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THE RISK MAPPING OF ENERGY AVAILABILITY OF AGRO-INDUSTRY IN INDONESIA IN 2015-2019

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ABSTRACT

Energy management could be done by analyzing the market risk fortofolio regarded availability and use of energy. The purpose of this study was to analyze risks potential and the availability of energy needed in the agro- industry sector through risk mapping. The framework approach used the principles of risk assessment based on market portfolio risk for agro-industrial sector using VaR (Value at Risk) technique. The subjects of the study were the agro-industries consisting of forest and plantation products industry, marine and fisheries food industry, as well as beverages and tobacco industry. The main types of non-renewable energy sources included petroleum, gas, and coal. The main types of renewable energy sources consisted of hydropower, biomass, micro hydro, geothermal, solar power, and wind power. Primary data consisted of production and energy consumption data of 11 types of existing products in the agro-industry sector. Primary data were obtained by conducting in-depth interviews to industries. Field observations of the condition of the use of energy to produce a ton of products on various agro industries conducted in East Java and West Java as a case study. Secondary data consisted of energy availability data, obtained from the Ministry of Energy and Resources of the Republic of Indonesia. The phases included the risk assessment and risk mapping of energy availability of agro-industry in Indonesia. Risk assessment process used the method of Value at Risk (VaR). The results of the risk assessment were described by using risk maps within the agro-industrial sector. The survey conducted in the province of West Java and East Java gave the information about the need of energy per ton for various types of agro-industries. In addition to the data obtained from the total production, it showed that the agro-industrial sectors which had the highest productions were plantation and forest product industries, i.e. pulp, paper and paper board industry. The second highest productions were crude palm oil and palm cooking oil. The results of the risk mapping indicated that the 6 industries were in quadrant I (tend to be high risk, tend to be high returns), in quadrant III (tend to be low risk, tend to be low returns), and in quadrant IV (tend to be low risk, tend to be high returns). The industries in quadrant I were sugar and paper industries. The industries in quadrant III were processing and preservation of meat, fish canning and other aquatic biota, cooking oil from palm oil, livestock/fish woof, food of chocolate and confectionery, as well as pulp and paper industry. The industries in quadrant IV were instant noodle, soft drink, and the oleo-chemical industry. Based on the results of risk mapping, it needed considerable attention to the energy availability for the sugar and paper industry because they had a fairly high risk (in quadrant I). It was advisable to develop new and renewable energy for the need of energy in these both industries.

Keywords: risk mapping, energy, agro industry, value at risk.

1. INTRODUCTION

Indonesia's current energy situation still has a lot of problems. A deep dependence on petroleum and the low utilization of renewable energy compared with its potential remains a challenge in the energy sector. Besides, the energy infrastructure limitation and the use of insufficient energy restrict people to consume energy. High energy growth was not supported by good policy of energy supply. The data showed that the oil was still the largest segment of 49.5 percent of the total energy of 1.176 billion barrels of oil equivalent (BOE) / Barrel Oil Equivalent (BOE) in 2011. The next largest segment was coal and gas by 26 percent and 20.4 percent in a row. This indicated a very high dependence on fossil fuels by 95 percent [7].

Based on the users, there are four main sectors of energy users, i.e. the household, commercial, industrial and transportation sector. Currently, the largest energy user is the industrial sector in the amount of 44.2 % consisting of agro- industry, manufacturing industry, and high technology industries [8]. Agro-industries use a huge amount of energy both for unit processes such as processing, manufacturing, packaging and for their supporting utility units. The unit processes generally use a lot of machines and require a huge amount of heat. The types of energy used in general are fossil energy such as petroleum, gas, and coal. Due to varied types of industries, efficiency energy depends heavily on equipment and technology used for the production process.

As mentioned in [8], the total of electricity needed for 5 years (2015-2019) in the business as usual scenario was 295,928 MWH, in the acceleration scenario was 320,664 MWH and in the acceleration with efficiency scenario was 193 079 * with MWH. Total Gas Requirement for 5 years (2015-2019) in the business as usual scenario was 941.45 million Nm3, in the acceleration scenario was 2.009345 billion Nm3 scenario, and in the acceleration with efficiency scenario was 1.808414 billion Nm3. Diesel needed for 5 years (2015-2019) in the business as usual scenario was 367.38 million liters, in acceleration scenario was 415.578 million liters, and in the acceleration with efficiency scenario was 374.904 million liters. The projection on the availability of electrical energy in 2015-2019 was 527 103 MWH of electricity, 59, 378, 163, 000 liters of diesel, and gas was

14, 668, 505 Nm3. Moreover, the results showed that the energy needed of the agro-industrial acceleration scenario approached to the amount of energy availability, so it needed energy management.

Research on energy management has been carried out by [10] , in which energy management could be done by analyzing the market riskfortofolio regarded availability and use of energy using the VaR (Value at Risk). Although VaR was more widely used to analyze risk in the banking and finance industry [1], but as mentioned in [10], power utilities, refineries or any other energy market player can use valuable information derived from the VaR, to plan and implement their future risk management strategy.

Based on the background and the problems that have been described, risk mapping needed to be done in terms of the supply and the use of energy for the agro-industrial sector. The purpose of this study was to analyze risks potential and the availability of energy needed in the agro- industry in 2015-2019 sector through risk mapping.

2. VALUE AT RISK

In general, the risk was the level of uncertainty of the realization of something happened or unachieved goal condition, to a time period. As mentioned in [12], risk was variability (diversity) of return to the expected return. One of the important paradigms on risk management in managing risk was that risk could be associated by using a rational frame of mind. Risk analysis that took a lot of advantages from statistical methods had an important role in determining the size of the risk as an important element in risk management.

Application of Value at Risk (VaR) method is a part of risk management. VaR at this time is widely accepted, applied and considered as a standard method to risk measurement. VaR could be defined as an estimation of the maximum loss that would be obtained over a period of time (time period) specified under normal market conditions at the level of confidence (confidence level) specific [6].

In short, the VaR wanted to answer the question "how much (in percentage or certain amount of money) investors might lose money during the investment period t with the level of confidence" [5]. Investors could use VaR as a benchmark to determine how big the target risk. The most important aspect in the VaR calculation was to determine the type of methodology and assumptions in accordance with the distribution of returns. This was because the calculation of VaR based on the distribution of security returns. The application of appropriate methods and assumptions would result an accurate calculation of VaR to be used as a risk measurement.

VaR could be calculated by the following formula [9]:

$$VaR = \overline{x} + z\left(\frac{s}{\sqrt{n}}\right) \quad (1)$$

Where:

VaR = Impact of losses caused by risky events
$\overline{x}$ = Average value of losses from risky events
z = z value drawn from the normal distribution Table with alpha 5%
s = standard deviation of losses due to risky events
n = number of events at risk

As mentioned in [9], the first thing to do before handling the risk is creating a risk map. Risk map is an overview of the risk position on a map of the two axes, namely the vertical axis and the horizontal axis which were represented of the probability that illustrated the impact, or vice versa. Examples of risk map layout could be seen in Figure-1.

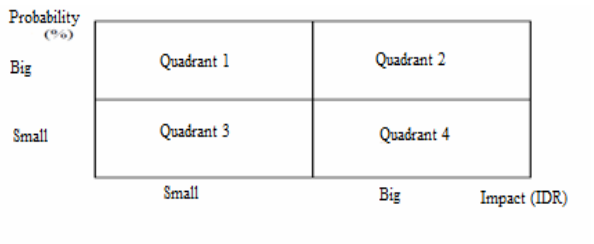

Figure-1. Risk map.

The smallest risk was in quadrant 3. Most high-risk activity with a high likelihood was in quadrant 2, while quadrant 4 had a low risk although it had a major impact. The probability or likelihood of the risk was divided into two parts, large and small. The impact of risk was also divided into two parts, large and small. The boundary between the probability or likelihood of large and small was determined by management, but generally risk probability was 20 percent or more considered as big probability, while less than 20 percent considered as small probability.

3. METHODOLOGY

The subjects of the study were agro-industries consisting of forest and plantation products industry, marine and fisheries food product, as well as beverages and tobacco industry. The main types of non-renewable energy sources included petroleum, gas, and coal. The main types of renewable energy sources consisted of hydropower, biomass, micro hydro, geothermal, solar power, and wind power.

Primary data consisted of production and energy consumption data of 11 types of existing products in the agro-industry sector. Primary data were obtained by conducting in-depth interviews to industries. Field observations of the condition of the use of energy to produce a ton of products on various agro industries conducted in East Java and West Java as a case study. Secondary data consisted of energy availability data, obtained from the Ministry of Energy and Resources of the Republic of Indonesia. Observations on the condition of

energy use to produce products per ton of on varied agro-industries were conducted in East Java and West Java as a case study.

The phases included the risk assessment and risk mapping of energy availability of agro-industry in Indonesia. The framework approach used the principles of risk assessment based on the market portfolio risk for the agro-industrial sector using VaR (Value at Risk) technique. The results of the risk assessment could be described by using risk maps within the agro-industrial sector and the calculation of the market portfolio risk for the agro-industrial sector.

4. RESULTS AND DISCUSSIONS

Based on a survey of 11 agro-industrial products, data of energy used per ton of products in the agro-industry in Indonesia can be seen in Table-1, while the production data in the industrial sector are shown in Table-2.

Table-1. Total energy needs per tons of product in each type of industry.

Types of Industry	Demand of Energy / tons Products			
	Electricity (KWH)	Gas (Nm3)	Solar (Liter)	Alternative Energy
Pulp	4170			
Paper	2030			
Food of chocolate and confectionery	820			
Instan Noodles	2.3125			
Processing and preservation of meat	495.15		58.82	
Cane sugar	82.39			3000 cane tons/day
Canning of fish and other aquatic biota	724			
Palm oil	18			
Livestock/fish woof	**0.414**		**6.93**	
Oleo Chemical	166	173		
Soft drink industries	0.0614	0.02	0.02	

Table-2. Number of production by type of industry (Year 2007-2012).

Types of Industrial	Unit	2007	2008	2009	2010	2011	2012
PLANTATION AND FOREST PRODUCTS INDUSTRY							
Pulp	Ton/year	6282330	5910416	6525099	7047107	7140537	6581098
Paper	Ton/year	8680804	8251972	9308225	10518294	12446090	9841077
Oleo Chemical	Ton/year	728897	905648	827339	975705	1461924	979903
FOOD INDUSTRY, FISHERIES AND MARINE PRODUCTS							
Chocolate and sugarm onfectionery	Ton/year	88224	93109	96192	73106	123710	94868
Processing and preserving of meat	Ton/year	34596	50357	59099	69155	86069	59855
Cane sugar	Ton/year	1445245	1256435	2031843	2356806	2481900	1914446
Canning of fish and other aquatic biota	Ton/year	219950	229113	244352	264297	267281	244999
Palm oil	Ton/year	7596000	8328000	8486500	8856820	8960291	8445522
Livestock/fish woof	Ton/year	5998102	6102911	6291028	6492012	6702912	6317393
Instant Noodles	Ton/year	1429392	1529111	1676042	1828888	1924885	1677664
INDUSTRI MINUMAN DAN TEMBAKAU							
Soft Drinks Industries	000 Liter	1269190	1341000	1408050	1476340	1546397	1408195

Based on the data obtained from the total production, it can be seen that the agro-industrial sector which had the largest production were plantation and forest products industry, i.e. pulp, paper and paper board industry. The second highest productions were crude palm oil and palm cooking oil. The result of the calculation of the Value at Risk for each type of industry demonstrated the value of risk for each type of agro-industry below.

Table-3. Value of risk per type of agro industry

Type of Industry	Portfolio Value (000 IRD)	Average Return (%)	Standard Deviation	Confidence Level	Min Return (%)	Value of Portfolio (000 IRD)	Value at Risk (000 IRD)
Processing and preserving of meat	1,834,470,169	39.40%	0.007	0.95	38.27	2,536,526,734	702,056,565
Canning of fish and other aquatic biota	6,606,059,602	33.64%	0.004	0.95	32.93	8,781,478,325	2,175,418,724
Palm oil	62,172,773,412	30.65%	0.008	0.95	29.26	80,363,649,886	18,190,876,474
Livestock/fish woof	42,703,824,128	31.31%	0.039	0.95	24.93	53,349,741,751	10,645,917,623
Cane sugar	42,601,058,763	60.15%	0.008	0.95	58.76	67,635,393,859	25,034,335,096
Food of chocolate and sugar confectionery	10,819,285,406	20.12%	0.007	0.95	18.96	12,870,709,810	2,051,424,404
Instant Noodles	9,116,144,216.35	40.88%	0.025	0.95	36.72	12,463,794,529	3,347,650,313
Soft Drinks Industries	16,117,047,085	48.05%	0.006	0.95	47.06	p23,702,203,847	7,585,156,762
Pulp	46,808,926,027	20.44%	0.029	0.95	15.67	54,145,835,403	7,336,909,376
Paper	72,214,152,191.8	70.50%	0.053	0.95	61.86	116,889,170,920	44,675,018,728
Oleo Chemical	3,873,590,687.21	44.09%	0.011	0.95	42.30	5,511,973,608	1,638,382,921

Based on the VAR calculation for each type of agro-industry by using the Confidence Level by 95 %, it meant that there were five times the likelihood of VAR results for each type of industry, where the losses were in the amount of calculation of the existing VAR value. In short, it could be concluded that 95% loss would not exceed the value of VAR in the next few years. In

conclusion, the VAR sought to answer the question, "How bad can things get?".

The maximum potential loss on the type of agro-industries could be found from the VAR calculation. Based on the calculation of risk portfolio (market portfolio risk) in the market for agro- industrial sector and mapping at risk of each type of the agro-industry products, the product which had big return percentage of 39.40 % with the smallest risk value of Rp702, 056, 565, 000, - was the preservation and meat processing industry, while the product with the highest risk was the paper industry with a return percentage of 70.50 % with a risk value of Rp.44, 675, 018, 728, 000. This value can be a great indication of capital that needs to be reserved to anticipate losses that may occur.

The risk mapping in some agro-industries indicated that there were 3 groups of quadrants, i.e. 6 industries in quadrant I (tend to be high risk, tend to be high returns), III (tend to be low risk, tend to be low returns), and quadrant IV (tend to be low risk, tend to be high returns). Industry groups in quadrant I were sugar and paper industries. The industries in quadrant III were the processing and preservation of meat, fish canning and other aquatic biota, palm oil, livestock/fish woof, food of chocolate and confectionery as well as pulp and paper industry. There were three industries in quadrant IV, i.e. the instant noodle, soft drink, and the oleo-chemical industry (Figure-2).

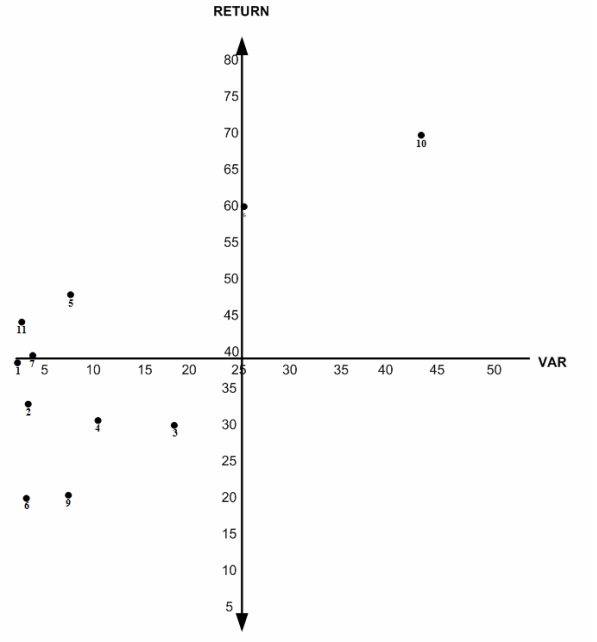

Figure-2. Risk mapping per type of agro industry

Based on the results of risk mapping, it needed considerable attention to the energy availability for the sugar and paper industry because they had a fairly high risk (in quadrant I). It was advisable to develop new and renewable energy for the need of energy in these both industries.

The sugar industry was an industry that needed both electrical and thermal energy intensively. In addition to consumers of energy, its inherent nature also could produce surplus contrast energy for other industries [4]. It produced sugarcane bagasse as one of the sources of available biomass. Sugarcane bagasse was the fibrous material remained after juice was extracted from sugarcane during the sugar manufacturing process, and like any other biomass, it was made up of mainly cellulose, hemicelluloses, lignin and some small fraction of extractives [3].

Pulp and paper mills also generated a large amount of biomass that is rich in energy as wastes, depending on technological level, pulp and paper grades as well as wood quality. These wastes were produced in all stages of the process: wood preparation, pulp and paper manufacture, chemical recovery, recycled paper processing, waste water treatment. Energy recovery from wastes of different origin became a generally accepted alternative to their disposal. Pulp and paper industry expressed an interest in adapting and integrating advanced biomass energy conversion technologies into its mill operations. Industrial adoption of these new technologies had the potential for higher efficiency, lower capital cost, and safer operation than conventional operations that burnt fossil fuels for energy. Incineration with energy recovery had the advantage of hygienic disposal, volume reduction, and the recovery of thermal energy by means of steam or superheated water that could be used for heating and power production [2]. In conclusion, pulp and paper industrial wastes could be converted to be bio fuels through physical, thermo-chemical, and biochemical processes [11].

5. CONCLUSIONS

Based on the survey and analysis, it could be concluded that in the field of agro-industry, the industries that had the greatest needs of energy were pulp, paper and palm oil processing industries.

The result of the risk mapping indicated that the 6 industries were in quadrant I (tend to be high risk, tend to be high returns), in quadrant III (tend to be low risk, tend to be low returns), and in quadrant IV (tend to be low risk, tend to be high returns). The industries in quadrant I were sugar, pulp and paper industry. The industries in quadrant III were processing and preservation of meat, fish canning and other aquatic biota, palm oil, livestock/fish woof, food of chocolate and confectionery as well as pulp and paper industry. The industries in quadrant IV were instant noodle, soft drink, and the oleo-chemical industry .

Based on the results of risk mapping, it needed considerable attention to the energy availability for the sugar and paper industry because they had a fairly high risk (in quadrant I) and it was advisable to develop new and renewable energy for the need of energy in these two industries.

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