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Creating Green Industry through the Implementation of an Energy Management System

Case Study at PT. X

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***Abstract* — The green industry is an industry that in its production process prioritizes the efforts to efficient and effective using of resources in a sustainable manner so as to be able to harmonize the industrial development with the environmental sustainability and can provide benefits to the community. One of the assessment criteria for the green industry is the energy aspect, namely industrial efforts in implementing energy efficiency, the usage of renewable energy, and conducting energy management activities. This research was conducted based on a case study of the application of Energy Management System at PT. X, which is one of the largest pulp and paper industry in Indonesia. The industry has an impact on reducing CO_2 emissions through the implementation of Energy Management System. PT. X can save energy consumption by 47,700 GJ and reduce CO_2 emissions by 11,805.75 tons CO2e, in 2017.**

Keywords : energy, energy management, green industry,

I. INTRODUCTION

The development of industrial sector in Indonesia has a significant impact on economic development and the opening of new jobs for the community. Environmental impacts are also caused by all activities that occur in the production process in industry. Industry is one of the biggest energy users, which is around 30% of the total national energy consumption [1], still using fossil energy sources in the production process. This fossil energy source consists of coal, petroleum and natural gas. Based on the data of International Energy Agency (IEA), coal demand has increased tripled since 2000 with an average growth of 8.8% per year. In 2016, coal demand reached 17% of the total primary energy needs [2]. The abundant of coal energy sources, causing the coal price to be lower compared to other fossil energy sources, so that their demands are increasing year by year. Oil is the most widely used as energy source. This is due to the increasing use of transportation facilities or private vehicles. The low quality of infrastructure for public transportation caused people choose private vehicles as a means of daily transportation. The natural gas demand has also increased because this is not only as a source of fuel, but also used as raw material for production processes in industry.

The use of fossil fuels in industrial production processes also give negative impact to the environment, such as the formation of CO and CO_2 gas which is included as Green House Gases (GHG) and harmful to environmental and living sustainability. The increasing concentrations of GHG in the atmosphere is caused by the inability of plants and sea to absorb these gas because they are not balanced with the increasing of combustion process using coal, oil, and other organic fuels. It is estimated that before 2100, an increase in GHG concentrations, especially CO_2, will cause an increase of the earth's surface temperature of more than 2°Celcius. The impact of an increase in the average surface temperature of the earth, exceed 2°Celcius, can result in changes of climate system, sea level, drought, floods, crop failure, and other [3].

The positive impact of the large development in industrial sector to economic development encourages the effort to realize the high competitiveness of industries. This is determined by the performance of the industry in carrying out its production process. This effort is aligned with the market dynamics that are increasingly open and competitive along with technological development, and supported by the strengthening of awareness and concern about the importance of environment sustainability. The ability to manage and implement best practices in order to improve energy performance is very important to be continuously improved. Global market have begun to appreciate the industrt that in its operational activities implements best practices in resource efficiency and reduce the waste that it causes. The application of the green industry principle is considered very relevant to this activity.

UU No. 3 of 2014 concerning industry, states that the green industry is an industry which in its production process prioritizes effort to efficiently and effectively use resources in a sustainable manner so as to be able to harmonize the industrial development with the environmental sustainability and can provide benefits to the community [4]. The green industry encourages companies to continually improve on its all line in order to increase the production efficiency and effectiveness, and provide evidence that the low cost or no cost approach can also have a significant impact for the company. The good

financial benefits through saving and productivity increasing, and also providing a new image for the company as a green industry. The development of the green industry is an effort by the Indonesian government to reduce GHG emissions, as stated by the president of Indonesia in a meeting of the Climate Summit in Paris in December 2015. Indonesia is committed to reduce 29% of CO_2 emission by 2030, with scenario business as usual.

The Ministry of Industry of the Republic of Indonesia has made various efforts to encourage the development of the green industry, through the awarding of the Green Industry Award. This award is given to industries which have carried out some efforts to save the use of natural resources. Assessment criteria related to energy are industrial efforts in energy efficiency implementation, the use of renewable energy, and conducting energy management activities [5].

Production efficiency and effectiveness can be achieved through the implementation of energy management, which is an integrated way to manage and control the energy use in order to achieve effective and efficient energy utilization to produce maximum output. Through Government Regulation No. 70 of 2009 concerning energy conservation, the government requires energy users equivalent to 6,000 TOE (Ton Oil Eqivalent) to carry out energy conservation through the implementation of energy management. Determination the number limit of 6,000 TOE is based on the consideration that energy users greater than or equal to 6,000 TOE (equivalent to 69,780,000 KWh) is not too much, but the total energy consumption reaches around 60% of national energy use. Energy conservation is a systematic, planned and integrated effort to conserve domestic energy resources and improve the efficiency of its utilization. This regulation is supported by Ministerial Regulation No. 14 of 2012 concerning energy management, which technically clarifies what steps and obligations must be carried out in energy management implementation. Through energy management, the implementation of energy efficiency can be carried out systematically, optimally and sustainably. Energy management activities use the management system model with the PDCA (Plan, Do, Check, Action) cycle approach so that energy utilization is efficient and sustainable. In the implementation process, this activity is better known as the Energy Management System (EnMS).

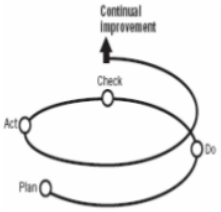

Figure 1. Continual improvement using PDCA cycle

International standard on EnMS were issued in 2011, namely ISO 50001, which was subsequently adopted identical by National Standardization Agency (BSN) in 2012 to SNI ISO 50001. EnMS helps an organization or industry to save energy so it can reduce energy costs, minimize negative impacts on the environment, improve work comfortability, enhance positive image for the company, increase productivity and competitiveness of the company [3]. The main objective of EnMS is to increase the control over energy consumption [6]. EnMS is done through several stages, namely :

- Establish energy policy
- Conduct energy planning
- Implementation and operation
- Checking
- Conduct management review as reporting to the top management about the EnMS activities that have been carried out [7]

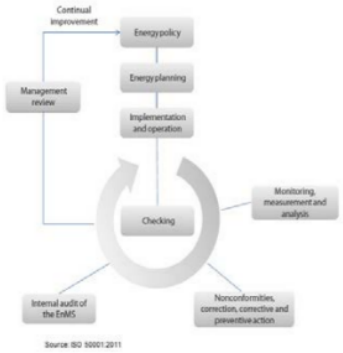

Figure 2. Energy management flow chart at ISO 50001

The energy policy is part of the commitment that indicates the company's target related to the implementation of energy management and how to achieve these targets. Energy planning are carried out with analyse the past and present energy use, determine the list of variables that affect energy consumption, determine significant energy users and analyse these factors so that potential savings can be achieved. This step can be done through energy audits or benchmarking with similar industries. Furthermore, at the implementation and operation stages, activities will be carried out that provide significant savings.. At the checking stage, monitoring and measurement of the current system, operating conditions, suitability of the plan with actual conditions, and energy performance are carried out. Periodically, management reviews are conducted to find out the progress of the implementation of EnMS in an organization.

One industry in Indonesia which has implemented EnMS is PT. X, one of the largest pulp and paper company in Indonesia. The industry has succeeded in becoming the largest color paper producer in the world with production capacity of more than 100,000 tons per year. Related to the rising of energy prices and as a company participation in reducing the impact of global warming or reducing CO_2 emissions, PT. X is committed to continual energy efficiency. Started in 2011, PT. X has implemented EnMS in its company.

Figure 3. Products of PT. X

This research was conducted to determine the efforts of EnMS implementation at PT. X and the impact of the reduction in CO_2 emissions which is obtained through energy saving that is achieved, so it will supports the efforts to realize the green industry.

II. METHODOLOGY

This research was conducted quantitatively through energy data analysis at PT. X. Related to the confidentiality of company information, the name of the industry in this study called PT. X. The energy data used as a reference or base year is 2016, because the operating conditions in this year present the operating conditions in the year which is observed, 2017. The analysis is done by using the regression equation by comparing the data in 2017 with data in 2016. [8]. From this analysis, it can be known the amount of energy savings can be achieved and the calculation of CO_2 emmission reductions that can be achieved.

III. RESULT AND DISCUSSION

The initial stages of data analysis of energy consumption is done by making regression equation based on data on energy consumption and products produced in 2016, as shown in table 1. The resulting equation is called the baseline equation and 2016 is called baseyear. Baseline equation is shown in equation 1. From equation 1, it can be seen that in order to produce a number of x tons products, the energy required is a number of y GJ (Giga Joule). R^2 value shows the correlation coefficient of the relationship between the number of products and their energy consumption. The correlation coefficient of 0.7679 is in the strong relationship level which means that the number of products produced greatly affects the amount of energy consumed to produce the product [9].

Tabel 1. PRODUCTION VS ENERGY CONSUMPTION

Month	*Production (Ton)*	*Energy consumption (GJ)*
January-16	9,464	73,487
February-16	10,044	78,690
March-16	10,550	87,624
April-16	10,299	85,340
May-16	10,439	86,843
June-16	10,274	87,598
July-16	10,362	89,722
August-16	10,587	90,368
September-16	10,149	88,182
October-16	10,570	92,070
November-16	10,135	87,873
December-16	10,353	89594

From the data in table 1, the regression equation is obtained as follows :

$$y = 14{,}953x - 67.089 \quad (1)$$
$$R^2 = 0{,}7679$$

where :
y = energy consumption
x = product capacity

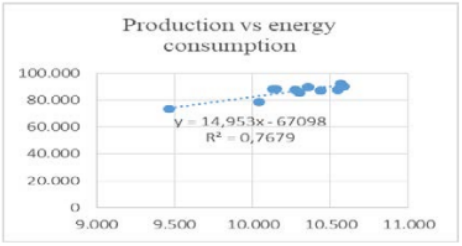

Figure 4. Production vs energy consumption

Equation 1 is then used to predict the amount of energy that should be consumed to produce a product of x tons in 2017. Data of product which is generated and used in the equation is the data on the actual number of product in 2017, resulted predictions of energy consumption as shown in table 2.

Tabel 2. ACTUAL PRODUCTION VS PREDICTED ENERGY CONSUMPTION IN 2017

Month	*Actual production (Ton)*	*Predicted energy consumption (GJ)*
January-17	11,106	98,969
February-17	10,050	83,180
March-17	10,677	92,559
April-17	11,005	97,459
May-17	11,231	100,845
June-17	10,298	86,885
July-17	10,862	95,322
August-17	10,541	90,516
September-17	10,337	87,474
October-17	10,988	97,200
November-17	11,002	97,416
December-17	11,061	98,303

Predicted energy consumption is then compared to actual energy consumption so the difference between the two values is obtained.

Tabel 3. ACTUAL ENERGY CONSUMPTION VS PREDICTED ENERGY CONSUMPTION IN 2017

Month	*Actual energy consumption (GJ)*	*Predicted energy consumption (GJ)*
January-17	92,999	98,969
February-17	80,278	83,180
March-17	88,735	92,559
April-17	88,640	97,459
May-17	92,771	100,845
June-17	86,460	86,885
July-17	93,641	95,322
August-17	91,547	90,516
September-17	90,294	87,474
October-17	93,366	97,200
November-17	89,589	97,416
December-17	90,107	98,303

Tabel 4. DIFFERENCE ENERGY CONSUMPTION VS CUSUM

Month	*Difference energy consumption (GJ)*	*CUSUM (GJ)*
January-17	(5,970)	(5,970)
February-17	(2,901)	(8,872)
March-17	(3,824)	(12,696)
April-17	(8,819)	(21,515)
May-17	(8,074)	(29,589)
June-17	(425)	(30,014)
July-17	(1,681)	(31,695)
August-17	1,032	(30,663)
September-17	2,820	(27,843)
October-17	(3,834)	(31,678)
November-17	(7,827)	(39,504)
December-17	(8,196)	(47,700)

Table 4 shows that the value of CUSUM until December 2017 was 47,700 GJ. The CUSUM value shows the cumulative amount of energy savings obtained based on the differences in energy consumption values between actual and predictive values . CUSUM values obtained can also be presented in graphical form as shown in figure 5.

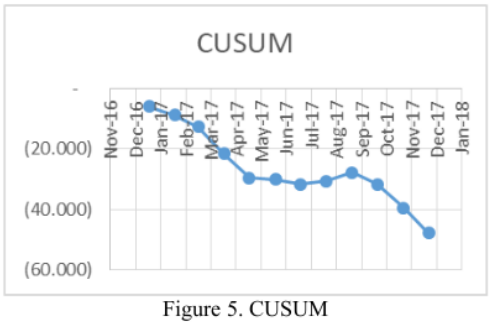

Figure 5. CUSUM

The CUSUM value or energy savings of 47,700 GJ are then converted into reduction of CO_2 emission. In Indonesia, the emission factor set for fossil energy use is 0.891 kg CO_2/kWH, based on the Minister of Energy and Mineral Resources No.3783/21/600.5/2008 [10]. Energy savings of 47,700 GJ or equivalent to 13,250,000 kWH in 2017 resulted in CO_2 reduction amount 11,805,750 kg or 11,805.75 tons.

The saving of energy consumption or reducing CO_2 emission at PT. X can be achieved trough steps :

- Implemented total predictive maintenance which is involving machine operators in maintenance activities.

- Promote 5R activities (Concise, Neat, Clean, Care and Diligent). This activity is a simple method for structuring and cleaning the workplace that was developed and implemented in Japan [11]
- Alignment pompa
- Modification of vaccum system in wire area

IV. CONCLUSION

- Energy Management System implementation can help the industry to reduce their production of CO_2 emission.
- PT. X can reduce their CO_2 emission amount 11,805.75 ton CO_2e in 2017 by implemented energy management system.
- The efforts of PT. X in efficiency use of energy source so as to reduce CO_2 emissions in line with the green industry concept which is launched by the government.

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