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ANALYSIS OF PLANS FOR IMPLEMENTING CARBON EMISSION REDUCTION AND CREDIT EMISSION PROJECTS IN THE STEEL INDUSTRY WITH A DYNAMIC SYSTEM APPROACH CASE STUDY: PT KRAKATAU STEEL (PERSERO)

Oktioza Pratama[1*], Zaki Almalik[2], Muhammad Jefta[3]
[1, 2, 3]Universitas Faletehan, Banten, Indonesia
Coresponding : oktioza.pratama29@gmail.com

Abstract- Analyze policy design for Emission Reduction Project and Carbon Emission Credits in PT. Krakatau Steel (Persero) Tbk. to reduce CO2 emission. System Dynamics model is used as basic for implementation the Emission Reduction Project scenario. Steel production, CO2 emission, and gross profit will be analyzed as macro output indicators. Moreover, feasibility study in every project will be analyzed as micro output indicator in finance point of view. This study shows that Emission Reduction Project can reduce CO2 emission. Unfortunately, the feasibility study said it is not feasible to implement although Carbon Emission Credits has been implemented too. Remembering how important the implementation of Emission Reduction Project is, it still needs another policies to support the implementation of project then. Methods: The system dynamic methodology is used in this study because it is able to model all causal relationships in the model variables by considering the feedback loop. In addition, dynamic systems are able to simulate systems for long periods of time (more than 10 years) and include policy variables and scenarios from the problem owner to intervene in the system to achieve the main goal. Result: For CO2 indicators, emission reduction project scenarios, reduction projects emissions + CDM and emission reduction projects + VCS are the best. For example, in 2029 these three scenarios produce the smallest CO2 emissions, namely 3,527,086.84 tons of CO2, compared to other scenarios, for the steel production indicator, all scenarios have the same results, so it can be said that steel production is not affected by the scenario whatever is applied. In addition, it can also be concluded that the CO2 emission reduction scenario does not affect or reduce the performance of PT. KS. For feasibility analysis, the VCS scenario is the best compared to other scenarios both in terms of Net Present Value (NPV), Internal Rate on Return (IRR) and Payback Period (PBP) for both the oxy-fuel burner project and the lime factory. However, when compared with the MARR of PT. KS (9.65%), this scenario is still not feasible (oxy-fuel burner: 7.76% and lime factory: 2.01%). so based on the results obtained, each of these policy alternatives has its own strengths and weaknesses. Determining what alternative is the best is the right of the problem owner and other stakeholders.

Keywords: Emission Reduction Project, Carbon Emission Credits, steel production, CO2 emission, gross profit, feasibility study.

1. INTRODUCTION

Along with the development of industrialization in Indonesia, then
the need for development is increasing, one of the most important is the construction and development of infrastructure. Development and development of infrastructure will not be separated from the need for metal and steel. Therefore, the steel industry is one of the national industries that must continue to be developed. The performance of the steel industry in Indonesia is also quite good. This can be seen from the high rate of Indonesian steel production which reached 3.7 million tons in 2005 and increased to 3.8 million tons in 2006. This high steel production placed Indonesia as the third best country for steel production in Southeast Asia. Apart from that, other evidence is the success of PT Krakatau Steel (Persero) tbk, a leading steel company in Indonesia, in continuing to increase the company's revenue amidst the global economic recession. In fact, in 2009 PT Krakatau Steel (Persero) Tbk managed to achieve a net profit of 1.02 trillion rupiah (PT Krakatau Steel (Persero) Tbk, 2011). However, the iron

and steel industry is also one of the industries with the largest contribution to environmental emissions, reaching 10% of CO2 emissions in the industrial sector (Indonesian Ministry of Environment, 2009). Therefore, reducing CO2 emissions in the steel industry is one of the main concerns that must be found a solution.

A. Carbon Emission Credits

Carbon Emission Credits is the common terminology used to represent a certificate or sales permit for every tonne of CO2 or other greenhouse gas emissions (Stavins, 2001). Carbon Emission Credits are commonly used by countries, industries or companies as compensation for every ton of emission reduction they make. An example is what was carried out by Indonesia Power in the project to increase the capacity of the geothermal power plant on Mount Salak. In this project, the use of geothermal as a substitute for fuel oil to generate electricity was able to reduce emissions by 1,125,225 tons of CO2. Furthermore, the amount of emission reductions of 1,125,225 is converted into certificates of carbon emission credits which are then sold to the carbon market. The carbon market is a market that functions to control pollution by providing incentives to each party that succeeds in reducing greenhouse gas emissions (Stavins, 2001). For industries and companies in developing countries, Indonesia is one of them, there are several carbon emission credits that can be done, namely the Clean Development Mechanism (CDM) and Voluntary Carbon Standard (VCS).

B. Clean Development Mechanism (CDM)

CDM is a mechanism whereby countries that are members of Annex 1, which have the obligation to reduce greenhouse gas emissions to a certain number by 2012 as stipulated in the Kyoto Protocol, help non-Annex 1 countries to implement projects. -projects that are able to reduce or absorb emissions of at least one of the six types of greenhouse gases according to the non-Annex 1 countries referred to are those that signed the Kyoto Protocol but have no obligation to reduce their emissions. Units of greenhouse gas (GHG) emissions that can be reduced are converted into credits known as Certified Emissions Reductions (CERs) - emission reduction units that have been certified. Annex 1 countries can use this CER to help them meet emission reduction targets as stipulated in the protocol (UNFCCC).

a) Feasibility of CDM Project Activities

A CDM project must be able to generate a reduction or GHG absorption, which is measurable in real terms and will not occur unless the project is implemented (United Nations Framework Convention on Climate Change (UNFCCC), 2001b). In other words, so that the project can be said to generate carbon credits the project must demonstrate reduction in emissions when compared to the initial conditions (baseline scenario), where the initial conditions are the conditions that occur at this time normal process. Another important aspect is the project that will become a CDM project must be in line with the environmental policy in force in that country concerned and also with the ultimate goal of sustainable development has been established by the State (United Nations Framework Convention on Climate Change (UNFCCC), 2001b). To meet this criterion, activity Reducing GHG emissions alone is not enough. Currently there are many governments in location countries that disclose information about development requirements. This sustainable development is known as "development criteria sustainable".

b) Classification of CDM Project Activities

CDM projects can be grouped into 2 main sections: (1) GHG emission reduction and (2) sequestration (sinks, carbon sequestration). Under these 2 main categories there are several sub categories which are classified based on the size of the project .

C. Verified Carbon Standards (VCS)

VCS is basically the same as CDM, namely a mechanism for carbon emission credits to facilitate all parties who wish to reduce greenhouse gas (GHG) emissions by selling every tonne of CO2 emission reductions to the carbon market. The main objectives of the VCS are as follows:

1) Creating a more transparent, credible and standardized voluntary carbon market by building the VCS program as a global standard for reducing GHG emissions and creating reliable voluntary carbon emission credits.
2) Stimulate innovation in GHG mitigation technologies and validation, verification and registration processes.
3) Providing security for all parties who wish to sell their emissions on the condition that they are not allowed to do double counting, an emission reduction project is valued at more than one carbon emission credit.
4) Providing security to investors, buyers and all parties involved in the voluntary carbon market with emission reduction project criteria that are: real, measurable, permanent, additional, independently verified, unique, transparent and conservative (VCS Association, 2008).Factors influencing knowledge

VCS is initiated by Climate Group, International Emissions Trading (IETA), the World Business Council for Sustainable Development and the World Economic Forum to create a voluntary sustainable carbon market to facilitate a less rigid market mechanism, such as the CDM (Sc 2014). The voluntary carbon market was created to facilitate this, companies or parties that you want to contribute to reduce emissions but do not have the capabilities of developed countries such as limited funds, small scale of emission reductions and so on. With a mechanism that is not rigid, VCS is able to create a new market, the scale of emission reduction is not as big as CDM, but in quite large quantities. Until now VCS has been used in more than 50 countries, the total certification has exceeded 125 million VCU (Verified Carbon Units). One VCU equals one tonne of CO2 emissions.

a) Scope of VCS

The VCU certificate has standards and validation that have been recognized worldwide, namely having standards and frameworks based on ISO 14064-2:2006 and ISO 14064-3:2006. The scope of VCS also includes all GHG emission reduction activities.

b) Parties involved

The parties involved in the VCS are:

1) Project Proponents
   Project proponents are parties submitting projects for carbon emission credits with the aim of obtaining VCU certificates to then sell them on the carbon market.
2) Validator and Verifier
   Validator and Verifier are bodies that validate and verification of each project submitted by the Project proponent. After the project has gone through the process of 5 times validation and verification, the project can only be submitted to the VCS secretariat.
3) Registry Operators
   Registry operator is the body that approves every project that has been validated and verified. After success registered, the project will receive a VCU certificate.
4) Buyers
   Is a buyer of a VCU certificate which can be a company, organizations and individuals.
5) VCS Association
   The VCS program is managed by the VCS Association (VCSA). VCSA is a non-profit organization that represents the Secretariat and VCS boards. VCSA is registered under Swiss regulations. VCSA responsible for all activities on the VCS, however VCSA will not process projects that are rejected and don't complies with the VCS standard.

c) VCS project classification

VCS divides the projects that will receive Carbon Emission Credits as follows:

- Micro projects: under 5,000 tons of CO2-e per year;
- Project : 5,000 – 1,000,000 tons of CO2-e per year;

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• Mega projects: Larger than 1,000,000 tons of CO2-e per year.

The verification and validation carried out will differ according to the project criteria each.

2. METHOD

A. Type of Research

At this stage the researcher determines and studies the basic theory needed in discussing the subject matter of the research. The basic theory used includes dynamic system theory, as well as steel production process theory, scenario theory and policy analysis. The dynamic system methodology is used in this study because it is able to model all causal relationships in the model variables by considering the feedback loop. In addition, dynamic systems are able to simulate systems for long periods of time (more than 10 years) and include policy variables and scenarios from the problem owner to intervene in the system to achieve the main goal.

3. RESULTS AND DISCUSSION

Table 1. Steel production validation and verification

Tahun	Produksi Total		
	Real	Simulasi	Discrepancy
2007	3,071,766.00	3,026,189.46	1 %
2008	2,726,544.00	2,746,977.55	1 %
2009	2,609,141.00	2,622,450.78	1 %
2010	2,409,350.00	2,424,100.24	1 %
2011	2,802,902.00	2,799,575.16	0.12%
2012	2,868,219.00	2,870,227.48	0.07%

Based on table 1. it can be seen that the simulated steel production and real data from the annual report of PT. KS has a discrepancy of around 0.07% - 1%. This shows that the module is valid because it does not exceed 10% discrepancy.

Table 2. validation and verification of CO2 emissions

Tahun	Total Emisi CO_2 KS		
	Real	Simulasi	Discrepancy
2007	2,008,452,095	1,915,842,120.94	5 %
2008	1,795,699,857	1,765,567,630.20	2 %
2009	1,414,394,297	1,398,264,465.85	1 %
2010	1,600,000,118	1,580,379,132.96	1 %
2011	1,649,316,169	1,642,477,767.91	0.41%
2012	842,288,954	798,441,909.80	5 %

Based on tabel 2. It can be see that the total CO2 emissions do not differ much between real data (from K3LH division) and simulation. It is proven by results that are not much different and do not exceed 5%.

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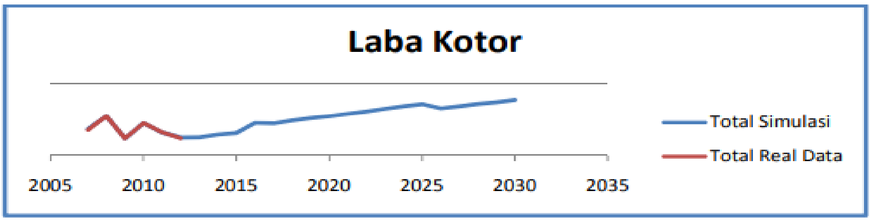
Table 3. Validation and verification of gross profit

Tahun	Profit Perusahaan		
	Real	Simulasi	Discrepancy
2007	1,772,602,000,000.00	1,849,794,285,635.58	4 %
2008	2,716,064,000,000.00	2,714,820,547,202.02	0.05 %
2009	1,185,389,000,000.00	1,184,413,465,704.95	0.08 %
2010	2,234,780,000,000.00	2,233,670,651,886.96	0.05 %
2011	1,598,811,000,000.00	1,593,451,569,257.35	0.34 %
2012	1,203,388,600,000.00	1,255,923,003,879.49	4 %



Based on table 3. it shows population does not differ much between the simulation and real data from the Annual report of PT. KS in 2009-2012. It is proven by results that are not much different and do not exceed 4%.

Table 4. Feasibility Analysis of oxy-fuel burner with three different scenarios

FS Criteria	Oxy-fuel Burner (Scenario 2)	Oxy-fuel Burner + CDM (Scenario 3)	Oxy-fuel Burner + VCS (Scenario 4)
NPV	(Rp 111,787,673.48)	(Rp 287,826,297,68)	(Rp 68,236,072.82)
IRR (MARR:9.65%)	4.45%	0.18%	7.76%
Payback Period	11 years and 4.24 months	15 years and 0.65 months	10 years and 3.16 months

Based on table 4. the feasibility analysis results of oxy-fuel burner. Seems likethe VCS scenario has the best results compared to other scenarios. The results of Net Present Value (NPV), Internal Rate on Return (IRR) and Payback Period (PBP) in this scenario are the best compared to other scenarios. However, when compared to the Minimum Attractive Rate on Return (MARR) set by the project management division of PT. KS, the three scenarios cannot be said to be feasible. Because, the MARR project of PT. KS is 9.65%, still higher than the IRR of the VCS scenario, which is 7.76%.

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Table 5. Lime plant feasibility analysis with three different scenarios

FS Criteria	Pabrik kapur (Scenario 2)	Pabrik kapur + CDM (Scenario 3)	Pabrik Kapur + VCS (Scenario 4)
NPV	(Rp 24,540,333,553)	(Rp 24,113,402,695)	(Rp 23,696,915,238)
IRR (MARR:9.65%)	1.57%	1.81%	2.01%
Payback Period	14 years and 0.78 months	13 years and 8.81 months	13 years and 7.03 months

Based on table 5. The results of the feasibility analysis of lime factory construction. Seen that the VCS scenario has the best results compared to other scenario other. Net Present Value (NPV) results, Internal Rate on Return (IRR) and Payback Period (PBP) this scenario is the best compared to other scenarios. However, when compared with the Minimum Attractive Rate on Return (MARR) set by the project management division of PT. KS, third scenario is not yet feasible. Because, the MARR project of PT. KS is 9.65%, still much higher than the IRR of the VCS scenario, namely 2.01%.

4. DISCUSSION

PT. Krakatau Steel is an effort by PT. KS to reduce its emissions through two ways, namely oxy-fuel burner and the construction of a lime factory. As explained in the previous chapter, both of these methods reduce CO2 emissions by reducing electricity consumption. Because PT. KS has its own power plant, namely through PT. Krakatau Power Electric with a source of power generation through natural gas, so every consumption of electricity for the production process produces CO2 emissions.Verification and validation are carried out to ensure that the simulation model created can represent the actual conditions. In general, verification is carried out on all variables in the model. Verification and validation are carried out by comparing the characteristics of changes in the values of each variable in the company's performance subsystem resulting from simulations with actual values in actual circumstances. However, in this research report, verification and validation are shown only in some calculations which have an important role for the validity of the dynamic system simulation model made from an academic point of view (Dhania 2010).

The purpose of creating this simulation model is to simulate the goal of reducing CO2 emissions, while still considering PT. KS. In this case, the limits set refer to the system structure boundaries that have been made in the system diagram in the previous chapter, which are made based on the understanding gained from previous research studies and discussions with various divisions and parties at PT. KS. In this case, external elements, such as corruption, natural disasters and terrorism are not taken into account in this model (Pavydė et al. 2015). This emission reduction project scenario will later be included in the model. When the scenario is entered, the sub runs. The variables that will be included are obtained from the project management division of PT. KS. In addition to analyzing from the company's macro perspective; through three output indicators: steel production, CO2 emissions and gross profit; analysis is also carried out on a micro scale, namely from the side of the project.

5. CONCLUSION

Based on the research results from analysis in this study, the researchers can conclude that there is Emission Reduction Project: In the emission reduction project scenario, PT. KS implemented

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the oxy-fuel burner and lime construction projects to reduce overall CO2 emissions which also considered the financial aspects, namely gross profit and feasibility analysis of each project. Emission Reduction Project + CDM: In the Emission Reduction Project + CDM scenario, PT. KS, in addition to implementing the oxy-fuel burner and lime factory projects to reduce CO2 emissions, also sells every tonne of CO2 emission reduction through a Clean Development Mechanism (CDM) certificate. Emission Reduction Project + VCS: In the Emission Reduction Project + CDM scenario, PT. KS besides implementing the oxy-fuel burner and lime factory projects to reduce CO2 emissions, also sells every tonne of CO2 emission reduction through a Verified Carbon Standard (VCS) certificate.

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