

CHAPTER I

INTRODUCTION

1.1 Background

Environmental pollution, global warming, climate change, biodiversity and natural resources degradation are environmental issues that have awakened human consciousness to the importance of environmental sustainability for human well-being. This underlies the environmental pillars as one of the sustainable development concepts in the sustainable development goal (SDGs), which have the same position with the other Three pillars of economic, social, and law and governance pillar (UN-SDG, 2018).

Today the world is more complex and unpredictable than ever before. The manufacturer, PT. Tirta Investama Klaten has experienced the increasing of market demand and so that it also increases the production capacity. This leads to the increase of energy consumption that lead to depletion of sources like natural gas, fossil fuels and many more. The worst is the depletion of natural resources influenced by the unsustainable extraction of raw materials becomes an increasing concern.

As one of the highest populations densities among other countries, without doubt, human impact on the environment is one such subject. Then, it now finally come to most people have recognized the degree to which they will have to change in order to resolve these problems. For most of human history, the density of global population has grown simultaneously with industrial beginnings. The development of new technology and implementation of fossil fuel technology have marked the beginning of Industrial Revolution. In which, it enables the industry especially manufacturers to develop more

efficient factories but as output increased, so did the environmental damaged caused by industrial activity. That's why the industrial activity should link the environmental and financial impact, since those are becoming an urge recently. Like what depicts in Figure 1.1, it represents total electricity consumed in AQUA – Danone for 3 different period recently.

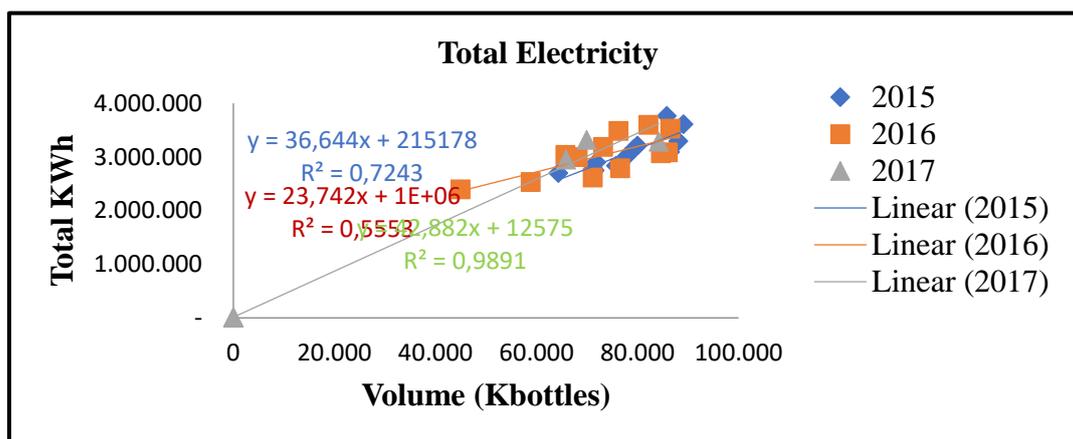


Figure 1.1 Total electricity used for the recent three years in global consumption
Source : Danone-AQUA

As industry has grown and taken an increasingly large role on the global competition, put most of the manufacturing organizations are facing the urge to seek more in adapting new strategies in order to gain more support for sustainability measures. These enable the manufacturer to respond to the market and customer's demand for sustainable products due to the scarcity of the natural resources or government policies. Now, number of manufacturers have establishing the standard that were once a nice benefit, such as reducing water and energy, minimizing waste and decreasing the pollution resulted from manufacturing activity. Because manufacturing process give the most significant effects towards the sustainability of environment. Therefore, in this study, aimed to evaluate the entire life cycle of product –Polyethylene terephthalate (PET) bottled drinking water, as commonly named AQUA-, in PT. Tirta Investama using life cycle assessment in order to assess the environmental impacts as result of industrial and manufacturing activities that lead to destruction of ecosystem. The life cycle assessment is carried out as the method in this research because this is the latest development in assessing the environmental impact along the product chain, to manifest the sustainable measure. While in implementing this method, one thing should be set is the system boundary of the study.

Here, the system boundary is adopting cradle-to-grave approach, it includes the activities from raw material extraction until the product is leaving from factory. Additionally, even though using cradle-to-grave, this research does not touch the disposal, recycled or the waste management area. Then the central role of life cycle assessment is substantiated giving the consideration in implementing and taking further action related to improvement action. The role of engineer and manufacturer in order to improve the performance of operation process as well as the sustainability is judged a bit challenging. It concludes that industry should not only meet the marginal profit but also the product's environmental justification. By this situation, the optimization using eco-efficiency was the most suitable method and approach addressed to manufacturer who want to attain both the beneficial in economic view simultaneously respond to environmental urge. Besides, using this eco-efficiency can measure the productivity performance in manufacturing activities. Additionally, this approach also will derive the Eco-efficiency ratio (EER) that represent the percentage of how cost-effective the project would be running and still considering in ecological or environmental impact. Then to ensure that the project or solution has met the objective, the post-implementation analysis was reviewed by considering the net saving of pre and post implementation of project. The net saving will then answer and evaluate whether the manufacturer gets the greatest possible benefit from the project or not corresponding to the alternative that has been proposed. Yet, considering the productivity as the urge in assessing the life cycle of PET bottle production.

1.2 Problem Formulation

Based on the background of research above, then the problem is derived to be built, what is the solution or proposed alternative to improve the performance of existing system resulted from environmental impact of PET bottled life cycle by optimizing the ecological and economical aspects.

1.3 Research Objectives

Based on the problem formulation derived above then this research has objective to build the new system and/or propose alternative as the improvement corresponding to the result

of environmental impact of PET bottled drinking water life cycle by optimizing the economical and ecological aspect.

1.4 Research Limitation

The following are the limitation of the research:

1. This study provides no comparison such a kind of those similar product –water drinking bottle- since the research only takes place in one manufacturer only.
2. The life cycle assessment excludes the disposal stages or waste management and customer usage (due to lack of information from customer and need a longer study observation).

1.5 Research Benefits

The following are the benefits of the research:

1. The manufacturer or the company can use lesser energy simultaneously reducing the environmental impact of production process.
2. The manufacturer can improve the productivity and reach business sustainability.
3. The result will be considered as decision making of further action to keep and maintain the sustainable of manufacturing.

1.6 Systematical Writing

The systematical writing of this research are:

CHAPTER I INTRODUCTION

This chapter explains the background and problem characteristic that need to be solved. It explains more on the evidence of the current system in manufacturer and what are going to be attained. It shows some reasons and urgency behind why conducting life cycle assessment & eco-efficiency and why choosing these as the method. Also explains what are going to be found and solved. The background of problem that

will derive to problem formulation. This chapter also provides the scope or limitation of the study, so it would not exceed these borders.

CHAPTER II LITERATURE REVIEW

This chapter consists of two main theoretical study; inductive and deductive. Inductive study will focus more to compare and collect the current study of the related previous research and supporting literatures underlying the research. Most of the study and literature are searched with the keywords of “LCA”, “Eco-efficiency”, “Sustainable manufacturing”, “productivity” and “linear programming”. For deductive study consist of literature and theoretical studies related to LCA until eco-efficiency, including the definition, formula and illustrations.

CHAPTER III RESEARCH METHODOLOGY

This chapter consists of research methodology flow in which describing the detailed series of research object and method used that depicted in framework concisely. It also explains the LCA stages as the initial method and eco-efficiency as the approach to build the new proposed alternative. This chapter is more likely systematical writing that already structured and fitted with the case of life cycle assessment.

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter is the core among the other, since it describes the data collection and processing, analysis and result of LCA and eco-efficiency. It begins with how the data are obtained until the output or result from applying the life cycle assessment method and eco-efficiency approach. This chapter explains the way to gather the raw data until being inputted in software to gain the result. This chapter is a preliminary-guidance for generating the discussion of the result that will be written in chapter V.

CHAPTER V DISCUSSION

This chapter discusses about the result impact assessment in which generated by LCA and limitation of the study. Most of this chapter explain of “why” the process happened in certain ways, yet corresponding to the result and provide the interpretation of LCA result. Mostly tell about the objective and the meaning of the result. It will be the core discussion in order to get a comprehensive understanding about the whole research, in which basically derives the suggestion and recommendation. Also consider some of parameters and uncertainty in which can be either become the consideration to further research. This chapter is linked with the data processing and suggestion in chapter VI.

CHAPTER VI CONCLUSION AND RECOMMENDATION

This chapter provides short and precise statements described about the conclusion and what had been done. While for the recommendation are derived from the discussion in chapter V. The recommendation consists of two, addressed to manufacturer and further researcher.

REFERENCES Reference list contains the systematic writing of citation from the publication, e-book, journals, printed book, article and many more related to the literature review that support this thesis. All the lists are coming from each in-text citation.

APPENDIX This section is designated to place the additional information in detail related to the 11 impact categories resulted from LCA. It is placed at the end of thesis pages.