Green Economy in East Kalimantan Province: Achieving Emission Reduction Target and Economic Trade-off in Agricultural Sector

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ABSTRACT

East Kalimantan economy is heavily relied on natural resource sectors. Aside from a gigantic output produced, the economy also creates a significant amount of emission. In the long term, this situation is believed could create environmental risks for East Kalimantan Province. Therefore, East Kalimantan Government has formulated Regional Action Plan in Reducing Greenhouse Gas (RAD GRK) in 2012 for all sectors. The document provides framework for reducing emission and implementing green economy policy in East Kalimantan Province. This paper evaluates emission reduction target of Provincial Emission Reduction Plan (RAD-GRK) in East Kalimantan Province, Indonesia. Using Input-Output Table of year 2013, which disaggregates the agriculture sectors into several subsectors, and employing optimization model; this paper assesses the possibility of achieving the emission target. The paper shows that implementing emission reduction target, as well as maximizing level of output, hampers the economy to reach both economic and environmental targets. There is a trade-off between economic output and emission reduction. Moreover, it shows that there is macroeconomic cost of emission reduction policy for East Kalimantan economy. Even though there is a trade-off in terms of economic output, agricultural sector tends to contributes more to the economy. It implies that in order to achieve the emission target, there is a necessity economic structural transformation towards agriculture sector.

Keywords: *Emission reduction, Trade-off, Optimization, Agricultural sector output*

1. Introduction

Nowadays, natural scarcity and degradation has become an issue discussed in many countries. Natural resources, renewable and unrenewable, have been intensively exploited without considering its impact on environmental quality. Meanwhile, climate change and global warming are haunted the earth and they reduce the earth ability in providing resources for human needs. Therefore, there has been a transition on development paradigm from business as usual (BAU) to sustainable development.

Sustainable development was introduced by the UN World Commission on Environment and Development (Brundtland Commission) in 1987. It is defined as a societal development "… that meets the needs of the present without compromising the ability of future generations to meet their own needs". The idea of sustainability combines three goals, economic power with ecological responsibility and social justice. Moreover, the concept of sustainability that connects the economic activity of people with the nature as resource provides the idea that economic processes must be sustainable if long-term development goals shall not be sacrificed to short-term prosperity. Sustainable development is also defined as the increase of utility or welfare per capita along the time or the increase of a set of development indicators (Pearce, 1996).

UNEP (2011) stated that in order to deliver the goal of sustainable development, one economy should implements a green economy policy. Green economy is defined as: "*One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investment that reduce carbon emissions and pollution, enhance energy and resource efficiency, and preven the loss of biodiversity and ecosystem services*".

National Development Planning Agency (BAPPENAS) states that there are four pillars in achieving sustainable development. There are social, green economy, environment and governance. In Indonesian context, the concept of green economy is applied through green growth program. Green growth program is a new approach to achieve several goals in order to create sustainable development in Indonesia. The notion of the program is to stimulate green growth that recognizing the value of natural capital, increase resilience, building local economic and that is inclusive and fair. There are five dimensions of green growth: (1) sustained economic growth, (2) greenhouse gas emission reduction, (3) social, economic and environmental resilience, (4) inclusive and equitable growth and (5) healthy and productive ecosystems providing services. Therefore, although it is not explicitly stated, the concept of green economy in Indonesia is believed to be similar with the concept of inclusive green economy.

As a response to the national policy of green growth, East Kalimantan Government takes an active part by launching Kaltim Green (Kaltim Hijau) Program on 7th January 2010. Kaltim Hijau is defined a condition where East Kalimantan is equipped by policies, system of government and development programs that provides social and ecological protection, long term assurance of welfare and security for people of East Kalimantan, as well as environmental sustainability. Moreover, East Kalimantan Government has formulated Regional Action Plan in Reducing Greenhouse Gas (RAD GRK) in 2012 for all sectors. East Kalimantan Government has also developed Strategy and Action Plan for REDD+ (Strategi dan Rencana Aksi atau SRAP REDD+). The documents are providing framework for reducing emission. However, some challenges remain in implementing inclusive green economy policy in East Kalimantan.

Firstly, East Kalimantan economy is heavily relied on natural resources. This puts East Kalimantan as one of biggest emitter in Indonesia. In 2008, East Kalimantan Province emits 255

million ton CO_2e as a result of its economic activities. Therefore, some alternative sectors aside from natural resource-based sectors should be considered as exit strategy to the East Kalimantan economy. In other words, there is an urgent need to make an economic structural transformation shifting from natural-resource-based sectors dominance into others.

However, some empirical studies show that there is an economic cost by implementing emission reduction policy. Fan et. al. found that there is a positive correlation between emission reduction and output or value added decline. The higher the target of emission reduction, the bigger the output decline. Moreover, the decrease of the output occurs because of activity restriction of the sectors that have high emission intensity, and these sectors are dominant sectors in the economy (Yang 2000).

This paper focuses on assessing the inclusive green economy in East Kalimantan Province to shed more lights on the existing situation and the potential regarding its sustainable development. Moreover, it analyzes the impact of emission reduction target policy to the economy in terms of output and also measures the economic cost of the policy. The organization of the paper is as follows. In the next section, there is a discussion about emission reduction in agricultural sector. It elaborates how agriculture and emission are related and agricultural contribution in creating emission. Section III explains models used to measure economic trade-off due to emission reduction in East Kalimantan. Section IV reveals the economic optimal structure of East Kalimantan that may provide a pathway to sustainable development and shows the economic cost that occurs due to the policy implementation. Last section will summarize the findings of the previous sections and discuss possible effects as well as some recommendations in order to minimize the economic cost of the emission reduction policy.

2. Emission Reduction in Agricultural Sector

East Kalimantan economy is characterized by highly-dependent on natural resources, such as mining sector, which produces oil, gas and coal. Based on its structure, in 2015 mining sectors contributes more than 44 percent of total the economy. Compared to previous years, its contribution decreases overtime. This indicates that East Kalimantan Province economy slows down and its growth would be unsustained.

However, these dominant sectors contribute to the carbon emission so that they make East Kalimantan as the third largest emitter Province in Indonesia. Mining sector contributes significantly in creating emissions. Based on analysis result carried out by Mc Kinsey Company, DNPI (National Council of Climate Change) and East Kalimantan Government (2011), dominant sectors, such as forestry, mining and coal, as well as oil and gas, are main sectors that create CO_2 emission. In 2010, from the total of 251 million ton of CO_2e, 90 percent of emission is produced by those sectors, or called as land use sectors especially forest land use (Figure 1).

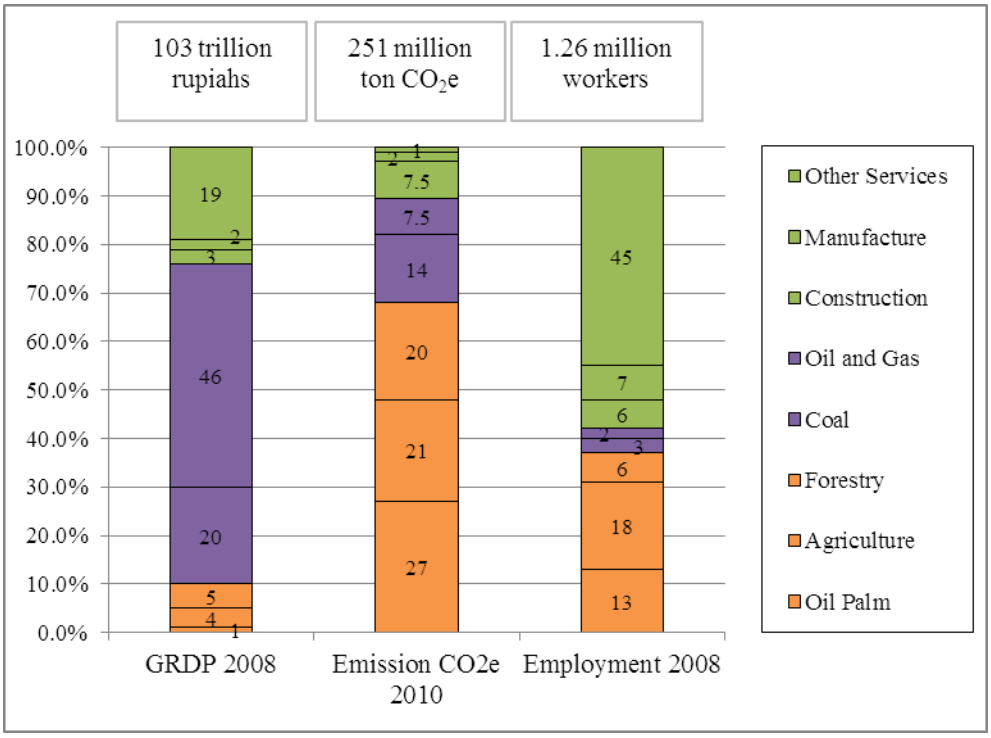

Figure 1. GRDP Distribution at Constant Price Year 2008, CO_2e Emission Year 2010 and Employment Year 2008 by Sector

In contrary, agricultural sector tends to increase overtime, from around 5 percent in 2010 to more than 7 percent in 2015. The increase of agricultural contribution to the economy due to expansion of the oil palm plantation in East Kalimantan. The area of oil palm plantation consists of 85.9 percent from the total planted area of estates in East Kalimantan. The oil palm plantation rises overtime and it reached around 1 million hectares in 2014.

However, the rise of the agriculture sector, especially in oil palm plantation sector, is likely followed by an increase in emission intensity. Government of East Kalimantan calculated emission generated during period 2007-2020 and documented in the Regional Action Plan of GHG Emission Reduction (RAD GRK). The calculation is based on assumption that the economy applies the strategy of business as usual (BAU). It shows that there is a sharp positive trend of generated emission. Land sector is the biggest emitter, especially mining sector.

Land sector is classified according to its land use, such as mining, forest, housings, open area, mangrove, and swamp; including agricultural activities, for instances estate and crops. Carbon stock of each classification has been calculated based on its land cover. If there is a land conversion, carbon stock difference will be calculated as a base in measuring emission that is produced because of the conversion in the land sector.

The calculation of emission in land sector is based on land use planning using assumptions what land use would be in 2020. There are 21 classifications in land use planning, such as food estate, protected forest, production forest, road, industrial estate, crops, wildlife preserve, housings, and peat land. There are some scenarios of emission reduction applied to each sectors. First scenario is conserving primary and secondary forest, while rehabilitating opened area to thicket area. Second scenario is pushing private sector to plant in opened area. Third scenario is conserving forest area. Fourth scenario is applied on plantation area, that is planting oil palm on the opened and bush area, and total plantation area is conserved. Fifth scenario is encouraging establishments accelerates reclamation and replanting so that in 2020 about 50 percent of mining area has been recovered. Sixth scenario is reforestation so that 30 percent of opened area can be converted to be bush area.

Seventh scenario is conserving area by applying eco-friendly practices. Eighth scenario is conserving area.

Method used in estimating emission and making projection is Land Use Planning for Low Emission Development Strategy (LUWES). Firstly, based on changes in land use or its canopy, total emission produced is predicted. Then, applying scenarios on the 21 plans of land used accordingly, total emission is measured and projected up to year 2020. This calculation shows the total amount of emission due to land conversion caused by development activities in East Kalimantan.

Estimation result shows that plantation is responsible for largest amount of emission, that is 29.94 percent and it is followed by mining which produces emission up to 12.81 percent from the total emission. However, it also significantly contributes to the total emission reduction when the scenario of emission reduction is applied. Plantation would contribute to 75.61 percent of the total reduction, while mining would reduce 7.95 percent of emission.

3. Method

Goal Programming (GP) is employed to analyze what is the impact of emission reduction policy on the economy in terms of output level. Moreover, GP model also estimates the economic cost of the policy when it is applied. Furthermore, the model provides a new alternative economic structure that is considered to be "green" as the emission reduction policy is applied to the economy. Therefore, GP model formulates an appropriate or optimal economic structure that is considered to be more environmental friendly.

Adopting Cristóbal model (2012), Goal Programming model can be applied in order to find the optimal economic structure that consider three goals that are social, economic and environmental to achieve IGE. In matrix form, Goal Programming model is formulated as follows:

Minimize $f = P_i.d_1^+ + P_i.d_2^+ + \ldots + P_i.d_n^+$

Subject to:

$$(I - A)X + d_1^- - d_1^+ = a$$

$$\hat{L}X + d_2^- - d_2^+ = b$$

$$\hat{E}X + d_3^- - d_3^+ = c$$

Where: X is the total output; $\hat{L}$ is a vector of direct impact coefficient of output on the employment; $\hat{E}$ is a vector of direct impact coefficient of output on the emission; P_i is rank or priority. i = 1, 2 or 3.

For economic objective, the target level refers to the output level in 2013 or it is equivalence with 1.59 percent of economic growth. The level of employment in 2013, that is 1,378.61 thousand labors, is used for social objective. As environmental objective in the model, emission target data taken from RAD-GRK is used, 563.29 million Ton CO_2e, and the classification of emission sector is modified to match IO classification. Additionally, IO Table of East Kalimantan Province Year 2013 is employed as constraints for GP model to represents level of technology in the economy of East Kalimantan.

The result of the model is expected to provide new economic structure of East Kalimantan that satisfies the economic, social and environmental goals. Moreover, the model will allow us to find the effects on output in different sectors of a reduction in the emission levels. Furthermore, the

model provides a role model of systematic procedure for examining the different goals that policymaker must implement in order to achieve IGE in East Kalimantan.

4. Optimal Economic Structure toward Sustainable Development: a Goal Programming Application

Economic transformation requires changes in the structure of the economy. However, an appropriate economic structure that is in line with IGE has not been provided. To formulate appropriate or optimal economic structure, it would need to firstly identify what are challenges and potential natural resources that are available in East Kalimantan economy. Moreover, other factor such as human capital is also should be taken into account in formulating the optimal economic structure.

To achieve sustainable development condition, therefore development in an economy should simultaneously consider among economic objective, as well as social and environmental objectives. Goal Programming model can be employed in assessing the achievement of an economy toward sustainable development. Moreover, model output suggests the new alternative economic structure that is optimal in order to achieve sustainable development. The result of the GP model is given in Table 1.

Table 1 the Impact of Emission Reduction on Output

No.	Sector	Output 2012 (Billion Rupiahs)	Output 2013 (Billion Rupiahs)	Maximize Value Added		Minimize Emission	
				Optimal Output (Billion Rupiahs)	Change Contribution Relative to 2012 (%)	Optimal Output (Billion Rupiahs)	Change Contribution Relative to 2012 (%)
1	Food Crops	7.11	7.25	7.24	0.021	7.24	0.021
2	Oil Palm	3.55	3.89	3.04	-0.081	3.89	0.054
3	Livestock	2.51	2.62	2.61	0.016	2.61	0.016
4	Logs	6.48	6.46	6.47	-0.002	6.46	-0.003
5	Other Forest Products	0.69	0.69	0.68	-0.002	0.69	0.000
6	Fishery	7.26	7.83	7.82	0.089	7.82	0.089
7	Oil and Gas	76.35	72.19	72.36	-0.633	69.52	-1.083
8	Coal	175.78	179.22	179.21	0.544	168.45	-1.163
9	Quarrying	2.01	2.34	2.34	0.052	2.34	0.052
10	Oil Refinery Products	79.83	79.03	78.19	-0.260	0	-12.661
11	LNG	97.98	89.76	89.76	-1.304	89.76	-1.304
12	Food Industry	8.34	8.9	8.89	0.087	8.89	0.087
13	Plywood	7.4	7.4	7.4	0.000	7.4	0.000
14	Other Industries	25.69	28.32	28.27	0.409	28.25	0.406
15	Electricity and Gas	2.32	2.42	2.42	0.016	2.4	0.013
16	Water	0.35	0.38	0.37	0.003	0.37	0.003
17	Construction	31.41	36.08	36.05	0.736	36.01	0.730
18	Trade	44.15	47.77	47.47	0.527	47.34	0.506
19	Transportation	26.07	28.08	27.86	0.284	27.71	0.260
24	Bank and Real Estate	10.64	12.27	11.91	0.201	11.8	0.184
26	Government	12.75	14.25	14.21	0.232	14.24	0.236
27	Other Services	1.84	2.06	2.02	0.029	2.03	0.030

No.	Sector	Output 2012 (Billion Rupiahs)	Output 2013 (Billion Rupiahs)	Maximize Value Added		Minimize Emission	
				Optimal Output (Billion Rupiahs)	Change Contribution Relative to 2012 (%)	Optimal Output (Billion Rupiahs)	Change Contribution Relative to 2012 (%)
	Natural-Resource Based Sector	431.95	422.54	421.86	-1.600	330.06	-16.159
	Non Natural-Resource Based Sector	198.56	216.67	214.73	2.565	215.14	2.630
	Total	630.53	639.20	636.60	0.963	545.21	-13.531

In general, there is a decline in the output level due to the emission reduction policy. First scenario is carried out by maximizing output level as first priority. It shows that there is a reduction in the output level by 33.45 percent compared to the output level in 2013. In 2013, East Kalimantan economic growth was 1.59 percent, however, if the policy of emission reduction is applied then there is a slower growth occurs in the economy. The economic growth would be expected to be only around 1.15 percent. Meanwhile, the environmental objective of emission reduction cannot be achieved. By considering output level as a priority policy, the emission level is 599.67 million ton or 6.5 percent higher than the level of emission target.

In details, significant output reduction share are given by natural-resource-based sectors, such as Oil and Gas (1.96 %), Coal (6.67 %), Oil Refinery Products (4.93 %) and LNG (5.20). These sectors are biggest emitter in the economy, and given the policy implementation, they contributes more to the total output reduction. This finding is similar to a study carried out by Cristóbal (2012) that is all output level declines in the Spain economy when the environmental policy of emission reduction is implemented. This indicates that there is a trade-off between emission reduction policy and output level. Moreover, aside from Coal sector, the highest shares to the total output reduction are given by industrial sectors, Oil Refinery Products and LNG. This result is also similar with study in Canada where the industrial output should reduce to meet the Kyoto Protocol target (Lixona *et al*. 2008).

Furthermore, second scenario is applied to the model by putting environmental objective as top priority provides the expected result of emission reduction. However, the economic cost is bigger compared to the result of previous scenario. The economic output is lower compared to the output level in 2013, it is a difference of 13.53 percent, when the emission reduction policy is being implemented and put as the priority. This decline is equivalence to a contraction in the economy, an economic growth of -9.04 percent.

The result shows that in general there are output declines in all sectors of the economy, and some sectors are recommended to have zero level of output, especially services. Natural-resource-based sectors, such as Coal, Oil Refinery Products, and LNG contribute more to the emission reduction compared to other sectors. Moreover, the shares are higher compared to their shares of the first scenario. This indicates that these sectors are quite responsive to the emission reduction policy.

In addition, the result shows there is a shift in the sectoral emission structure in East Kalimantan when the emission reduction policy is implemented. Due to the significant output reduction of the natural-resource-based sectors, there is also a significant in the emission reduction, especially from Oil and Coal sector activities, whereas there is an increase in the other sector emission, such as agriculture. This indicates there is a transformation in the economy from natural-resource-based sectors to the agricultural sectors, such as food crops and palm.

This finding is confirmed by Figure 2. In general, it shows that emission reduction policy tends to change the economic structure of East Kalimantan Province compared to baseline data on

2012. If the policy is applied while maximizing value added, there is a decline in natural resource contribution to the economy, and a greater contribution of the non-natural resource-based sectors. More significant contribution is given by non-natural resource-based sectors when emission reduction policy is applied while minimizing emission is prioritized. This implies that dominant sectors in East Kalimantan economy are significant emitters. Therefore, in order to achieve green economy, there has to be a slowdown in production activities of these sectors.

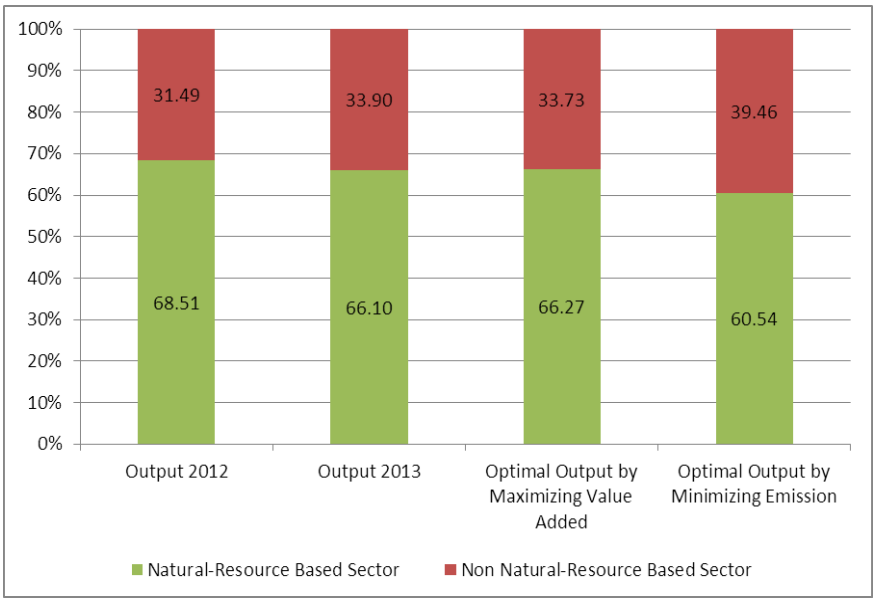

Figure 2. Structural Transformation of East Kalimantan Province due to Emission Reduction Policy

Figure 3 shows that there is structural change when an environmental objective is taken into account in the economy. In terms of output level, applying emission reduction policy causes a lower output level compared to the level of it should be that is output level in 2013. However, it may be successful in reducing emission level. Although in first scenario of maximizing value added, the level target of emission still cannot be achieved, the level emission is lower compared to the level of emission when Business as Usual practices applied in the economy and East Kalimantan economy still experiences a positive growth. Whereas, if second scenario is applied, there would be an even lower output level compared to output level in 2013, and East Kalimantan economy experiences negative growth. However, the level emission targeted can be achieved by applying this scenario.

These scenarios suggest that in order to achieve a greener East Kalimantan, emission reduction policy should be applied. However, there are consequences in applying this policy, lower output level that may cause a slower growth or even a negative growth of the economy. Aside from a slowdown in the economy, model also suggests that there has to be a structural transformation in East Kalimantan economy. In order to ensure a sustainable development, there is a necessity to shift from natural resource-based economy into non-natural resource-based economy, such as agricultural or industry.

Figure 3 shows that as the policy is applied, there is a tendency that agricultural sector contributes more to the economy. As the economy moves to more environmental practices, agricultural sector contributes more to the economy. This because emission intensity produced by agricultural activities is relatively lower than one produced by natural resource-based sector. This indicates that development in agricultural sector may benefit and support to create a green economy of East Kalimantan.

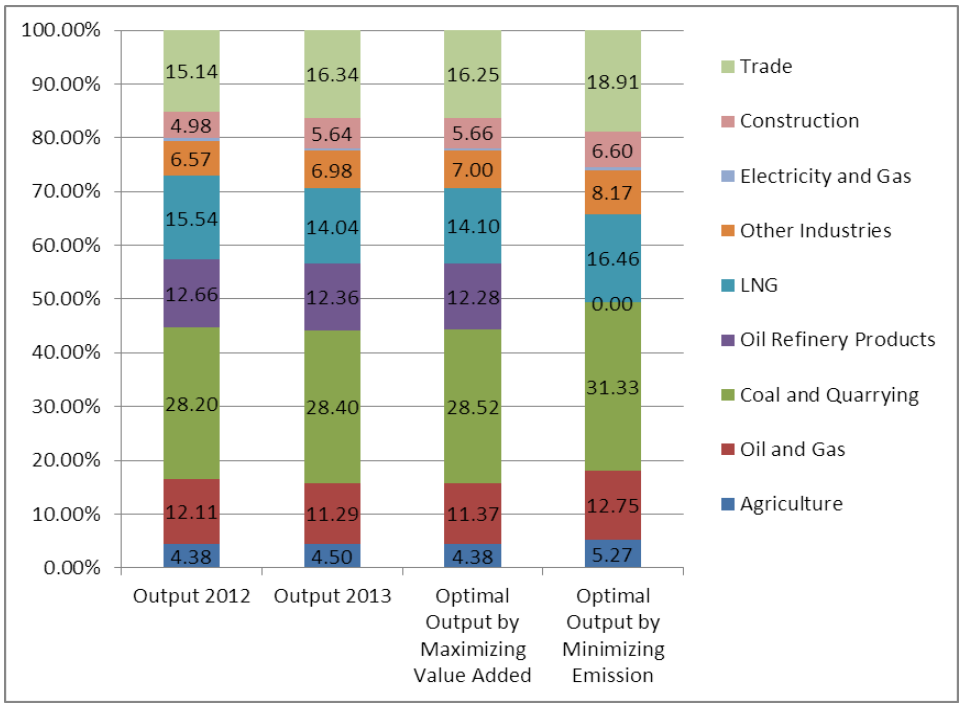

Figure 3. Economic Structure of East Kalimantan Province due to Emission Reduction Policy

5. Concluding Remarks

East Kalimantan economy is heavily relied on natural resources. It creates externalities. East Kalimantan becomes one of biggest emitter in Indonesia.

The performance of greenness aspect of East Kalimantan is indicated by emission intensity and energy intensity. During period 2000-2012, there is an increase in the emission intensity assuming that economy applies BAU practices. Moreover, there is also a tendency to use more energy per capita overtime. This suggests that the sustainability would be threatened given that there is no other new energy reserve found. Furthermore, DEA model indicates that East Kalimantan becomes less efficient overtime in terms of utilizing its natural resources and environmental management.

Emission reduction policy is believed to be a way in achieving sustainable development by creating a greener economy. However, there is economic cost in applying the policy. There is trade-off between emission reduction and output level. As it is expected, natural-resource-based sectors contributes more to the total output reduction. This implies that there is a contraction in these sectors; hence it reduces more emission compared to other sectors. The economic cost is even bigger when environmental objective of emission reduction becomes first priority. Therefore, it should be considered alternative policies in order to outweigh the incurred cost.

By applying the environmental policy, there is a change in the economic structure of East Kalimantan. A significant decrease in the output level of natural-resourced-based sectors implies that there is a transformation towards agriculture, especially palm plantation. Moreover, this indicates that there is an opportunity for East Kalimantan economy to be less dependent to the

natural-resources-based, as well as be greener. Thus, this implies that sustainable development in East Kalimantan can be achieved by developing agricultural sector.

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