

# The Influence of Management Control System, Encouragement of Environmental Management, and Proactive Environmental Management on Carbon Emission Efficiency

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**ABSTRACT:** The efficiency of carbon emissions in the production process contributes significantly to restrain the rate of global warming, and it is strongly correlated with industrial behavior. Therefore, this research was done to explore the dominant factors that influence the behavior of carbon emissions efficiency. The population in this study was manufacturing companies in Central Java, which have been classified by the industrial office of Central Java in 2007. This research used a purposive sampling technique and Multiple Linear regression analysis techniques to examine the factors that influence the behavior of carbon emissions efficiency. The results showed that three dominant factors that influence the behavior of carbon emissions efficiency are the encouragement of environmental management, proactive environmental management, and management control system. Based on this research, management control practice and policies of carbon emission efficiency can be formulated by appropriate authorities.

*Keywords:* management control system, carbon emission efficiency, environmental management

## 1 INTRODUCTION

The issue of global warming, energy crisis, and the increase in fuel consumption should increase people's awareness to conserve natural resources and reduce carbon emissions. Today, the earth's average temperature has increased by 0.20 Celsius per 10 years. NASA shows that the rise in global temperature has allegedly led to rising sea levels as high as 20 cm in 2000 compared to 1900. As the concentration of CO<sub>2</sub> in the air is higher than methane and nitrous oxide, CO<sub>2</sub> is stated as the leading cause of global warming. Energy Information Administration (EIA) showed that the amount of carbon dioxide emissions in 1990 was 21.6 million metric tons and increased to 23.9 million metric tons in 2001. The amount of CO<sub>2</sub> emissions are projected to increase to 27.7 million metric tons in 2010 and will be 37.1 metric tons in 2025.

If global warming cannot be controlled, there will be severe consequences of climate change for the life of humankind. The severe impacts are the shifting of the planting season, outbreaks of disease, the rising of average global temperatures and sea levels, as well as the disruption of production systems. Indonesia, as one of the countries that ratified the Kyoto

Protocol, is expected to become a pioneer in controlling global warming. Indonesia has a tropical forest, which is an ideal area to capture CO<sub>2</sub> through photosynthesis.

In fact, global warming has worried the world community and invites serious attention of the world body for environmental protection (UN- FCCC). Under the Kyoto Protocol, countries that ratified the protocol agreed to reduce the impact of global warming through various means, one of which is the efficiency of carbon dioxide emissions. The behavior of carbon emission efficiency is the first step in the concept of carbon trading. Companies, especially manufacturing industries, are the most significant contributor to CO<sub>2</sub> concentration in the air as a result of their production process. The behavior of carbon emission efficiency is a safe step in a green product strategy. In addition to obtaining the benefits from the consumer side, the company is also safe from a variety of social pressures that require companies to save the world from the effects of global warming. The behavior of carbon emission efficiency is also a strategic way to get carbon credits in the trade. Claim for carbon credits based on various measures, including the willingness to replace fossil fuels with environmentally friendly fuel (e.g., Bio-

ethanol) and efficient behavior on carbon emissions in each production line.

Therefore, identification of the factors that influence the behavior of efficient carbon emissions is an important step. Based on such identification, the patterns of policy, such as ranking the efficiency of carbon emissions, carbon trading, and incentives for carbon emission efficiency, can be formulated by the appropriate authorities. On the other hand, companies will gain various advantages such as market growth expectations because of consumer preferences, green product strategy, as well as the possibility of obtaining extraordinary gains due to carbon transactions.

Based on the ideas of carbon emission efficiency, this study explores the factors that influence the behavior of carbon emission efficiency in the production process. Previous research conducted by Shodiq (2006) showed that the Encouragement of Environmental Management (EEM) and Proactive Environmental Management (PEM) are the variables that affect environmental disclosure. External parties will have an impact on companies to control the environment. Furthermore, companies that care about global emissions will be proactive in controlling the environment. Encouragement from external and internal management will have a direct impact on the efficiency of carbon emissions.

Furthermore, research on Carbon Accounting conducted by Shodiq & Lisa (2009) showed that the Management Control Systems in carbon efficiency (MCS) is one of the important variables that affect the carbon accounting paradigm. MCS can be used to achieve compliance or improve environmental performance and can be used for various particular purposes at different times (Bui & Villiers, 2017), such as achieving environmental performance. The research conducted by Ratnatunga (2007) in the second half of 2003 resulted that one of the issues in strategic carbon cost management is MCS. This issue can impact on modifying employee behavior to achieve carbon efficiency targets. Business units that are not compliant with controlling carbon emissions may be subject to punishment. Thus, the carbon emission of MCS can control managerial behavior in terms of efficient carbon emissions.

Research on the concept of the behavior of carbon emission efficiencies, carbon emission management, and carbon cost accounting in industrial practice is still scarce. Even more, this research is applied to Small and Medium Enterprises, which, on average, are proprietorship firms. The nature of proprietorship has lower public responsibilities compared to the corporation (public companies).

### *1.1 Encouragement of environmental management and behavior of carbon emissions efficiency*

Berry & Rondinelly (1998) indicated that some forces drive the company to perform environmental management behavior. These factors are (1) Regulatory demand. The company felt it is important to be able to get an award in the field of environment, by trying to apply the TQEM principles effectively, for example by using pollution control technology through the use of clean technology. Porter (1995) proposed that the manufacture of environmental regulation should include the environment practical, legislative, government, and companies to create a chain of the economy, environment, resource productivity, innovation, and competition. (2) Cost factors. The existence of a complaint to the company's products will bring the consequences of the emergence of high-quality supervision costs. This will directly impact on the emergence of a reasonably high cost. The consequences of reducing pollution also impact on the emergence of various costs. (3) Stakeholder forces. A proactive strategy towards environmental management is built on the principles of management, which is to reduce waste and reduce production costs, as well as respond to the demands of consumers and stakeholders. (4) Competitive requirements. The continued development of global markets and the emergence of various trade agreements are very influential on the emergence of environmental quality management standardization.

Pfleiger et al. (2005) showed that environmental preservation efforts by the company would bring several benefits, including the interests of shareholders and stakeholders on company profits as a result of environmental management, including control of carbon emissions. Furthermore, Ferreira (2004) stated that the issue of environmental conservation is the duty of every individual, government, and corporations.

According to Berry & Rondinelli (1998), environmental concerns appear as the result of encouragement from an outside company, such as government, consumers, stakeholders, and competitors. Based on the issue and results of previous studies, the hypothesis is proposed as follows:

H1: Encouragement of Environmental Management affects the Behavior of Carbon Emission Efficiencies.

### 1.2 *Proactive environmental management and behavior of carbon emissions efficiency*

Various forces that drive the company to perform environmental management behavior encourage companies to perform environmental management proactively. The proactive management system is a comprehensive environmental management system consisting of a combination of five (5) approaches, namely: (1) waste minimization and prevention, (2) demand-side management, (3) environmental design (4) product stewardship, and (5) full-costing accounting. Proactive environmental management is closely related to the behavior of carbon emission efficiency.

To follow up the existence of encouragement of environmental management, it is necessary to create proactive management in minimizing negative impacts on the environment (Mori, 2000). The implication of proactive environmental management is the establishment of good corporate environmental performance. The higher the proactive environmental management, the higher the behavior of carbon emission efficiencies will be. Based on this argument, the hypothesis is proposed as follows:

H2: Proactive Environmental Management affects the Behavior of Carbon Emission Efficiencies.

### 1.3 *Behavior of carbon emission efficiencies and management control systems*

Management Control System (MCS) is defined as management accounting practices such as budgeting, which is used systematically to achieve corporate objectives. The results of previous studies indicated that there is a relationship between the environment and the MCS.

Ratnatunga (2007) showed that MCS is one of the important issues in Strategic Carbon Management Cost (SCM). Factor analysis conducted by Shodiq against SCM indicators from Ratnatunga (2007) showed that MCS is a critical component of the production strategy factors. Empirically, concerning aspects of behavior, MCS is a potential variable to the achievement of (performance) efficiency. Based on the previous studies, the hypothesis is proposed as follows:

H3: The Management control system affects the behavior of carbon emission efficiencies

## 2. RESEARCH METHODS

This study used a quantitative approach to explore the variables that affect the BCEE. This study used primary data obtained through a questionnaire distributed to respondents. The population in this study was the functional managers of middle-manufacturing companies in Central Java. A report from Central Java BPS in the “*Direktori Industri Pengolahan, Jawa Tengah 2007* (Manufacturing Industry Directory, Central Java, 2017)” indicates that the number of Small Medium Manufacturing in Central Java reached 5,544 companies.

Samples in this study were the companies that most vulnerable to environmental issues, particularly CO<sub>2</sub> emissions. Almost all manufacturing firms are vulnerable to problems caused by carbon dioxide gas from the production process. Therefore, the population of this study is all manufacturing firms in Central Java, Indonesia. The sample determined by purposive random sampling, which is the middle-manufacturing firms. According to the Manufacturing Industry Directory classification, the middle enterprise is the companies that have 20-99 employees. The reasons to collect the middle-manufacturing enterprise are 1) to minimize the confounding effect and 2) to collect the data for medium enterprise rather than a large enterprise.

There are 70% of medium enterprises, and 400 of them were determined by using proportional random sampling. Assuming that the response rate is 25%, so 100 data can be collected from the 400 data. By using the direct mail, 96 respondents returned the questionnaire, 92 with answers, and the other 4 without answers. From the 92 samples, an in-depth interview was conducted to 23 samples.

The variables in this study were measured by various indicators contained in Table 1. The indicators in each variable were developed from Berry & Rondinely (1998), Pfeifer et al. (2005), and extracted from Ratnatunga (2007) through content analysis. Multiple regressions were used to test the hypotheses (Ghozali, 2005).

Variables of behavior of carbon emission efficiencies (BCEE), using indicators as follows: Individual behavior of employees to control CO<sub>2</sub> emissions, the use of technology and carbon-friendly fuel, the use of raw materials and efficient production time, certainty use of low energy saving in the working environment, the use of the concept of total quality management for Carbon Efficiency, the use of cost control to reduce the cost of carbon emissions, the use of carbon cost classification (direct, indirect, fixed and variable costs), the use of Comparator Systems to the world-class company that implement

carbon emission efficiency, productivity consideration is given not only to economic efficiency, but also carbon usage efficiency, and changes in behavior toward the company's overall carbon emission efficiency.

Variables of encouragement of environmental management (EEM), using indicators as follows: regulatory demand; cost factor; stakeholder forces; and competitive requirement

Variables of proactive environmental management (PEM), using indicators as follows: Minimize and prevent waste; demand-side management; environmental design; product stewardship; and full-cost Accounting.

Variables of Management Control Systems (MCS), using indicators as follows: Management and employee behavior systems to achieve carbon efficiency targets; and reward and punishment system to achieve carbon efficiency.

All indicators are measured by using a six-point Likert scale. For the dependent variable, number 1 represents the value of "not very used", and the number 6 represents the value of "very used". For all the independent variables, the number 1 represents the value of "not very used / not very unimportant", and 6 represents the value of "very used / very important".

### 3. RESULTS AND DISCUSSIONS

Table 1 shows the results of validity, reliability, hypothesis, and descriptive statistics. Based on Table 1, it can be concluded that variables are valid and reliable. The multiple regression analysis was used to test the hypotheses. The entered method was used to test the main factors that affect the Behavior of Carbon Emission Efficiencies (BCEE). From Table 2, it can be seen that BCEE is influenced by MCS, EEM, and PEM significantly ( $p$ -value  $< 0.05$ ), where the  $b$  value is 0.149, 0.313, and 0.566, respectively.

Table 1. Hypotheses testing and Descriptive Statistics

	BCCE	MCS	EEM	PEM
Validity	Valid	Valid	Valid	Valid
VIF		Sig<0.05	Sig<0.05	Sig<0.05
Descriptive Statistics:				
Mean	3.81	3.44	3.80	3.741
Median	3.95	3.50	3.75	3.800
Hypothesis testing				
Coef.( $\beta$ )		0.149	0.313	0.566
t-sig. $\alpha$		0.000	0.000	0.000
R square adjusted : 0.984				
F-sig 0.000				
Normality: KS > 0.05				

Berry & Rondinelli (1998) showed the general indicators that affect management to control their environment. According to global warming, these environmental factors are correlated to the waste of gases, which mostly carbon dioxide.

Furthermore, Berry & Rondinelli (1998) and Pflieger (2005) classified these indicators into external and internal factors. The external factors are called the encouragement of environmental management, that is, the extent to which public institutions give attention and pressure on the company to care about their environment. In the case of global warming, the encouragement is the pressure into the company to pay attention to the carbon efficiencies.

Meanwhile, the internal factors are the internal motivation of management to control carbon emissions consciously and proactively. Proactive environmental management gave a strong impetus for management to production of goods and services based on green economy strategy (Berry & Rondinelli, 1998; Pflieger, 2005).

Ratnatunga (2008) stated that one of the main components in carbon emission efficiencies is the total quality management, lean production techniques, and the consciousness of every individual in the company to manage carbon emissions, thus not to exceed the threshold limit (the cap). Berry & Rondinelli (1998) suggested the treatment of waste effectively in every process of production. Public pressure, awareness of internal management, and the expectation of extraordinary gains in carbon emission efficiencies requires the company to create management control systems. Management behavior and punishment system allow the monitoring of product quality to minimize carbon pollution (Stanwick & Stanwick, 2000).

This research supports the study by Neu & Pedwell (1998), Niskanen & Nieminen (2001), Nyquis (2003), and Patten (2002). The results of this study indicate the existence of two important factors that affect BCEE; the external factors that are expressed by the EEM variable and internal factors that are expressed by the PEM and MCS variables. External factors in the form of EEM are all factors that encourage management to control and create environmental performance, such as government incentives in low-tax and appreciation (Belal, 2000); public pressure like the pressure from the society, NGO and press; and investor interest to the company's stock. Meanwhile, the internal factor is the internal awareness of management to control the environment properly as a form of Corporate Social Responsibility. They are, for example, waste management, full cost accounting, and Environmental MCS.

On the other hand, the company also has to design MCS to control the excessive carbon emissions in the production process. Unfortunately, until now, there has not been yet a study that explored the MCS indicators relating to the efficiency of carbon emissions. Ratnatunga (2007) stated that MCS is an important factor in the development of issues in strategic carbon cost management. This study showed that to achieve the efficiency of carbon emissions, management should implement the MCS that controls the behavior in carbon efficiency. In addition, the reward system needs to be applied to support carbon emission efficiency.

#### 4. CONCLUSIONS

Three critical factors affect BCEE, namely EEM, PEM, and MCS. These three variables can be classified into two important factors, that is, the external factor (EEM) and internal factors (PEM and MCS). The higher the public pressure, the higher the management interest to behave in carbon emission efficiencies. Likewise, the higher the pressure and incentives from the Government, such as regulation and low-tax, the higher the management interest to behave in carbon emission efficiencies. This study supports the stakeholders, such as Governments and NGOs, to more intensively promote the efficiency of carbon emissions. This study also supports the efforts of companies to have the behavior of carbon emission efficiency.

Interestingly, the research sample is from non-public companies. It can be concluded that there is a high level of attention from non-public companies on the issue of carbon emissions efficiency. The sample object in this study is limited to the manufacturing industry. Future studies are expected to use non-manufacturing companies because they also produce carbon in their transportation activities.

#### REFERENCES

Berry, A.M. & Rondinelli, D.A. 1998. Proactive Corporate Environmental Management: A New Industrial Revolution. *Academy of Management Executive* 12(2): 38-50.

Belal, A.R. 2000. Environmental Reporting in Developing Countries: Empirical evidence from Bangladesh. *Eco-Management and Auditing* 7(3): 114.

Bui, B. & Villiers, C. 2017. Carbon emissions management control systems: Field study evidence. *Journal of Cleaner Production* 166: 1283-1294.

Ferreira, C. 2004. Environmental accounting: the Portuguese case, *Management of Environmental* 15(6).

Ghozali, I. 2005. Aplikasi Analisis Multivariate Lanjutan dengan Program SPSS. Semarang: Badan Penerbit Universitas Diponegoro.

Mori, S. 2000. Effects of carbon emission mitigation options under carbon concentration stabilization scenarios. *Society for Environmental Economics and Policy Studies* 3(2): 125-142.

Neu, D.H.W. & Pedwell, K. 1998. Managing Public Impression: Environmental disclosure in annual report. *Accounting Organization and Society* 23(3): 265-286

Niskanen, J. & Nieminen, T. 2001. The Objectivity of Corporate environmental reporting: a study of finish listed firms' environmental disclosure. *Business Strategy and The Environment* 10(1): 29.

Nyquis, S. 2003. The Legislation of environmental disclosure in three Nordic Countries – a comparisons. *Business Strategy and The Environment* 12(1): 12.

Patten, D.M. 2002. The relation between environmental performance and environmental disclosure: a research note. *Accounting, Organization and Society* 27: 763-773.

Pflieger, J., Fischer, M., Kupfer, T. & Eyerer, P. 2005. The contribution of life cycle assessment to global sustainability reporting of Organization. *Management of Environmental* 16(2).

Porter, M.E. 1995. Green and Competitive. *Harvard Business Review*. September- October: 120-134

Shodiq, M.J. 2006. Pengaruh dorongan manajemen lingkungan, manajemen lingkungan proaktif dan kinerja lingkungan terhadap public environmental disclosure. *Symposium Nasional Akuntansi IX*. Padang, IAI.

Shodiq, M.J. & Lisa K. 2009. Need Assessments: Standar Akuntansi Karbon dan Praktik Carbon accounting, *Proceeding, The 3rd National conference, Toward a New Indonesia Business Architecture*. Fakultas Ekonomi, Unika Widya Mandala. Surabaya, 397-415.

Stanwick, S.D. & Stanwick, P. 2000. The Relationship Between Environmental disclosure and financial performance: and empirical study of US Firms. *Eco-Management and Auditing* 7(4): 155.

Ratnatunga, J. 2007. Carbon Cost Accounting: The Impact of Global Warming on the Cost Accounting Profession, *JAMAR* 5(2):1-8.

Ratnatunga, J. 2008. Carbonomics: Strategic Management Accounting Issues, *JAMAR* 6(1):1-10.