.5x10<sup>6</sup></b>	<b>3,587.6</b>		<b>33.10</b>

Source: All Regional Offices of Energy and Mineral Resources in Kalimantan

From Table 5 it can be seen that coal is available in every area of Kalimantan with the largest deposit is in East Kalimantan and the smallest one is in West Kalimantan. In terms of the amount of energy resources, even though gas is the largest energy resources available with, once again, East Kalimantan as the major supplier, South and West Kalimantan do not have it. Nevertheless, the utilization of CBM gas resources in Central Kalimantan will certainly gives benefit not only to the people of Central Kalimantan province itself, but also will benefit peoples in its neighboring

provinces such as East Kalimantan and South Kalimantan since the distribution chains of the gas will be shorter hence the price of the gas in the end user could be lowered.

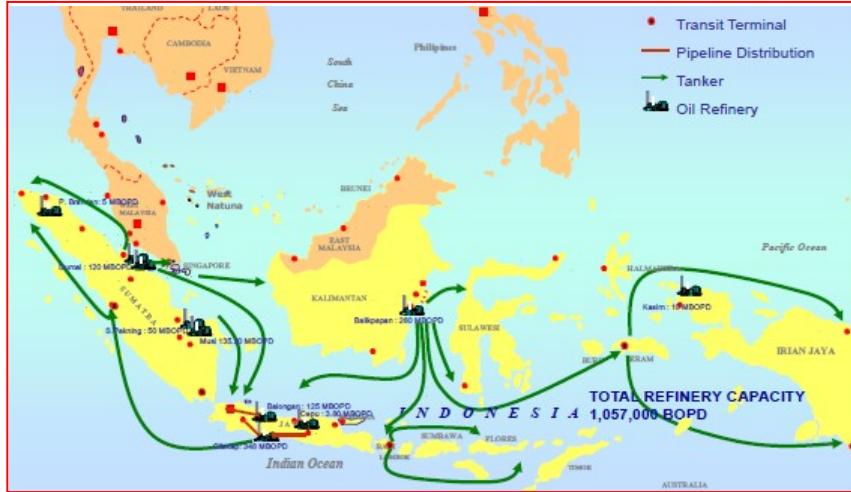


Fig. 1 Kiln and Fuel Transportation Mode, 2007  
 Source: National Energy Blueprint 2025

Considering the current energy systems and potential energy resources in the Kalimantan region, these are the possible options to meet future energy demand.

## Options for meeting energy demand

- **The electricity demand:** coal is the most advantageous option among other energy resources in Kalimantan since all provinces has it. In terms of cost is also the least cost, however, the backdrop of coal is the emission of CO<sub>2</sub> is also the biggest compared to any other energy resources (Tarjanne and Kivistö 2008). Another challenge is the dispute between central government and local government on the railway built for coal transportation.
- **Gas demand for household:** gas for Kalimantan can be supplied not only from East Kalimantan but also from CBM reserves in Central Kalimantan (RUEDCK 2011) in order to supply for South Kalimantan as well. The local government involvement is needed to ensure the utilization of these energy resources.
- **Fuel demand for transportation:** gas is one option to reduce the dependence on fossil fuels and all provinces in Kalimantan has potential reserves of it. Another option is to develop biofuel as many non-productive lands available across Kalimantan region to make it relatively easy to find the area to develop it.

#### 4. Challenges for Meeting Future Energy Demand and Strategies to overcome them

This section discusses the possibility of challenges not only in terms of technical and geographical constraints such as cost, carbon emission and sparse population, but also from institution barriers which actually will hamper the development of renewable energy technology start from industry structure until financing matter and how to handle them. The strategies on how to handle such challenges are also presented.

- **Industry structure:** the monopoly of PLN as the single authorized buyer of electricity in Indonesia is seen a major problem to renewable energy development in Indonesia (IEA, 2008).

**Strategies to overcome:** market reform should be introduced in order to allow the country to better harness the power of market forces and private capital within the energy sector (IEA, 2008).

- **Price Issues:** exclusion of externalities in energy price, subsidies, incentive are the issues that also hinder the development of renewable energy hence making it difficult for meeting energy demand (Pétursson 2011).

**Strategies to overcome:** inclusion of externalities in energy price, to give subsidies to renewable energy development (Beck and Martinot 2004), to give incentives to private investors, to share the risk.

- **Regulatory Environment:** lack of clarity and transparency due to inconsistency and insufficient details of legislation and poor coordination, Petursson (2011) said, had hindered investment in energy sector especially in renewable energy.

**Strategies to overcome:** serious implementation of the regulation of related renewable energy by government institutions, to form a transparent and independent regulator which is able to operate separately from government.

- **Government and Public Institutions:** severe corruption, low effectiveness of government and security issues such as terrorism and mass violence.

**Strategies to overcome:** law enforcement should be upheld by the authority in order to minimize corruption not only in energy sector but also in every aspect of Indonesia, to give information on renewable energy project to local people by socializing it and to involve local people as many as possible into the project to avoid misunderstanding between local people and private investors.

- **Technological capacity:** availability of qualified personnel and organizations, lack of technological resources, very limited state-owned company in research and development in energy sector.

**Strategies to overcome:** to form a National System of Innovation (Pétursson 2011) which is capable of fostering low carbon innovation and attracting foreign direct investment (FDI) and technology transfer (TT).

- **Financing:** limitation of government budget and limited knowledge of capital market on renewable technology make it difficult for the private company to develop renewable energy technology (USAID 2008).

**Strategies to overcome:** from domestic utilities, from direct private sector who seek an economic return, or from budget financing supplied either directly or through subsidies provided by government.

## 5. Scenarios for Meeting Future Energy Demand and Its Implications

After the discussion on the possibilities of energy options for meeting future energy demand in Kalimantan, its challenges and the strategies to overcome them, it is decided to create scenarios for meeting those energy demands. The importance of these scenarios is to give some information on what implications actually we will face should we choose certain policy in order to meet our energy demand. Due to data and time constraint, it is decided to examine the general information of implications of the scenarios mainly on the supply of primary energy between two scenarios and

environmental effect it creates i.e. GHG emission in the Kalimantan region based on the data gathered from previous discussion.

It is decided to develop two scenarios for meeting the future energy demand. First scenario is called **Business-As-Usual (BAU) scenario** with the assumptions based on the continuation of current trend in the Kalimantan's energy sector with energy mix in accordance with national energy policy 2006-2025. Second scenario will be based on renewable energy and is called **Renewable (REN) scenario** with the same amount of future energy demand as in the first scenario but different pattern use of primary energy sources in the future with the share of oil and coal will be reduced and the share of renewable energy such as biodiesel will be increased hence energy mix will be different from first scenario.

These are the results of the scenarios:

- BAU scenario:

After the calculation, in this scenario the need of coal to fuel power plants in the Kalimantan region in 2025 is about 593,861 tons/year, oil needed for power plant and transportation will be 10,422,341.35 KL, natural gas will be 4,710,013.97 KL, biodiesel will be 1,005,688.48 KL, and LPG will be 239,248,282 kg.

- REN scenario

After the calculation, in this scenario the need of coal to fuel power plants in the Kalimantan region in 2025 is about 358,768 tons/year, oil needed for power plant and transportation will be 7,886,925.16 KL, natural gas will be 4,710,013.97 KL and biodiesel will be 4,025,654.59 KL, and LPG needs will be 239,248,282 kg.

- Here is the comparison of both scenarios:

Scenario	Primary Energy requirement in 2025				
	Oil (KL)	Coal (Ton)	Natural gas (KL)	Biodiesel (KL)	LPG (kg)
BAU	10,422,341.35	593,861	4,710,013.97	1,005,688.48	239,248,282
REN	7,886,925.16	358,768	4,710,013.97	4,025,654.59	239,248,282

- Implications of scenarios

BAU scenario:

- Compare to 2010, it can be concluded that as all the power plants in Kalimantan region are mostly oil-fired ones, the need of oil is unavoidably increasing hence burdening the government with heavier subsidies.
- The national energy policy 2006-2025 set by government actually reflects the commitment to the energy diversification and the utilization of renewable energy but since the main fuel to replace oil is coal which actually dirtier than oil despite its cheaper price and abundant reserves in the region, it will only lead to more GHG emission hence affecting the human health in long term.
- One way to overcome this emission problem is to use more advance technology in coal-fired power plants called IGCC (Integrated Gasification Combined Cycle), a relatively new option for power generation, have efficiencies of 38 to 42%. Another way is by using carbon capture and storage (CCS) which captures CO<sub>2</sub> in power plants and injecting them into deep

geologic formations for permanent storage (ASME 2009). For transportation, biodiesel can be used to also reduce the reliance on fossil fuel. Another option is to use solar-powered vehicles which will suit the climate in Kalimantan perfectly. Solar-powered equipments for households and small industries will be helping people in the rural area of Kalimantan.

REN scenario:

- The impact on environment of this REN scenario is obvious: less CO<sub>2</sub> emission compare to BAU scenario.
- In this REN scenario one thing need to be put into consideration is the increase in biofuel share in energy mix will have some consequences such as how many land needed to grow the related plants since it will raise food security issue as well.
- However, if we put into account the health risk brought by coal burning, all parents who care on their children's future will have to push the government to put aside the option on using coal to fuel al new power plants.
- It can be concluded also that the more renewable energy share in the energy mix, the better the country's preparedness on the uncertainty of other non-renewable energy sources such as oil, coal and natural gas which their reserves can be false (lesser than the prediction).

## 6. Policy Options for Meeting Future Energy Demand

The policy options for meeting future energy demand in Kalimantan will be based on real situation in the region such as the availability of indigenous energy resources i.e. renewable and non-renewable, the existing infrastructures of energy and its system, supporting regulatory framework, financial conditions, technology capacity and pricing policy. The scenario developed in the chapter 6 is also to give better consideration for decision makers on deciding policy options. Here are some energy policy options can be adopted for Kalimantan region:

- To increase the utilization of renewable energy resources as well as to reduce GHG emission
- To ensure the utility of indigenous energy resources, renewable and non-renewable, for meeting future energy demand of Kalimantan.
- To ensure the development of energy infrastructure in Kalimantan region in order to boost the energy consumption of Kalimantan region.
- To ensure energy diversification and efficient energy utilization
- To ensure the environmental conservation by adopting sustainable development
- To form partnership of government and private investors
- To encourage research and development in energy sector by government institutions
- To improve the financial and legal framework for private investors in renewable energy
- To increase capacity building and technology transfer

## 7. Conclusions

It is concluded that based on the findings in this research, Kalimantan is suppose to be able to meet its current and future energy demand if the indigenous potential energy resources can be utilized in a proper way. The current lack of energy in Kalimantan region indicates that there is something wrong in the energy policy in Indonesia in general. That is why it is deemed important to examine thoroughly the real energy consumption and the current energy systems within the region, continued by acknowledging the potential energy resources, renewable and nonrenewable, and also to identify the challenges for meeting energy demand, technically as well as institutionally, altogether with the strategy on how to handle such challenges in order to have a comprehensive energy planning and

policy to ensure that we can manage our resources in a proper and sustainable way. It is identified also that the current policy from central government, reflected in the National Energy Blueprint 2025, to rely heavily on coal is just to repeat the mistakes done in the past on oil. Furthermore, not only is able to supply energy for the region, Kalimantan particularly East Kalimantan also is able to supply other parts of the country such as Java, Sulawesi, and eastern Indonesia. Even though endowed with abundant energy resources, it is realized that to rely fully on the non-renewable energy is considered unwise. Therefore it is deemed important to encourage as well the development of indigenous renewable energy to make sure that in the future when all nonrenewable energies have gone, we have already prepared our self with all needed means.

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