CARBON COST MANAGEMENT OF COAL ENERGY (CASE STUDY AT PT. SEMEN PADANG)

THESIS

ALVIN NOVALINO
07153138

ACCOUNTING DEPARTMENT
FACULTY OF ECONOMICS
ANDALAS UNIVERSITY
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NIP. 196412281992071001

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07153138

ABSTRACT

The purpose of this study was to determine the carbon cost management in PT Semen Padang. This study is descriptive research in form of case study. The outputs of this study are the information related to tons of coal energy consumed, coal energy reduction consumption, coal energy CO2 emission reduction, coal energy cost reduction during last three years (2009-2011) and PT Semen Padang initiatives to reduce CO2 emission to create competitive advantage.

This study result showed that PT Semen Padang did not conduct yet the reduction of CO2 emission based on the calculation of coal energy consumption reduction and CO2 emission. The number of tons of coal energy consumed by PT Semen Padang increased in last three years. The increasing of coal consumption in line with the number cements produced. The number of CO2 emission produced increased accordance with the number of coal energy consumed in last three years. This research also calculates cost reduction due to coal consumption efficiency, in year 2010, cost reduction due to coal consumption was efficient which is Rp.5,238,497,202. In 2011, cost reduction due to coal consumption was inefficient which is Rp.585,034,149. These results could be used as reference in order to evaluate the efficiency of coal energy consumption, cost of coal consumption and CO2 emission.

Keyword: *carbon cost management, coal energy consumption reduction, coal energy CO2 emission reduction, coal energy cost reduction*

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INTRODUCTION

1.1 Problem Background

The environmental issues became more popular nowadays around the world. One of the environmental issues which developed is Global Warming. Global warming is basically the increase in the temperatures of the Earth's atmosphere, land masses and oceans (Fiset, 2007). This circumstance happened because of many factors, one of the factors is the Carbon Dioxide which is the most important greenhouse gases (GHG) causing global warming that are being dumped in the atmosphere due to human activity. The main human contribution to total carbon dioxide in the atmosphere comes from burning fossil fuels, namely oil, coal, and natural gas. In addition, GHG emissions are accumulating in the atmosphere, causing climatic changes and potential negative feedback on the health of ecosystems (Haberl et al., 2007). Without the seriousness of dealing with climate change, Earth will be threatened.

This issue also became interest to the manufacturing company that run their business relate to burning fossil fuels, namely oil, coal, and natural gas which produces Carbon Dioxide as their output. Especially after Kyoto protocol was released on December 11, 1997 in Kyoto, Japan but it entered into force on February 16, 2005. It was an international agreement linked to

into force on February 16, 2005. It was an international agreement linked to the United Nations Framework Convention on Climate Change, dictated how governments, business entities and consumers would need to change behavior and bring about a new economic environment. This protocol has purpose to reduce global warming and to cope with the effects of temperature increases that are unavoidable after 150 years of industrialization. This appointment also stated that the industrial countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990. And the Kyoto Protocol was also generally seen as an important first step towards a truly global emission reduction regime that will stabilize greenhouse gas emissions, and provides the essential architecture for any future international agreement on climate change. Some of the key measures in this Kyoto protocol that business entities are considering are: investments in low- CO2 emission technologies, counting the costs of carbon regularity compliance and passing on the increased cost of carbon regulation to consumers through higher prices (Ratnatunga, 2007).

Indonesia as a country in which the energy sector contributed immensely not only to drive the national economy, but also in contributing direct income from the sale of energy products, particularly fossil fuels (Nugroho, 2004). This country became the 124th country to ratify the Kyoto Protocol through ratification of Law No.17 of 2004, on July 28. And Indonesia as the developing country also gets the benefits in the form of

financial flows and technology from developed country like Japan as Clean Development Mechanism (CDM) of Kyoto Protocol. The manufacture companies in Indonesia should follow this Kyoto Protocol in order to participate in reducing global warming effect.

PT. Semen Padang as one of Manufacture Company in Indonesia also gets the impact of this Kyoto Protocol. As the first cement factory in Indonesia, PT. Semen Padang which incorporated on March 18, 1910 under the name NV *Nederlandsch Indische Maatschappij Portland Cement* (NVNIPCM) has production capacity of 6 million tons/year with the demand for coal by 760 thousand tons/year and CO2 emissions that could potentially generate a large enough. As a form realization of Indonesia ratified the Kyoto Protocol into the climate change legislation, Industry Minister, Mohammad Hidayat Sulaeman, on October 20, 2011, inaugurated the power project which is a join NEDO (New Energy and Industrial Technology Development Organization) of Japan which is a Japanese government agency which undertakes research and development in renewable energy and energy conservation and PT Semen Padang, to process gas of carbon dioxide (CO2) into electricity.

Power project, called the *Waste Heat Recovery Power Generation* (WHRPG), was the first time applied to the Indonesian cement industry. According to Memorandum of Understanding (MoU) between NEDO and PT. Semen Padang, for this project NEDO to bear 64 percent to the cost of

procurement of equipment from the total value of this investment to operate the plant reaches 2 billion yen, equivalent to 200 billion. The Japanese invested funds amounting to Rp130 billion in the form of equipment. Meanwhile, the rest came from PT Semen Padang 36% (73.6 Billion) which provides the supporting infrastructure WHRPG project. Since the first time this project began in 2009 with the target of process in civil construction work in late November 2010, the mechanical and electrical construction work in late November 2011, the commissioning in the end of November 2011, and test demonstration in the end of May 2012. This technology is also expected to apply to other cement producers in order to perform efficient use of energy will be more expensive in the future.

This agreement not only gives impact to reduce CO2 emissions by up to 46 thousand tons per year through the Clean Development Mechanism, but also able to suppress the production cost of Rp.33 billion per year after the operation of power generation from waste heat during combustion because WHRPG believed to be able to lower and stabilize the temperature of exhaust gas carbon dioxide produced by cement plants (Viva News, 2011).

Based on the description above, the writer is interested to develop the research which entitles **"Carbon Cost Management of Coal Energy in PT. Semen Padang"**.

1.2 Problem Definition

Based on the explanation in the background, the major questions of the research are:

1. How many tons does PT Semen Padang consume coal energy?
2. How to determine the tons of coal energy reduction consumption?
3. How to determine coal energy CO2 emission reduction?
4. How to determine coal energy cost reduction?
5. What are PT Semen Padang initiatives to reduce CO2 emission of coal to create competitive advantage?

1.3 Research Objective

The purposes of this research are:

1. To obtain tons of coal energy consumed by PT Semen Padang
2. To determine of coal energy reduction consumption
3. To determine coal energy CO2 emission reduction
4. To determine coal energy cost reduction
5. Semen Padang initiatives to reduce CO2 emission to create competitive advantage

1.4 Significance of the Study

This research is expected to provide the benefits to many parties, among others;

1. For PT Semen Padang

   Analysis result obtained from this research is expected to be consideration to increase the environmental performance in PT Semen Padang, since

environmental performances are also plays an important role beside the financial performance. PT Semen Padang can lead to the superiority in competition in the present and future and of course to bring into a betterment of the organization. It is also appropriate with the vision of PT Semen Padang

2. For Writer

   Giving insight to comprehend the cost reduction for the creation of the competitive edge especially in PT Semen Padang.

3. For Academies, analysis and other parties this research can be used for guidance for the next research.

1.5 Writing Systematic

This research explanation divides into five chapters which consist of:

Chapter I Introduction

This chapter explains about problem background, problem definition, research objective, significance of study, and writing systematic.

Chapter II Theoretical Framework

This chapter explains about Previous Research, Stakeholder Theory, Sustainable Development, Corporate Social Environment Responsibility, Kyoto Protocol, Carbon Trading, Carbon Cost Accounting, CO2 Reduction Effort and Carbon Foot Print, Cost Management, CO2 Reduction from Consumption of Coal Energy.

Chapter III Research Methodology

This chapter explains about Type of Research, Scope of Research, Type and Sources of Data, Data Gathering Method and Data Analysis

Chapter IV Data Analysis and Result

This chapter explains about the result and decision of the analysis

Chapter V Conclusion

This chapter presents the conclusions, limitations and suggestions of this research

CHAPTER II

THEORETICAL FRAMEWORK

2.1 Previous Research

The previous research was conducted by Fefen Suhedi in 2005 which the title is"CO2 Emissions from Domestic Energy Consumption". This paper presents the results of a survey on household energy consumption contribution to CO2 emissions in either a residential area in the City of Cirebon involving 200 respondents. Household energy consumption includes the consumption of electric energy and fuel for domestic uses which is not for production purposes. The research methodology used in this research by estimating CO2 emissions from energy consumption obtained from volume of energy use (eg, kWh of electricity, liters of fuel) multiplied by a factor of the average CO2 emissions (eg, electricity emission factors in units of kg CO2/kWh).

This research estimates of CO2 emissions from fuel consumption divided by type of fuel used. Average emission from household fuel consumption was 74.8 kg of CO2 per home per month. Furthermore, average emissions from the use of gas coming from the state gas company by 55 kg of CO2 per month, families who use bottled gas emissions an average of 48 kg of CO2 per month, and families use kerosene emits an average of 96 kg of CO2 per month.

Obtained from this survey, there is no strong correlation between family income, class of installed power, and electrical energy consumption. This

means that most households have electric energy usage patterns that are relatively similar. Estimation of CO2 emissions from fuel consumption divided by type of fuel used.

The main factors affecting CO2 emissions from the generation of electrical energy is the energy needs, the type of fuel used, and the efficiency of thermal power plant. A number of other factors that influence emissions, among others: economic growth, price of electrical energy, climate, fuel prices, and the amount of electrical energy that can be derived from hydroelectric power, the sources are renewable, and nuclear power.

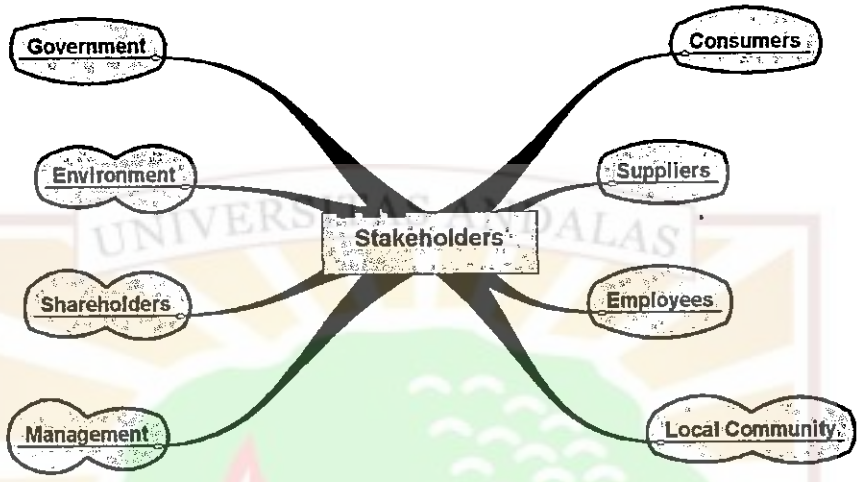
This paper used this previous research as a guidance to calculate the Carbon Dioxide (CO2) Emission by using the formula which according to Greenhouse Gas Inventory Guidelines, IPCC.

2.2 Stake Holder Theory

The stakeholder theory is a theory of organizational management and business ethics that addresses morals and values in managing an organization (Philips, 2003). The traditional definition of a stakeholder is "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984). It can be defined also as a person, group, or organization that has direct or indirect stake in an organization because it can affect or be affected by the organization's actions, objectives, and policies. A very common way of differentiating the different kinds of stakeholders is to consider groups of people who have classifiable relationships with the organization

organization Friedman means that there is a clear relationship between definitions of what stakeholders and identification of who are the stakeholders.

Figure 2.1 Stakeholder Diagram



Source: Aashwin, 2006 (Bized)

This resource will look at some of the rights and responsibilities of each stakeholder group and look at some examples of where the different expectations of each stakeholder group might conflict with others. The problem for the business is how they satisfy the different responsibilities they have to these different groups. A common problem that arises with having numerous stakeholders in an enterprise is that their various self-interests may not all be aligned. In fact, they may be in conflict with each other. The existence of an enterprise is strongly influenced by the support provided by stakeholders to the company (Chariri, 2011).

The stakeholder theory can be, and has been, presented and used in a number of ways that are quite distinct and involve very different methodologies, types of evidence, and criteria of appraisal (Donaldson, 1995).

Stakeholder view, use the following definition of the term "stakeholder": "The stakeholders in a corporation are the individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities, and that are therefore its potential beneficiaries and/or risk bearers (Post, Preston & Sachs, 2002). This definition differs from the older definition of the term stakeholder in Stakeholder theory (Freeman, 1984) that also includes competitors as stakeholders of a corporation. In the meantime, business managers may beneficially consider non shareholder constituencies. The motivation for doing so may be pragmatic (for the long-term well-being of the company) or normative (for moral reasons), but the law does not currently require corporations or their managers to implement stakeholder theory. (Mayer, 2006)

2.3 Sustainable Development

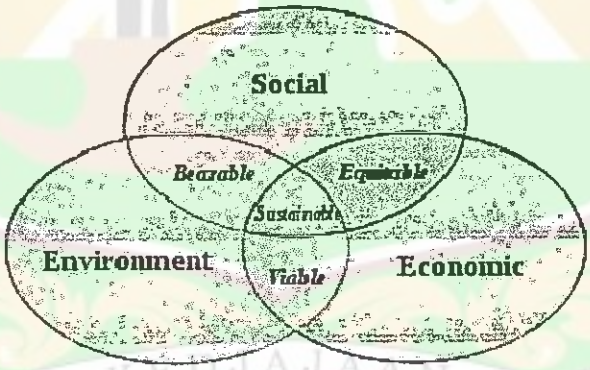
Among the many ways that sustainability has been defined, the simplest and most fundamental is: "the ability to sustain" or, put another way, "the capacity to endure. It can be defined as the ability of an ecosystem to maintain ecological process, function, biodiversity and productivity into the future. In ecology, the word describes how biological systems remain diverse and productive over time. For human, it is potential for long-term maintenance of well being, which in turn depends on the well being of the natural world and the responsible use of natural resources. Sustainability means meeting the needs of

the present without compromising the ability of future generations to meet their own needs.

Corporate sustainability reporting has a long history going back to environmental reporting. The first environmental reports were published in the late 1980s by companies from the chemical industry which had serious image problems. The waste of their production has damage the environment. To repair their image, the companies need to reduce the environment damage and conserve the current environment which has best ideal condition.

Not only for chemical industry has this condition but also faced by mining industry. Many parties blame the industries as the main contributor for forest damage, landslide, flood and any other environment damages.

Figure 2.2 Sustainability Development



Source: Adams, 2006 (Wikipedia)

As the time goes, the sustainability term was expanding to broad meaning, not only for environment but also all aspects that related to surviving the continuity. Aspects such as social, economics, human right and many more has

been additional aspects to nowadays sustainability terminology. Based on the picture 2.2 can be more clear seen the meaning of sustainability. The picture explained how the balance between social, environment and economic can achieve the ideal condition. By maintaining the three aspects the company can maintain their sustainability. (Habib, 2010)

2.4 Corporate Social Environment Responsibility

Currently there is no definition of Corporate Social Responsibility that is universally accepted by various institutions. Some definitions of Corporate Social Responsibility below Show the diversity of understanding of CSR by various organizations.

a. According to World Business Council for Sustainable Development (WBCSD), corporate social responsibility defined as continuing commitment of businesses to behave ethically and contribute to economic development, while improving the quality of life of employees and their families, as well as local communities and the wider community in general.

b. According to ISO 260001 Guidance on Social Environmental Responsibility, CSR is:

> *"The responsibility of an organization against the effects of decisions and activities on society and environment in the form of a transparent and ethical behavior consistent with sustainable development and social welfare; consider the expectations of*

stakeholders, in accordance with established laws and norms of international behavior; and integrated with the organization as a whole"

c. Undang-undang No.40 year 2007 about Corporate Social Responsibility (CSR) stated that CSR is a company's commitment to support the endurance development in order to increase the quality of live and environment so that it could give advantages both to company and society.

Based on the above definition, Corporate social Responsibility can be defined as responsibility of company toward costumer, supplier, employees, shareholders, community and the environment in all aspect of operation due to company's decisions and activity.

By applying the CSR, the company will gain social legitimacy and maximize their long-term financial strength. This indicates that companies that implement CSR would expect a positive response by market participants.

Corporate required disclosing the activities and efforts in tackling environmental problems by having Corporate Environmental Responsibility (CER) as a subsection of Corporate Social Responsibility (CSR) (Fitra, 2010).

2.5 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh in 2001, and are called the "Marrakesh Accords."The provisions of the Kyoto Protocol are legally binding on the ratifying nations, and stronger than those of the UNFCCC.

Countries that ratify the Kyoto Protocol agree to reduce emissions of six greenhouse gases that contribute to global warming: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, HFCs and PFCs. The countries are allowed to use emissions trading to meet their obligations if they maintain or increase their greenhouse gas emissions. Emissions trading allow nations that can easily meet their targets to sell credits to those that cannot.

Energy sector, particularly with the activities of burning fossil fuels (mainly coal, petroleum and natural gas) is a major cause of emissions of carbon dioxide (CO2) which is considered responsible for global climate change and are targeted to be reduced by the Kyoto Protocol. In three-quarters of greenhouse gas emissions emitted in the 1990 Earth comes from fossil fuel combustion activities. Based on this relationship, the impact of the Kyoto

Protocol for the energy sector is very clear: urged changes in consumption patterns, production, energy distribution and development of environmentally friendly energy technologies or that produce minimal greenhouse gas emissions.

To achieve carbon dioxide emission reduction targets that enactment, the Kyoto Protocol is equipped with a flexible mechanism which became a very important part of the Protocol. Included in the flexible mechanisms of Kyoto Protocol are emissions trading (ET), joint implementation (JI) and the "clean development mechanism" (CDM).

JI and CDM are referred to as project-based mechanisms because they are funding projects actual; JI generally funds projects in Eastern Europe and former Soviet Union, while projects CDM only take place in developing countries who do not have emission reduction targets as in Kyoto Protocol. Thus, the CDM is the only part of the Kyoto Protocol that is directly involving developing countries in reducing greenhouse gas emissions. Under the Kyoto Protocol offers win-win solution between developed to developing countries in order to further reduce greenhouse gas glass, where developed countries invest in developing countries in projects that can GHG emissions reductions, in exchange for CERs (Certified Emission Reductions).

CDM is a mechanism of the Kyoto Protocol that allows Annex-I countries and developing countries work together to do a "clean development". With the facility CDM, Annex-I countries can meet their emissions reduction obligations by doing the project "emission reductions" in

a developing country and the developing countries get financial compensation and technological co-operation from them.

The purpose of CDM as defined by the Kyoto Protocol (Article 12) is to assist developing countries to sustainable development (sustainable development) and contributing to the achievement of global emissions reduction goal, and to assist Annex-I countries achieve their emission reduction targets. Annex-I countries investment in developing countries that produce emission reductions will be certified and credit of "certified emission reductions" (certified emission reduction, CER) will be given to Annex-I.

The advantages of the CDM is not owned by the Kyoto Protocol flexible mechanisms is that CERs obtained from 2000 to 2007 can be used as credits to meet emission reduction targets in the first period of implementation Kyoto Protocol. However, these efforts do CDM projects will only be rewarded later when developing countries where doing CDM projects have ratified the Kyoto Protocol. Without ratification of the Kyoto Protocol, the efforts seemed unlikely to be recognized as an official activity of CDM and cannot be given credit or certificate of his emission reduction (Nugroho, 2004).

2.6 Carbon Trading

Implicit within the decision to publish a special debating forum of the European Accounting Review on carbon trading is the assumption that 'carbon' refers to something of significance with respect to the accountability of firms to stakeholders for their financial and non-financial performance. Put

more carefully, the area of concern for the special debating forum is not with carbon per se but arises from a concern about the extent to which anthropogenic induced global climate change is a possibility (which itself arises from increased concentrations of greenhouse gases (hereafter GHGs) in the atmosphere).

Carbon emissions trading is a form of emissions trading that specifically targets carbon dioxide (calculated in tones of carbon dioxide equivalent or tCO_2e) and it currently constitutes the bulk of emissions trading. This form of permit trading is a common method countries utilize in order to meet their obligations specified by the Kyoto Protocol; namely the reduction of carbon emissions in an attempt to reduce (mitigate) future climate change.

The carbon trade came about in response to the Kyoto Protocol. Signed in Kyoto, Japan, by some 180 countries in December 1997, the Kyoto Protocol calls for 38 industrialized countries to reduce their greenhouse gas emissions between the years 2008 to 2012 to levels that are 5.2% lower than those of 1990.The idea behind carbon trading is quite similar to the trading of securities or commodities in a marketplace. Carbon would be given an economic value, allowing people, companies or nations to trade it. If a nation bought carbon, it would be buying the rights to burn it, and a nation selling carbon would be giving up its rights to burn it. The value of the carbon would be based on the ability of the country owning the carbon to store it or to prevent it from being released into the atmosphere. For example if Country A exceeds its capacity of GHG and Country B has a surplus of capacity, a

monetary agreement could be made that would see Country A pay Country B for the right to use its surplus capacity.

A market would be created to facilitate the buying and selling of the rights to emit greenhouse gases. The industrialized nations for which reducing emissions is a daunting task could buy the emission rights from another nation whose industries do not produce as much of these gases. The market for carbon is possible because the goal of the Kyoto Protocol is to reduce emissions as a collective. On the one hand, carbon trading seems like a win-win situation: greenhouse gas emissions may be reduced while some countries reap economic benefit. On the other hand, critics of the idea suspect that some countries will exploit the trading system and the consequences will be negative. While carbon trading may have its merits, debate over this type of market is inevitable, since it involves finding a compromise between profit, equality and ecological concerns (Investopedia Website, 2011).

In addition, Carbon trading also defined as a strategy for mitigating these and other emissions through a Cap-and-Trade system. Cap-and-Trade systems are regulatory programs that 1) cap harmful emissions such as mercury, sulfur and carbon by limiting them through a permitting system and 2) distribute the emissions permitted to different stakeholders (these rights are called allowances, permits or credits) and The Kyoto Protocol is a global Cap-and-Trade program to mitigate the anthropogenic (man-made) production of greenhouse gases that is driving climate change.

2.7 Carbon Cost Accounting

Today's challenges to business to raise the level of its environmental performance come from many quarters. They arise from new legislation and government regulations, market pressures from the 'green consumer', the interests of stakeholders such as investors and employees, and general public awareness, focused by the activities of environmental groups and reporting in the media. It has become essential for companies to increase their responsibility regarding all aspects of the environment and to adapt existing practices so as to cause less environmental damage.

Environmental cost is a core part of managerial accounting. So that a company's activities do not damage the environment or that any such damage is put right.

Carbon Cost Accounting is a subset of the push towards 'environmental cost accounting' that highlights the cost impacts 'beyond' those related to a specific cost object such as a product (Adams, 2006).

Typical environmental cost:

1. Raw Material

   Raw material environmental costs are simply the cost of the raw materials such as plastics, cartridges and steel in the waste. Every time a raw material is used and does not become a product, it becomes a waste. Even

when such materials become saleable products, on the obsolescence of the product, it goes into landfills as waste.

2. Labor

   Prior to sale, the typical labor environmental costs would be the labor component of an off-specification product that becomes waste. Post sale, the labor costs that are required for re-cycling of parts is an environmental related cost.

3. Overhead

   Utility costs, such as water and energy, are also often overlooked in determining the true cost of waste generation, both before and after a sale. These costs are a significant item in CO2 emissions management

4. Waste Management

   The most obvious environmental expenses are the treatment and disposal costs of waste generated in the production process

5. Recycling

   This is a form of waste management at the obsolescence end of the product life cycle

2.8 Carbon Dioxide Emission Reduction Efforts and Carbon Footprint

There are three primary methods for reducing the number of carbon dioxide in the atmosphere: employing energy efficiency and conservation practices; using carbon-free or reduced-carbon energy resources; and

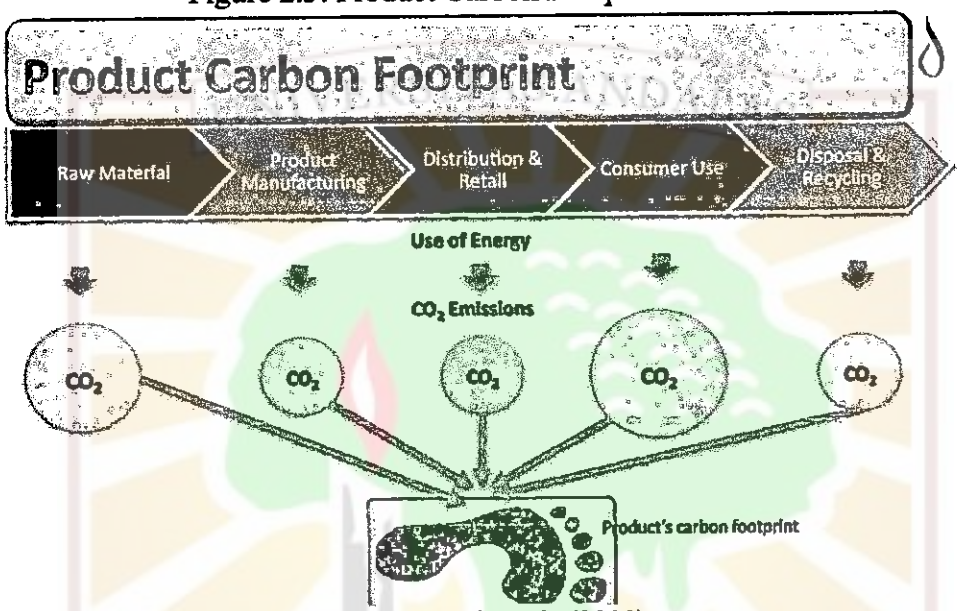
capturing and storing carbon either from fossil fuels or from the atmosphere. The other method to reduce CO2 is Carbon Footprint.

There is no exact academic definition of Carbon Footprint yet, and debate continues. The concept of Carbon Footprint derives from the concept of Ecological Footprint raised by Wackernagel and Rees in 1996. As one part of Ecological Footprint, the land area needed to sequester CO2 emitted from burning fossil fuel is measured to estimate the land requirement for energy use (Wackernagel & Rees, 1996). However, with increasing public and political concern of climate change, Carbon Footprint has been developed into a separate concept with extended scopes.

The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product. According to National Centre for Sustainability, a carbon footprint is a green house gas emissions inventory which captures all business activities resulting in emissions. It can assist organizations to identify and target resource in efficiencies and be used to report the impact of products and services on clients and stakeholders. It can be concluded that Carbon footprint is the total set of Green House Gas (GHG) emission caused by an individual, organization, event, region, products/services or building (Deshpande, 2010). It is also defined as the contribution of individual, product or company to climate change through the emission of CO2 and other green house gasses.

The Product Carbon Footprint shown in the picture bellow. It shows as kind of Product Carbon Footprint such as Raw Material, Product Manufacturing, Distribution and Retail, Consumer Use and Disposal and Recycling which the output of this system is Carbon Dioxide (CO2).

Figure 2.3: Product Carbon Footprint



Sources: Deshpande (2010)

2.9 Cost Management

Cost management focuses upon measuring performance, comparing against expectations and finding reasons for divergence. It also endeavors to predict final outcomes and to provide strategic recommendations for changing or mitigating such. It is forward looking and attempts to answer why, what it means and what can be done about it.

Cost management consists of the four main activities or processes such as Resource Planning, Cost Estimating, Budgeting and Cost Control. (Tichacek, 2005)

1. Resource Planning

   Cost management is begun by planning the resources that will be used to execute the project

2. Cost Estimating

   Estimating is the process of determining the expected costs of the project

3. Budgeting

   The budget is a spending plan, detailing how and at what rate the project funding will be spent

4. Cost Control

   Cost control is the final step of the cost management process but it continues through the end of the project

Four objectives in cost management (Tichacek, 2005):

1. Spending timely—Ensure that money or resources are expended in accordance with the project or corporate capital expenditure plan;
2. Spending wisely—Ensure that monies are well-spent, i.e. that a planned unit of gain is achieved for each unit of expenditure;
3. Spending correctly—Ensure expenditures only for those things for which we are obligated;
4. Spending perceptively—Ensure that spending versus achievement variances are identified, analyzed, corrected or trended so that early warnings can enable timely actions.

2.10 Carbon Dioxide Emission from the Consumption of Coal Energy

Coal is a combustible black or brownish-black sedimentary rock usually occurring in rock strata in layers or veins called coal beds or coal seams. It is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, with smaller quantities of sulfur, oxygen and nitrogen. Throughout history, coal has been a useful resource for human consumption. It is primarily burned as a fossil fuel for the production of electricity and/or heat, and is also used for industrial. It also has long been used, mainly for production activities in the cement industry and power plants. This source is as an energy alternative that has economical value high enough so that it can replace the role of fuel oil in production activities for the industry.

In Indonesia, over the past eight years, the development of coal consumption in cement industry fluctuates. During 1998 - 2001, the average coal consumption increased very significantly, i.e. 64.03%, but in 2002 and 2003 had decreased to 7.59%. Entering 2004, the demands for coal in cement industry have changed positive, i.e.19.78% as economic growth began to improve in the country. Year 2005, there were approximately 17.04% of domestic demands for coal used by the cement industry or 5.77 million tons (The review team of the National Coal Policy Review Group Mineral and Coal Technology Research and Development Center for Mineral and Coal 2006). This nonrenewable resource also used by PT. Semen Padang as energy

source in cement production. The energy of this coal needed to produce cement. As addition, in the manufacture of cement, coal used as fuel in the *kiln mill* (function of the *kiln mill* is a place of *raw mix* into *clinker* burning with coal fuel) both at the beginning heating (pre-heater), and in the process of the *kiln* itself (Patria, 2008)

Coal is used as an energy source in cement production. The energy required to produce cement. The oven is usually burn coal in powder form and need coal by 450g for 900g of cement produced. It is likely to remain an important input for world cement industry in the years upcoming. It is also one of the sources of greenhouse gas emissions caused by activities humans and the industry is committed to suppress emissions. Greenhouse gases associated with coal including methane, carbon dioxide (CO2) and oxides nitro substances (N2O). CO2 and N2O released when coal is used for electricity generation or industrial processes such as production of steel and cement plants.

The general method for estimating greenhouse emissions from energy sources can be describes as follows:

Emissions = Ai x EFi

Where:

Emissions = Emissions (kg)

A*i* = Consumption of type *i* or the amount of product *i*

EF*i* = Emission factors of material type *i* or product *i*

Emission factor is the amount of GHG emissions released into the atmosphere per unit of specific activity. Status of GHG emissions is a condition of GHG emissions in a certain period of time which can be compared based on the results of a calculation using the methods and GHG emission factors / uptake is consistent (Regulation of The President of The Republic of Indonesia Number 71 2011).

Emission factor is determined based on the research and very specific for any material or product. Because of there is no specific emission factors for Indonesia, the emission factors are used specified by the IPCC (Greenhouse Gas Emissions in Numbers - The Ministry of The Environment of The Republic of Indonesia, 2009).

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Type of Research

The type of the research is qualitative. It defines qualitative research as "a form of systematic empirical inquiry into meaning". Qualitative research is used to gain insight into people's attitudes, behaviors, value systems, concerns, motivations, aspirations, culture or lifestyles. It's used to inform business decisions, policy formation, communication and research. Focus groups, in-depth interviews, content analysis, ethnography, evaluation and semiotics are among the many formal approaches that are used, but qualitative research also involves the analysis of any unstructured material, including customer feedback forms, reports or media clips and also to describe the real condition of the object.

3.2 Scope of Research

This research is focused on the carbon management of coal energy only in year 2009, 2010 and 2011 because it represents current condition of carbon management of coal energy.

3.3 Types and Sources of Data

The data used in this research are primary and secondary data.

1. Primary data is the data collected from the site of research.
2. Secondary data are obtained through existing sources

3.4 Data Gathering Method

In order to get Information that appropriate to research objective, researcher is willing to use some method which think suitable to the data needed.

3.4.1 Field Research

1. Interview

   One method of collecting data is to interview respondents to obtain information on the issues of interest. Interview could be unstructured or structured, and conducted either face to face or by telephone or online. For this research, the writer is willing to use Structured Interviews. This Interview method is conducted to the parties who responsible and take a apart on the management of Department of Production, Department of Accounting and Department of Occupational Health, Safety and Environment (K3LH) that conducted face to face, directly come to the Company and ask with a list of predetermined questions to be asked of the respondents either personally

2. Observation

   Observation is the technique in finding the data by comes directly to the object research by participating in measuring or preparing or just discuss and brain storming with the person who in charge.

However, this research conducted by direct observation to the company and interviewing the management of PT Semen Padang, especially management of Department of Production, Department of Accounting and Department of Occupational Health, Safety and Environment. This interview is aimed to understand and get information about coal energy consumption of PT Semen Padang in last three years, production process, and development of Alternative Fuel and Raw Materials.

Table 3.1: List of Primary Data Collection Process

No.	Date	Person	Topic	Times
1	9 January 2012 16 January 2012	Ir. Benny Ismanto (Head of Planning and Control of Production and Energy)	Explore the coal consumption and cements produced data during last three years	30 Minutes
2	19 January 2012 24 January 2012	Mulya Andhika Putra, ST (Head of Environment of Occupational Health, Safety and Environment Department)	Explaining the effort to reduce CO2 emission by using alternative fuel and raw material	30 minutes
3	19 January 2012 1 February 2012	Arini Kasmira,SE (Head of Cost accounting Bureau of Accounting Department)	Explore the production process and cost assigned to coal consumption	30 Minutes

3.4.2 Library Research

Data collection that is theoretical by discussing and studying the books of literature and writings relating to the carbon cost management.

3.5 Data Analysis

This research is aimed to see the carbon cost management of coal energy in PT Semen Padang. In this research, the author will do several steps to collect the data related to:

1. Coal Energy Consumption Reduction

   Several steps to determine coal consumption reduction:

   a. Determine the number of coal energy consumed by PT Semen Padang during last three years, the data is as follows:

Table 3.2: Coal Energy Consumption 1

Year	Coal Energy Consumption (Ton)
2009	884,121
2010	926,345
2011	1,005,107

Sources: PT Semen Padang

   b. Determine the number of cement produced by PT Semen Padang during last three years, the data is as follows:

Table 3.3: Cement Produced

Year	Cement Produced (Ton)
1	3
2009	5,364,706
2010	5,675,227
2011	6,151,636

Sources: PT Semen Padang

c. Determine the ratio of total coal energy consumption to total cement produced by PT Semen Padang during last three years,

The formula is:

$$\frac{\text{Coal Energy Consumption}}{\text{Cements Produced}}$$

The purpose of calculating this ratio of the total coal energy consumption to total cement produced is to measure how efficient a process consumed input.

d. Determine the coal energy consumption efficiency

The formula is:

(Current Year Ratio – Previous Year Ratio) x Cement Produced in Current Year

The purpose of this calculation is to determine the efficiency of coal energy consumed in certain period

2. CO2 Emission Reduction

Several steps to determine CO2 emission reduction:

a. Determine the number of coal energy consumed by PT Semen Padang during last three years, the data is as follows:

Table 3.4: Coal Energy Consumption 2

Year	Coal Energy Consumption (Ton)
2009	884,121
2010	926,345
2011	1,005,107

Sources: PT Semen Padang

b. Convert the unit of coal energy consumed from Ton to Giga Joule. 1 ton of coal equivalent (TCE) is equal to 29.3076 gigajoules (GJ). Because there is no direct conversion from ton to terra joule as the units of CO2 emission factor of fuel type, it should be converted to gigajoules.

c. Convert the unit of coal energy consumed from Giga Joule to Terra Joule.

1 Giga Joule = 1/1000 Terra Joule. This converting has a purpose to synchronize the units of coal energy consumed in gigajoule to units of terra joule

d. Determine CO2 Emission by using formula:

$$\textbf{CO2 Emission} = C\textit{i} \times EF\textit{i}$$

Where:

C*i* = Consumption of Fuel Type *i*

EF*i* = CO2 emission factor of fuel type *i*

The amount of EF*i* by using the table below:

Table 3.5: the amount of EF*i* 1

No	Product	CO2 Emission Factor	Unit
1	Gasoline	69,300	KG/TJ
2	Diesel Fuel	74,100	KG/TJ
3	Kerosene	71,900	KG/TJ
4	Coal	94,600	KG/TJ
5	LPG	63,100	KG/TJ
6	Coal Briquettes	97,500	KG/TJ
7	Wood Charcoal	112,000	KG/TJ
8	Firewood	112,000	KG/TJ

Sources: *Greenhouse Gas Inventory Guidelines, IPCC, 2006*

This formula based on IPCC and "Greenhouse Gas Emissions in Number" which published by Ministry of the Environment Republic of Indonesia.

e. Convert the units of CO2 Emission from KG to Ton

1 KG = 1/1000 Ton. Units of KG should be converted to units of Ton as the standard units of CO2 emission (IPCC and "Greenhouse Gas Emissions in Number")

f. Determine CO2 emission of coal per ton

The purpose of this calculation is to determine the CO2 emission efficiency in certain year

3. Coal Energy Cost Reduction

a. Determine the coal energy consumption efficiency

The formula is:

(Current Year Ratio – Previous Year Ratio) x Cement Produced in Current Year

The purpose of this calculation is to determine the efficiency of coal energy consumed in certain period.

b. Determine the price of coal energy consumption efficiency

This research assumed the price of coal energy consumption is Rp.585,250.00- based on the average of market price (Ministry of Energy and Mineral Resources Republic of Indonesia – Coal Statistic) and it is similar in three years in order to make it comparable.

The formula is:

Coal Energy Consumption Efficiency x Price of Coal Energy Consumption

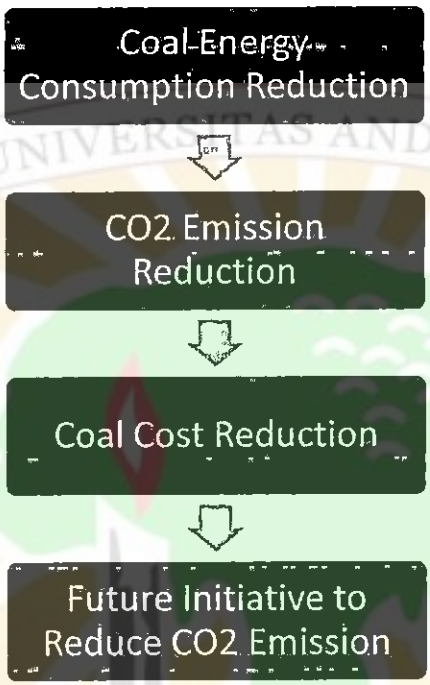
The purpose of this calculation is to determine how efficient the cost related to coal energy consumption, whether it is efficient or inefficient.

4. Future Initiative to Reduce CO2 Consumption

To find Alternative Fuel and Raw Materials (AFR) as a substitute for coal

This research explains clearly from chart data analysis below:

Figure 3.1: Data Analysis Chart



CHAPTER IV

DATA ANALYSIS AND RESULT

4.1 PT. Semen Padang Overview

4.1.1 History of Establishment Factory

In 1896, a Dutch officer guy who Germany Nationality named Ir. Carl Christophus Lau interested in stones in the White Stone hill and Hill Grotto. The stones were sent to the Dutch and the results showed that the stones can be used as a raw material of cement. On January 25, 1907, Ir. Carl Christophus Lau submitted an application to the Dutch East Indies to establish a cement factory in Indarung then on August 16, 1907 the petition was approved.

To continue his efforts, Lau compile cooperation with several companies such as Fa. Gebroeders, Fa. Dunlop, Fa. Yarman & Soon and other private parties, so on March 18, 1910 stood *Nederlandsc hIndische Maatschappij Portland Cement* NVNIPCM by notaries deed Piede Johannes Smith in Amsterdam as the oldest cement plant in Indonesia. Plant located approximately 15 KM from the center of the city of Padang began operating in 1913 with a capacity of 22,900 tons and by 1939 had reached the highest production 172,000 Tons.

When Japan controlled Indonesia in 1942 to 1945 cement factory was taken over by *Asano Cement Japan* management. When the proclamation of

independence in 1945, the factory was taken over by Indonesia and the employee subsequently submitted to the Government of the Republic of Indonesia under the name *Kilang Semen Indarung.* Further development, the company increased its production capacity by optimizing the Indarung I and development Indarung II, III A, III B, III C, then on January 1, 1994, installed cement capacity increased to 3,720,000 per year. Indarung I as the oldest mills used wet process is now no longer operating efficiencies given the scarcity of spare parts and equipment but still well maintained.

Indarung II plant was built in 1977 and completed in 1980. After that the plant was built successively Indarung III A (1981 - 1983) and III B Indarung completed in 1987. Indarung III C factory was built in 1994.

In 1995, the Government turned ownership of its shares in PT Semen Padang to PT Semen Gresik (Persero) simultaneously with plant development Indarung V. At present, shareholders are PT Semen Gresik (Persero) Tbk with shareholding of 99.99% and the Cooperative Family Semen Padang with shares of 0.01%. PT Semen Gresik (Persero) Tbk own majority shares are owned by the Government of the Republic of Indonesia at 51.01%. The rest of shareholders of 48.09% held by the public. PT Semen Gresik (Persero) Tbk. is a company whose shares are listed on the Indonesia Stock Exchange (PT. Semen Padang Website).PT Semen Padang shareholder shown below:

Table 4.1: PT Semen Padang Shareholder

Shareholders	**Issued capital and fully paid up**	**Percentage**	**Total**
	Share	**%**	**Rp 000**
PT Semen Gresik (Persero) Tbk	332.000.000	99,99%	332.000.000
Koperasi Keluarga Besar Semen Padang	1	0.01	1
Total	332.000.001	100,00	332.000.001

Sources: PT Semen Padang

The Company also has subsidiaries within the industry that includes PT Igasar (12% shareholder ownership), PT Sepatim Batamtama (85%), PT Bima Sepaja Abadi (80%), and PT Sumatra Utara Perkasa Semen (10%). PT Semen Padang also has interests within a number of supporting organizations, such as the Semen Padang Pension Fund, the Igasar Foundation, the Semen Padang Family Cooperative, the Semen Padang Hospital Foundation, PT Pasoka Sumber Karya and PT Yasiga Sarana Utama. Through its subsidiaries, Semen Padang involves in the business of packaging, distributing/transporting cement, and cement trading. In addition, through its R&D Department, the Company also offers engineering services, industrial equipment, and other products. Subsidiaries companies of PT Semen Padang shown below:

Table 4.2: PT Semen Padang Subsidiaries

Name of Company	Semen Padang Shares
PT Sematim Batamtama	85%
PT Bima Sepaja Abadi	80%
PT Igasar	12%
PT Sumatera Utara Perkasa Sement	10%

Sources: PT Semen Padang

Having high technical ability, PT Semen Padang has been the first cement producer in Indonesia awarded the API Q 1 & API Spec 10A Certification in 1985. In Addition, the company also obtained the European Certification for production of low alkaline cement. The high commitment of Semen Padang towards quality management of international standard was among others proved by the ISO 9002 Certification awarded in 1995 and ISO 9001 Certification awarded in 1994 that was upgraded into ISO 9001:2000 Certification in 2003. Other certification that have been acquired are: ISO 14001: 1996 certification in 1999 that was further upgraded into ISO 14001:2004 Certification in 2005, SMK3 Certification in 2002 and OHSAS 18001 in 2004, SNI 17025 Certification in 2005 and ISPS Code Certification in 2005. (Thamrin, 2010)

4.1.2 Company Location

PT Semen Padang Factory is located in sub districts Indarung, Lubuk Kilangan, Padang Municipality, about 15 KM from Padang, West Sumatra, at an altitude of 350 M above sea level. PT Semen Padang covers a large area and not concentrated in a particular place. Limestone quarry as raw materials

are located on the white coral within 1660 M of the plant. Silica stone quarry is located in the Kampung Baru which is approximately 1000 M from the factory. Bag factory located in Bukit Putus, while the packing plant is located in several places, namely packing Indarung, Gulf Bayur, Belawan, Tanjung Priok and Batam (Notarissa, 2010)

4.1.3 Vision, Mission and Organizational Structure

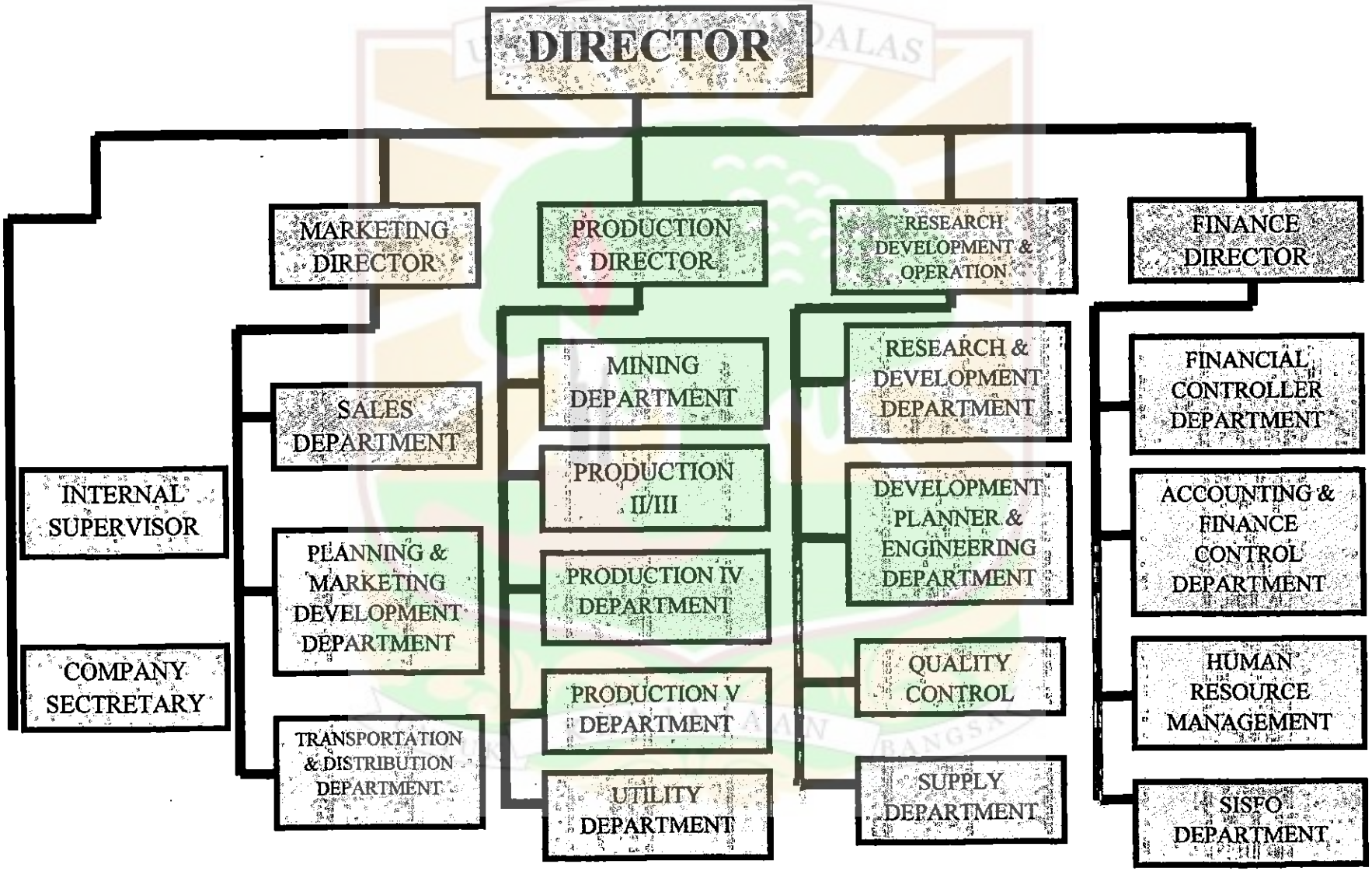
The vision of PT. Semen Padang is

"To become a reliable, excellent and eco- friendly cement company".

The Missions of PT. Semen Padang are:

1. To improve the Company's value for the stakeholders, to grow and to provide the best services to the customer
2. To develop an environmentally conscious industry
3. To develop competent and professional human resource

Figure 4.1: The Organizational Structure



Sources: PT Semen Padang

4.1.4 Raw Material, Production Processes and Products Produced

Cement is a hydraulic adhesive substance which contained compounds that will have the adhesiveness of the rocks if the cement reacts with water. Nature of the hydraulic of cement will cause indirect harden when blended with water, soluble in water, can be harden even in water. Some of the main natures of the cement are the nature of cement hydration, setting and hardening, comprehensive, strength, shrinkages, and durability.

Raw materials of cement industry can be classified into the main and additional

1. The Main Raw Material
   a. Limestone ("*Batu Kapur*")

      Limestone is a source of calcium oxide (Cao) and calcium carbonate (CaCO3). Limestone was taken from processed through exploding the in the "Bukit Karang Putih". The used of limestone needs on 80% - 81% (Primary material). Process of the mining of this limestone are:

      1. Shipping is removing or opening the shelf of the Bukit Karang's stone surface, so the layer of the limestone is achieved.
      2. Drilling is the process of the drill by using the crawler drill and drill master with air power push from the

compressor. The hole drilling with 5.5 inch diameter is purposed to place the bomb.

3. Blasting is the process of exploding using dynamite and mixing material using Nitrate Ammonium and Fuel oil (ANFO)
4. Dozing is the process of collecting the pieces of limestone that exploded using dozer for the next step to be transported to the accommodated place.
5. Crushing is the process of resizing the material/limestone to the formatted size. This process is directly done in the mining are
6. Delivering the material to the silo of accommodating is used *belt conveyor*.

b. Silica Stone (*"Batu silica"*)

This material is a source of Silica Oxide (SiO2) and Aluminum Oxide (Al2O3). This material is mined on the Grotto Hill. Mining carried out without the use of explosives but pulled down with excavators and transported to the crusher with a wheel loader or dump truck and needs approximately 9-10% of raw material requirements

c. Clay

Clay is the source of Aluminum Oxide and Iron Oxide. It mined around the plant (Hill Top) retrieval is done using excavators and trucks and transported to the dumb and

needs approximately 9-10% of the total needs of the total raw materials

d. Iron Sand

Sand Iron has Oxide main form of Fe2O3 (Iron Oxide) whose needs are only about 1-2% of total raw material requirements. PT. Semen Padang has no iron mines but are bought from outside, usually taken from PT. Aneka Tambang Cilacap.

1. Additional Raw Material

a. Gypsum

Cement with a certain trait can be obtained with additional material gypsum. The function of gypsum is as a substance that can slow the hardening process at the beginning and added at the end milling

b. Coal

In the manufacture of cement, Coal used as fuel in Kiln Mill, both on initial heating (Pre Heater) and in the process of Kiln Mill itself. Coal used were obtained from coal mines in the Sawah Lunto district and other place.

There are basically two methods in the manufacturing process of cement used by PT. Semen Padang:

1. Wet Process

It used in Indarung I factory, but now it no longer operated as a lot of fuel usage and high costs of operation

2. Dry Process

   It was implemented at the Indarung II factory and later in Indarung III, IV and V factories

   The advantages of Dry process are:

   a. kiln that is used relatively short, so the heat consumption will low and the used of oil relative lower
   b. able to process in large capacity
   c. lower operating cost

   The Disadvantages of Dry process are:

   a. The resulting blend is less homogeneous
   b. This method produces a lot of dust

Production process can be explained as follows:

1. Mining and Storing the Raw Material

   Preparation of raw material is lime stone, silica stone, clay and *pozzoland* conducted by the division of the mine. Raw materials are mined from deposits that were around the factory site called quarry.

2. Milling and Mixing of Raw Material

   In this step, raw material which prepared in a specific composition is milled till the material is smooth in certain level. This process is conducted in *raw mill* and *soil tromol.* The process of mulling it's self

contains of two; dry milling and wet milling. Basically, these two processes differentiate of making cement

a. Wet Milling

The mixing of raw material is milled in *raw mill* by adding a few of water in a certain amount, commonly 30%-40%. The mixing is conducted using *grindin gmedia*, which is the balls steel with 30mm-90mm diameter. The mill will rotate, so the material and grinding will crush. The mixing of raw material that informs liquid now from the raw mill is called as *slurry*. In order the produced slurry is homogeny, so the technicians are homogenizing the slurry by stirring \up the material mechanically or use the boiler air in the patch bucket.

b. Dry Milling

In this process, the material that will milled will drying till the water contains in the material met in a certain scale. Drying may conduct before the milling (*drying and grinding*) or in the process of milling the raw material (*drying during grinding*). To drying, use the hot gas that produced from *kiln,* or from the hot produced by diesel or the hot get from the tool called *hot air generator*. The mixing of the raw material that before processed contain of 6-11% water after the milling become ± 0,8%.This powder material compulsory said as *raw mix (raw meal)*.

3. Burning

The main objective of the burning is to produce the chemistry reaction and the forming of oxide compounding that contained in raw mater itself. The burning is done with maximum is 1400°C temperature. In the burning process are happen some steps;

a. Drying (for wet process)
b. Pre-heating
c. Calcinations
d. Sintering
e. Cooling

The burning is conducted in a tool called *a kiln*. This kiln is cylinder with 5 meter diameter and length till 80 meter with 3° slope. This kiln is lined with anti-fire stone with height of 20 meter because it's self only the common steel. This kiln is rotate along the burning process in order the material are fairly burned. The fuel of this burning is *coal* that process become a *fine coal*. Raw meal and slurry that already sintered in the kiln will be cooling down in *cooler*. Now, the material resulted by the kiln called *clinker* with 140°C.

4. Last Milling

In this stage, the clinker that has cooled in silo is feed with gypsum into cement mill. In cement mill, the clinker 1 – 40 mm^3 milled with gypsum till meet a certain smoothness using a grinding media from a ball steel. The produced cements subsequently are store to the cement

silo which ready to be packaged and transported. Quality and Quality control of cement is conducted in laboratories with X-ray using computer quality control.

5. Packaging

   Bulk cement in the silo is inserted into the packing tool (Pecker) and packed with a size of 50 Kg. This packing machine works automatically and cement can be delivered to truck or ship into the hold with a truck loading crane or overall the production, production manager makes a production manager makes a production report on the reached volume production. The process of packaging is conducted based on the number of distribution need. So there is no cement stored and special warehouse to accommodate the cement in this factory. The cement taken from Silo directly moves to packaging unit transporting by *air slide conveyor.* After packaged, the cement carried using belt conveyor over the truck. There are *eight* of *packer* unit in PT Semen Padang, 2 units in Indarung I, 6 unit in PPI, 4 unit in PPTB (one unit is rotary packer, with capacity 80.000 kg per hour).

All the machines used in the production of cement are included in the inputs. There are a many types and kind of machine in each factory, since in PT Semen Padang there are 5 factories; Indarung I- Indarung V. The machines also have a different function to treat a different raw material, which consume a different power and energy. In the operation process, most of the machines run by fuel or energy.

In PT Semen Padang, the energy used to operate the machines is Coal as the main and diesel fuel as the secondary energy, and of course electricity. All this kind of energy that the factory used will allocate to machine in produce a final product and also for running equipment such as computer, air conditioner and others.

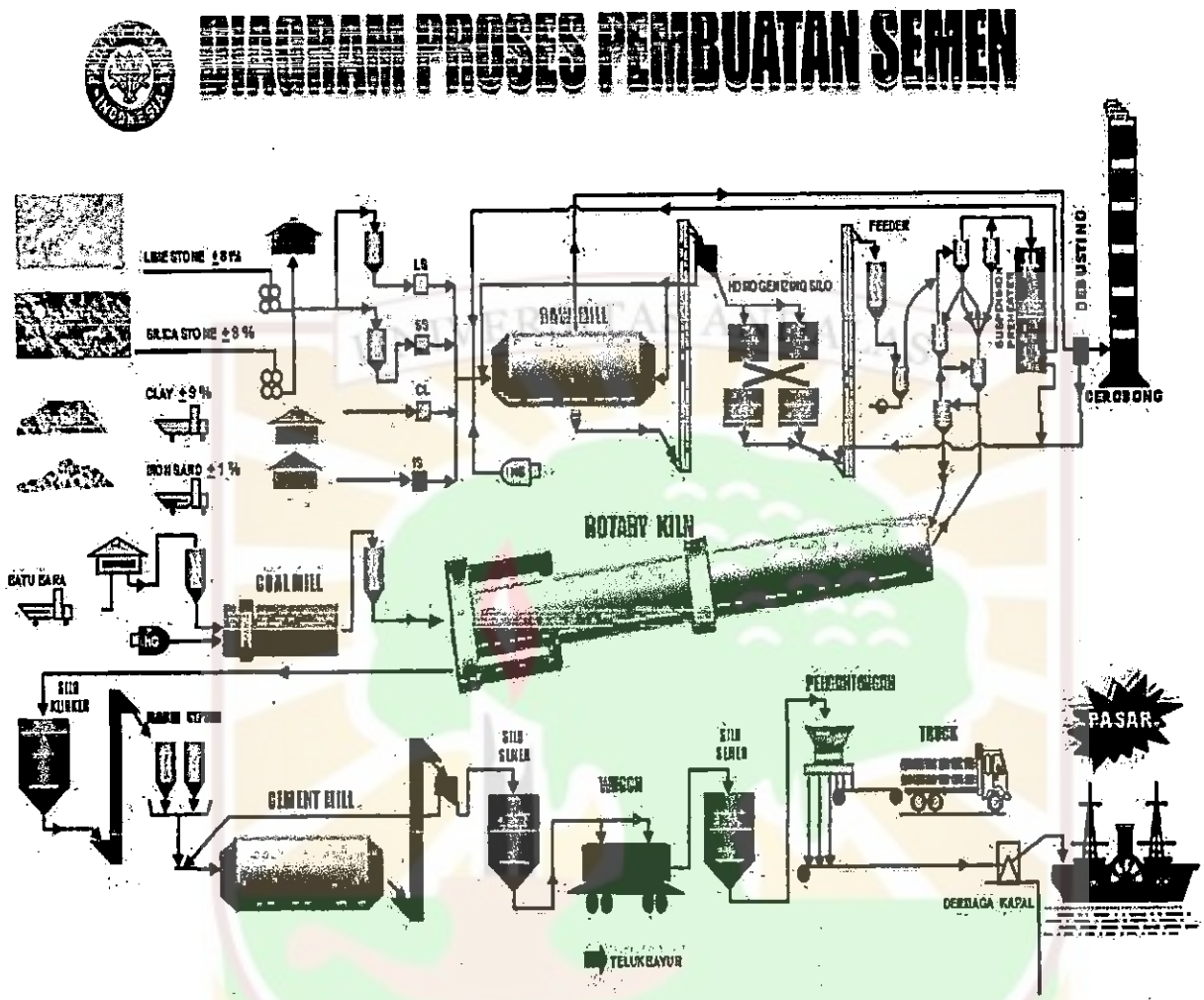
The capacity of production by PT Semen Padang showed below:

Table 4.3: PT Semen Padang Capacity of Production

Plant	Capacity (Ton)
Indarung II	660,000
Indarung III	660,000
Indarung IV	1,620,000
Indarung V	2,300,000
Plant Optimization	760,000
Total	6,000,000

Sources: PT Semen Padang

Figure 4.2: Process Flow Diagram



Sources: PT Semen Padang

The products produced by PT. Semen Padang

a. *Portland Cement* Type 1 (*Ordinary Portland Cement*)

It is used for general construction which does not require any special requirements of heat of hydration and the initial compressive strength. It is also suitable for use in land and water that contain sulfate from 0.0 to 0.10% and can be used for building residential houses, buildings and others.

b. *Portland Cement* Type II (*Moderate Cement Type II*)

It is used for construction of the concrete mass, on the location of the land and water containing from 0.10 to 0.20% and the heat of hydration medium, such as building on the seafront, building on former marshland, irrigation, concrete for the foundation of the dam and bridge

c. *Portland Cement* Type III (*High Early Strength Cement*)

It is used for the construction of buildings requiring high compressive strength the beginning on the after binding occurred with the previous phase, such as road construction, way concrete, building a high level, the building in the water that does not require resistance to sulfate attack

d. *Portland Cement* Type V (*High Sulfate Resistance*)

More appropriately used for the construction of the buildings on the land / water containing sulfate > 0.20% and is suitable for installation of sewage treatment plant, construction of water, bridges, tunnels, ports, and nuclear power plants

e. *Super Masonry Cement* (*SMC*)

Cement is more appropriate to be used for residential construction of buildings, roads and irrigation of a maximum of K 225 concrete structures. It can also be used to manufacture the raw materials of concrete tile, hollow brick, paving blocks, tiles and other building materials

f. *Oil Well Cement* (Class G-HSR)

It is special cement that is more appropriately used for the manufacture of oil wells and natural gas with the construction of oil wells beneath the surface of the sea and earth. For now this type of OWC that has been produced is a class G, HSR (High Sulfate Resistance) is also called as "BASIC OWC". Materials additive/extra can be added /blended to produce a combination of OWC products for use at various depth sand temperatures.

g. *Portland Pozzolan Cement*(*PPC*)

Hidrolid cement made by grinding clinker, gypsum and pozzol and material. This product is more appropriate to be used for public buildings and buildings that require sulfate resistance and heat of hydration medium, such as: bridges, highways, housing, docks, mass concrete, dams, irrigate on and building the foundation of a full plate.

Among kinds of cement produced by PT Semen Padang, the *Portland Cement Type I* is the superior product.

4.2 Coal Energy Consumption Reduction

Efficiency is the ratio of outputs to inputs, or the number of output per units of input. It is used to measure how efficient a process consumed input. To determine the efficiency of coal energy consumption, this research included the ratio of Total Coal Energy Consumption to Total Cements Produced by PT Semen Padang, during 2009, 2010 and 2011. It is shown in table below:

Table 4.4: Ratio of Total Coal Energy Consumption to Total Cements Produced

Year	Coal Energy Consumption (Ton)	Cement Produced (Ton)	Ratio	Coal Energy Consumption Efficiency
1	2	3	4 = 2 : 3	5
2009	884,121	5,364,706	0.16480	
2010	926,345	5,675,227	0.16323	8,951*
2011	1,005,107	6,151,636	0.16339	-1,000**

* *(0.16480 - 0.16323) x 5,675,227 = 8,951*

** *(0.16323 - 0.16339) x 6,151,636 = -1,000*

Sources: Self Calculation

The ratio of Coal Energy Consumption to Cements Produced of PT Semen Padang during last three years (2009, 2010 and 2011) can be explained as follows:

1. 2009

   On table 4.4: Ratio of Total Coal Energy Consumption to Total Cements Produced, total coal energy consumed is the lowest in this year compared to next two years (2010 and 2011). However, the ratio of coal energy consumption to cement produced in this year was the

highest that is 0.16480. It means each ton of cement produced needs 0.16480 tons of coal.

2. 2010

Coal energy consumed increased by 42,224 tons (from 884,121 tons in 2009 to 926,345 tons in this year). The total cements produced also increased by 310,521 tons (from 5,364,706 tons per year in 2009 to 5,675,227 a year in 2010). However, the ratio of coal energy consumption to cement produced in this year was the lowest one among last three years. Ratio of coal energy consumption to cement produced was 0.16323. Meaning each ton of cement produced needs 0.16323 tons of coal.

3. 2011

PT Semen Padang has the highest production during last three years. The total cement production was 6,151,636 tons and increased by 476,409 tons compared to 2010 of 5,675,227 tons. This increased also happened with coal energy consumption. The coal energy consumed also the highest one in last three years. The number of coal used was 1,005,107 tons and increased by 78,762 tons than previous year (2010) of 926,345 tons a year. The relationship between cement produced and coal consumed is straight line. Meaning, if cement produced increased then coal consumption also increased. The ratio of coal consumption to cement produced in this year was in the medium compared with last two years. The number of ratio was 0.16339. It means each ton of cement produced needs 0.16339 tons of coal.

This research determines how efficient coal energy consumption by PT Semen Padang in last three years. This efficiency could be determined by comparing the ratio of total consumption of coal energy to cement produced. The result could be used as reference in order to evaluate the efficiency of coal consumption.

The formula of coal energy consumption efficiency is:

(Current Year Ratio – Previous Year Ratio) x Cements Produced in Current Year

This research calculated coal energy consumption efficiency in 2 years; it can be calculated as follows:

a. 2010

Coal energy consumption efficiency can be calculated as follows:

(0.16480 – 0.16323) x 5,675,227 ton = 8,951 ton

The number of coal energy consumption efficiency in this year was 8,951 ton. It represents the efficiency which related to the quality of coal energy consumed based on the discussion with the management.

The quality of coal is the physical and chemical properties of coal which affects the potential usefulness. It can be distinguished based on its calorie. The higher calorie coal, the higher its quality. Coal with a higher quality is generally harder, stronger and often brilliant like black glass. It has more carbon contents, lower humidity levels and produces more energy. This research concluded in this period coal consumed are sub-bituminous coal

(medium quality) which has a calorific value between 5100 to 6100 cal / g with a moisture content of 10-25 percent and bitumin or high-quality coal has a calorific value between 6100 to 7100 cal / g with a moisture content around 5-10 percent.

b. 2011

Coal energy consumption efficiency can be calculated as follows:

(0.16323 – 0.16339) x 6,151,636 ton = -1,000 ton

The number of coal energy consumption efficiency in this year was - 1,000. That is less efficiency compared to previous year. It represents the inefficiency of coal energy consumption in this year. One of factor that influenced the number is quality of coal used. The efficiency of Kiln Mill process, both on initial heating (Pre Heater) and in the process of Kiln Mill itself, depends on the quality of coal used. The better quality coal consumed will have less quantity than the medium quality which needs to consume more. This research concluded the inefficiency caused by consumption of Low quality coal with a calorific value of less than 5100 cal / g and water content of 30 - 45 percent. Coal of this type is often referred to lignite

It can be concluded that for 2010, the efficiency of coal energy consumption for 8,951 ton, it represents efficiency. In 2011, the efficiency of coal energy consumption for -1,000, it represents inefficiency. Net coal energy consumption in these years was 7,951 ton.

4.3 CO2 Emission of Coal Energy used by PT Semen Padang

Emission factor is determined based on the research and specifically for each material or products. Because of there is no specific emission factor for Indonesia, it used emission factors specified by the Intergovernmental Panel on Climate Change (IPCC).

Basically, the emission of CO2 Emission can be calculated by using the formula:

$$\textbf{Emissions} = \textbf{A}i \times \textbf{EF}i$$

Where:

Emissions = Emissions (kg)

A*i* = Consumption of type *i* or the amount of product *i*

EF*i* = Emission factors of material type *i* or product *i*

In IPCC and "Greenhouse Gas Emissions in Number" which published by Ministry of the Environment Republic of Indonesia, coal can be classified as an energy and based on emission resources. The CO2 emission from coal aspect which classified as the energy consumption can be calculated by formula shown below:

$$\textbf{CO2 Emission} = \textbf{C}i \times \textbf{EF}i$$

Where:

C*i* = Consumption of Fuel Type *i*

EF*i* = CO2 emission factor of fuel type *i*

The amount of EF*i* by using the table below:

Table 4.5: the amount of EF*i* 2

No	Product	CO2 Emission Factor	Unit
1	Gasoline	69,300	KG/TJ
2	Diesel Fuel	74,100	KG/TJ
3	Kerosene	71,900	KG/TJ
4	Coal	94,600	KG/TJ
5	LPG	63,100	KG/TJ
6	Coal Briquettes	97,500	KG/TJ
7	Wood Charcoal	112,000	KG/TJ
8	Firewood	112,000	KG/TJ

Sources: *Greenhouse Gas Inventory Guidelines, IPCC, 2006*

The calculation of CO2 Emission (Unit in Ton) is as follows:

Table 4.6: The calculation of CO2 Emission

Year	Coal Energy Consumption (Ton)	Coal Conversion to Joule (Giga Joule)	Conversion Giga Joule to Terra Joule	CO2 Emission Factor (KG/TJ)	CO2 Emission (KG)	CO2 Emission (KG to Ton)	CO2 Emission of Coal Per Ton
1	2	3 = (2 x 29.0376 GJ)	4 = 3 / 1000	5	6 = 4 x 5	7 = 6 / 1000	8 = 7 / 2
2009	884,121	25,672,752	25,673	94,600	2,428,642,334	2,428,642	2.75
2010	926,345	26,898,836	26,899	94,600	2,544,629,845	2,544,630	2.75
2011	1,005,107	29,185,895	29,186	94,600	2,760,985,669	2,760,986	2.75

Sources: Self Calculation

The steps of calculation will show below:

1. The unit of coal (in ton) should be converted into joule as unit of energy. 1 ton of coal = 29.3076 gigajoule (Wikipedia). Table 4.6 column 2 listed the coal energy consumption and column 3 listed the conversion from ton to gigajoule (Coal Energy Consumption time by 29.3076 gigajoule)
2. Units of coal should be converted from Giga Joule to Terra Joule. In line with "Greenhouse Gas Emissions in Number" which published by Ministry of the Environment Republic of Indonesia, using KG/TJ (kilo gram per terra joule) as the units. The units of Giga in math calculation, times by the 10 power of 9 (nine) and the units of Terra times by 10 the power of 12 (twelve). The units divided by a thousand (1,000). The result shown on the table 4.6 column 4.

3. After synchronizing the units of energy consumption from gigajoule into terra joule, the next step is calculating the CO2 emission by using the formula below:

CO2 Emission = C*i* x EF*i*

Where:

C*i* = Consumption of Fuel Type *i*

EF*i* = CO2 emission factor of fuel type *I* = 94,600 KG/TJ

The number CO2 emission factor of fuel type *i* (Ef*i*) is listed on table 4.3: Greenhouse Gas Inventory Guidelines, IPCC, 2006. The results of CO2 Emission are shown on table 4.6 column 6.

4. The next steps of calculation is conversion the units of CO2 Emission from kilo gram (KG) into tons as the standard units of CO2 Emission. According to IPCC and booklet titled "Greenhouse Gas Emissions in Number". The number of CO2 Emission divided by a thousand (1 KG equal with 1/1000 Ton). The results of CO2 Emission are shown on table 4.6 column 7.
5. The last step is CO Emission in ton units divided by Coal Energy Consumption per year to find out the CO2 Emission of coal per ton. The result will be same for three years and it is shown on table 4.6 column 8.

The number of CO2 emission in coal increased in line with the number of coal energy consumed by PT Semen Padang during last three years. The lowest number of CO2 emission during last three years was in 2009 which is 2,428,642.33 tons; the middle was in 2010 which is 2,544,629.85 tons and the highest one in 2010 which is 2,760,985.67 tons. This company should be aware of this circumstance and try to develop alternative fuel raw material in order to reduce CO2 emission.

This research also included the calculation of CO2 emission reduction to determine the amount of CO2 emission reduction in certain periods. It is calculated as follows:

Table 4.7: CO2 Emission Reduction

Year	Coal Energy Consumption Efficiency	CO2 Emission of Coal Per Ton	CO2 Emission Reduction
1	2	3	4 = 2 x 3
2009		2.75	
2010	8,591	2.75	23,625
2011	-1,000	2.75	-2,750

Sources: Self-Calculation

This research calculated CO2 emission reduction in 2 years; it can be calculated as follows:

a. 2010

CO2 Emission reduction can be calculated as follows:

8951 ton x 2.75 = 23,625 ton

PT Semen Padang conducted CO2 Emission reduction by 23,625 ton. It is also influenced by coal energy consumption efficiency in this year.

b. 2011

CO2 Emission reduction can be calculated as follows:

$$-1{,}000 \text{ ton} \times 2.75 = -2{,}750 \text{ ton}$$

The number of CO2 Emission reduction in this year increased by 2,750 ton. It represents inefficiency which influenced by coal energy consumption inefficiency in this period.

The purpose of calculation of CO2 emission reduction is to determine how much the reduction of CO2 emission produced related to coal energy consumption, whether it is efficient or not efficient. The result could be used as reference in order to evaluate the efficiency of CO2 Emission.

This research concluded that in year 2010, CO2 emission reduction was efficient which is 23,625 ton. In 2011, CO2 reduction was inefficient which increased by 2,750 ton. Net CO2 emission in these periods was 20,875 ton (23,625 – 2,750).

4.4 Cost Reduction of Coal Energy Consumption

To calculate the cost of coal energy consumption efficiency, the coal energy consumption efficiency should be determined first. This research already figures it out the number of coal energy consumption efficiency in previous calculation. The purpose of this calculation is to

determine how efficient the cost related to coal energy consumption, whether it is efficient or not efficient. The result could be used as reference in order to evaluate the efficiency of coal energy cost consumption.

The formula to calculate the cost reduction of coal energy consumption efficiency is as follows:

Coal Energy Consumption Efficiency x Price of Coal Energy

The price of coal energy is Rp.585,250.00-. This number is the average price from the market price in 2009 (Ministry of Energy and Mineral Resources Republic of Indonesia – Coal Statistic) and it is similar in three years to make it comparable.

This paper calculated cost reduction of coal energy consumption efficiency in 2 years; it can be calculated as follows:

a. 2010

The cost reduction of coal energy consumption efficiency calculated as follows:

8591 ton x Rp.585,250/ ton = Rp. 5,238,497,202

This number represents the cost of coal energy consumption efficiency by PT Semen Padang by Rp.5,238,497,202 which influenced by coal energy consumption efficiency in this year.

b. 2011

The cost reduction of coal energy consumption efficiency calculated as follows:

-1,000 ton x Rp.585,250/ ton = Rp. -585,034,149

The number of coal energy cost consumption in 2011 was Rp.-585,034,149. This number represents the inefficiency of cost of coal consumption which influenced by coal consumption inefficiency in this year.

Based on the calculation, this research concluded that in year 2010, the cost of coal consumption was efficient which is Rp.5,238,497,202. In 2011, the cost of coal consumption was inefficient which is Rp.585,034,149. Net cost saving due to coal energy consumption reduction was Rp. 4,653,463,053.

4.5 PT Semen Padang Future Initiative to Reduce CO2 Emission

Based on increasing of coal energy consumption and CO2 Emission of PT Semen Padang, this company should determine the cost reduction due to the CO2 emission reduction in term of coal aspects is by using alternative fuel and material such as Hull of rice. The definition of Hull of rice according to Agency for Agricultural Research and Development, Department of Agriculture (2005) is a hard layer covering kariopsis consisting of two parts called the lemma and palea are interlocked. In the rice milling process will separate the chaff from the grain of rice and a scrap or waste material grinding. Chaff is categorized as a biomass that can be used for various needs such as industrial raw materials, animal feed and energy or fuel.

In Indonesia, hull of rice still classified as waste materials from the processing of agricultural products. Waste destruction process is naturally slow, so the waste does not only disturb the surrounding environment but

also interfere with human health. On every mill rice will always produce at so many hull of rices. Nowadays utilization of hull of rice is still slightly, so that the hull of rice remains of waste materials that interfere with the environment.

Hull of rice is a hard layer covering kariops is consisting of two parts called the lemma and palea which interlocked. In the rice milling process will separate husk from the grain of rice and a scrap or waste material grinding. Husk is categorized as a biomass that can be used for various needs such as industrial raw materials, animal feed and energy or fuel.

Hull of rice was chosen because of the research results are known, the potential for considerable heat energy content that is potentially produce 1 kilogram of hull of rice 3700 kilocalories of heat energy (PT Semen Gresik).

Utilization of waste biomass such as hull of rice as alternative fuel co-processing has multifunctional, those are:

1. Implement programs of energy conversion by utilizing industrial waste as an alternative fuel to replace fossil fuels so as to reduce the cost of fuel needed in the industrial process and can save non-renewable sources of energy reserves.
2. Lower levels of emissions in the air by industrial wastewater treatment systems are appropriate and efficient equipment which in the cement kiln system.

3. Obey the regulations (legal requirement) which applies from the government:
    a. Kyoto Protocol (Clean Development Mechanism) which has been ratified by the Government of the Republic of Indonesia.
    b. Laws and regulations on National Energy Policy and Energy Saving.
4. Support efforts in the framework of "Sustainable Development".

In PT Semen Padang official website stated that this company continues to make efforts to find alternative fuel or Alternative Fuel and Raw Materials (AFR) as a substitute for coal. If it was already make use of old tires and used oil, Semen Padang to test the utilization of hull of rices in Indarung IV.

The use of AFR is expected to provide an environmentally friendly solution to the problem of waste, reduce dependence on nonrenewable natural resources such as coal, reduce emissions, and economic opportunities for community activities.

Other alternative fuels that can be used are shell oil, cashew nuts, tires, oil, paper, wood, fruit spacing, and rod spacing. Companies that use alternative energy are also able to get compensation through the Clean Development Mechanism (CDM). The use of hull of rices is not new in Indonesia. This alternative fuel is used in PT Semen Gresik, Tonasa, and at Holcim.

What about the availability of hull of rices? According to PT Semen Padang opinion, in Sumatra, there are difficulties to hold hull of

rice. Different conditions experienced by PT Semen Gresik and Tonasa which easier to get it. In Semen Gresik, (parents company of PT Semen Padang) hull of rice has been able to replace 5 to 6 percent of coal consumption.

And one of the benefits if PT Semen Padang implemented hull of rice as AFR, among cooperatives and small businesses have an opportunity to supply the hull of rice to PT Semen Padang. Using renewable energy utilization is also provided opportunities for local communities to increase the welfare of society.

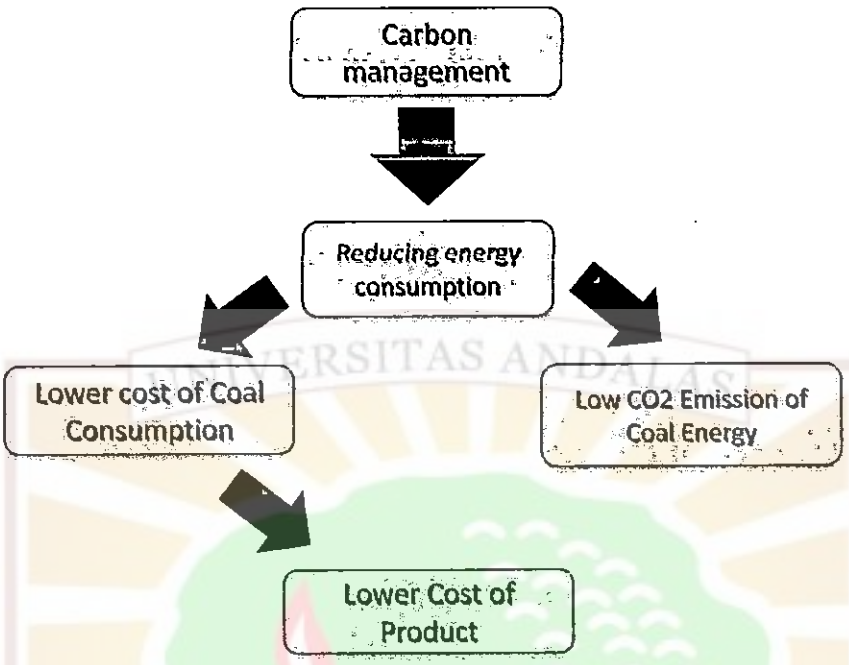
Another difficulty is about the price of hull of rice. The price was much cheaper. In Semen Gresik to the procurement of one ton of hull of rice will cost about Rp.250.000 to Rp270.000. Semen Padang must issue a more expensive price, which is above Rp.300.000. (PT Semen Padang Website).

Nevertheless, it is not easy to realize this plan given the various constraints that exist, including the supply of hull of rice is dependent on growing season and freight is not cheap.

PT Semen Padang should realize the magnitude of the impact caused by greenhouse gas emissions, by using a number of initiatives aimed at reducing greenhouse gas emissions, such as the conservation of energy to replace fossil fuel use including coal, hull of rice with the use of more environmentally friendly by releasing less CO2.

By using Carbon Management concept, PT Semen Padang could create the competitive edge shown below:

Figure 4.3: Carbon Management Competitive Edge

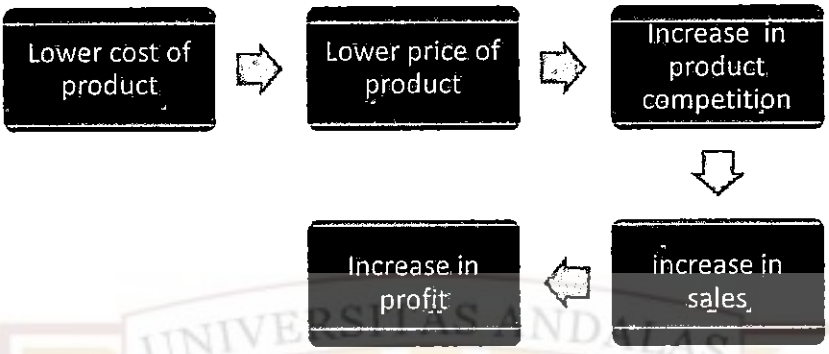


Carbon Management developed to decrease energy consumption. Reducing Coal energy consumption meaning that decreasing coal or non renewable energy consumption and it would have an impact to decrease CO2 emission of coal energy produced. In financing aspect, reducing coal energy consumption will decrease the cost of coal energy and cost of product produced.

Lower cost of product, actually will affect the price of product produced, even there are many aspects to determine the price of product, but cost of product, especially for cost of sources of product, could be one of the consideration to determine the cost of product.

It will also affect the sales of the product because if price of product is lower than competitor, the customer will choose the product and it will increase in sales and off course it will also increase in profit in the future.

Figure 4.4: Competitive Edge from Lower Cost of Product

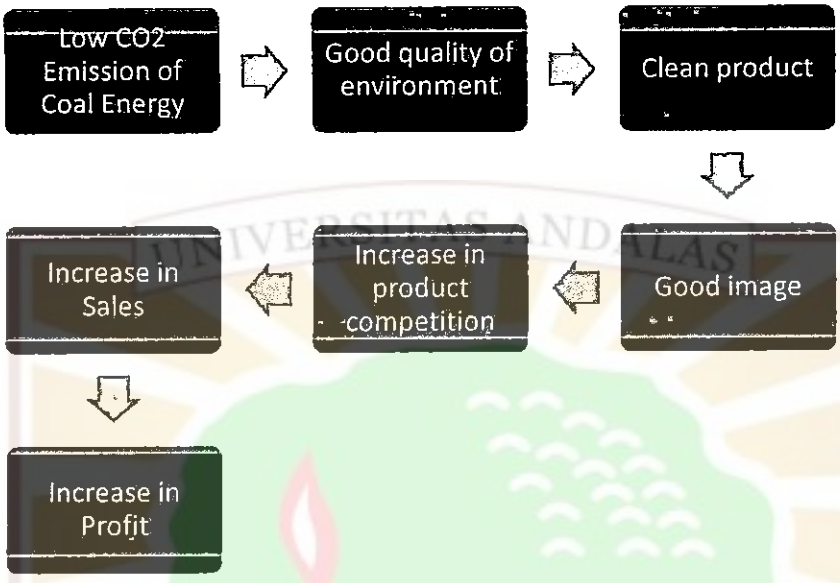


From the side of emission, the lower of using energy will decrease the emission produced. If a company produced less emission which also means less energy consumption, it will have an impact to good quality environment. This is in line with one of the mission of PT Semen Padang "To develop an environmentally conscious industry" which means environmentally friendly ("Proper Hijau" from 2012) and social responsibility and compliance with laws and regulations. Contribute to help boost the local economy around the plant, in particular the city of Padang, West Sumatra and generally.

Good quality environment also cause clean product. Clean products means that the products which produced do not affect or threat the environment. This clean product will make a good image of PT Semen Padang. Nowadays, the customer will choose the product from company which has a good image in environment than the company which only focuses on the profit without considering their environment. Meaning that product competition of PT Semen Padang will also increase. It will also increase sales and profit in the future

It will show on the chart below:

Figure 4.5: Competitive Edge from Low CO2 Emission of Coal Energy



4.6 Analysis of Coal Energy Consumption, CO2 Emission and Cost of Coal Energy Consumption in PT Semen Padang

Coal energy consumed and total cements produced by PT Semen Padang increased in last three years. This research calculates the ratio of Total Coal Energy Consumption to Total Cements Produced to obtain the efficiency of coal energy consumption in two years (2010 – 2011). In the 2010, the efficiency of coal energy consumption was efficient which is 8,951 ton. In 2011, it was inefficiency which is 1,000. Net coal energy consumption in these periods was 7,951 (8,951 – 1,000). Based on discussion with management, this paper concluded that the efficiency and inefficiency influenced by quality of coal energy consumed.

The number of CO2 Emission in coal aspect increased in line with the number of coal energy consumed by PT Semen Padang during last three years. The lowest number of CO2 Emission during last three years was in 2009 which is 2,428,642.33 tons, and the middle was in 2010 which is 2,544,629.85 tons and the highest one in 2010 which is 2,760,985.67 tons.

Based on the calculation, this research concluded that in year 2010 CO2 emission reduction was efficient which is 23,625 ton. In 2011, CO2 reduction was inefficient which increased by 2,750 ton. Net CO2 emission in these periods was 20875 ton (23,625 – 2,750). This company should be aware of this circumstance in order to develop alternative fuel and reduce CO2 emission.

From the explanation above, it can be analyzed that PT Semen Padang not conducted yet the reduction of CO2 emission based on the calculation of coal energy consumption reduction and CO2 emission. The number of CO2 emission produced increased accordance with the number of coal energy consumed in last three years.

This research also calculates cost reduction due to coal consumption efficiency. Based on the calculation, this research concluded that in year 2010, cost reduction due to coal consumption was efficient which is Rp.5,238,497,202. In 2011, cost reduction due to coal consumption was inefficient which is Rp.585,034,149. Total cost saving for these periods up to Rp. 4,653,463,053 (Rp.5,238,497,202 - Rp.

585,034,149). This research does not calculate the impact of cost reduction due to high quality of coal energy consumption.

Based on discussion with the management, PT Semen Padang already conducted the research to develop alternative fuel material. But this company not implemented yet alternative develop fuel material. PT Semen Padang should develop alternative fuel material in short, middle and long term in order to reduce the use of coal as the main fuel and to decrease CO2 emission produced. The other benefits of reducing consumption of coal energy, the cost of coal energy consumption will also decrease.

CHAPTER V

CONCLUSSION

This chapter provides conclusions drawn from findings and discussion presented in the previous chapter, followed by assessment of the potential limitations present in this study and possible future directions for research.

5.1 Conclusion.

The number of tons of coal energy consumed by PT Semen Padang increased in last three years. In 2009, the number is 884,121 ton, in 2010, the number is 926,345 ton and in 2011, the number is 1,005,107 ton. The increasing of coal consumption in line with the number cements produced.

Based on the analysis conducted, the results obtained are:

1. Coal Energy Consumption Reduction

   It can be concluded that for 2010, the coal energy consumption reduction was efficient which is 8,951 ton. In 2011, the coal energy consumption was inefficient which increased by -1,000. Net coal energy consumption in these years was 7,951 ton.

2. CO2 Emission Reduction

   This research concluded that in year 2010, CO2 emission reduction was efficient which is 23,625 ton. In 2011, CO2 reduction was inefficient which increased by 2,750 ton. Net CO2 emission in these periods was 20875 ton (23,625 – 2,750).

3. Coal Energy Cost Reduction

This research concluded that in year 2010, the cost of coal consumption was efficient which is Rp.5,238,497,202. In 2011, the cost of coal consumption was inefficient which Rp.585,034,149. Net cost saving due to coal energy consumption reduction was Rp. 4,653,463,053.

4. PT Semen Padang Future Initiative to Reduce CO2 Consumption

   PT Semen Padang initiates to decrease coal as main energy by developing Alternative Fuel and Raw Materials such as hull of rice. By developing this Alternative Fuel and Raw Materials will affect the reduction of CO2 emission and increased efficiency of cement production.

This research leads to conclusion that PT Semen Padang did not conducted yet the reduction of CO2 emission based on the calculation of coal energy consumption reduction and CO2 emission

These results could be used as reference in order to evaluate the efficiency of coal energy consumption, cost of coal consumption and CO2 emission.

5.2 Limitation of Research

Limitations of this study are:

1. Calculating the coal energy efficiency is based on the average market price in 2009 published by Ministry of Energy and Mineral Resources Republic of Indonesia – Coal Statistic.
2. This research does not calculate the impact of cost reduction due to high quality of coal energy consumption.

5.3 Suggestion

Suggestions will be divided into two parts;

1. Suggestions for PT Semen Padang;
    a. PT Semen Padang should develop carbon cost management of coal energy in order to decrease CO2 emission that produced by company and to reduce cost of coal energy consumption
    b. PT Semen Padang should develop alternative fuel energy that has low impact on environment
2. Suggestions to next researcher:
    a. The observation period needs to be extended in order to make sure whether or not the efficiency of coal energy consumption exists.
    b. Calculate the impact of increase in price due to high quality of coal energy used

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