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The Sustainability of Energy Management System Implementation in Pilot Company's Industry of Indonesia

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Abstract. The economic growth encourages the increasing of production activity in the industrial sector. As the second largest energy user in total national energy use, the industry needs to improve its energy performance through the implementation of Energy Management System (EnMS) so that it can also reduce Green House Gas (GHG) emission which has a negative impact for the environment. Socialization and support to the industry for EnMS implementation, is carried out by the government of Indonesia in cooperation with international institutions as a step for implementing energy conservation programs in accordance with the government regulations no. 70 of 2009. The research results show that 24 industries from 28 pilot company industries, or around 86%, still implement EnMS. There are 10 industries that have obtained ISO 50001 certification so that they monitor their EnMS implementation and energy performance improvement through ISO 50001 surveillance audits which is carried out by the certification body. Industry that still implement EnMS but has not received ISO 50001 certification will monitor their EnMS implementation and energy performance improvement through internal audit activities, which is carried out by the company itself.

1. Introduction

One of the biggest energy user sectors in Indonesia is the industrial sector which is ranked second after the transportation sector. The industry uses energy of 30.88% of the total national energy consumption [1]. Energy use in the industry mainly comes from fossil energy sources, namely coal, oil and natural gas [2]. The use of fossil energy sources in operational activities in the industry produces exhaust gases which have the potential to increase the concentration of CO and CO₂ gases in the atmosphere. CO and CO₂ gas is a component of greenhouse gases (GHG) that have a negative impact for the environment and living things [3]. The increasing of energy use is increased by industrial activity as an impact of economic growth and also inefficiency of industrial energy uses itself. The higher world oil prices and the negative effects of production activities are the driving factors for the industry in implementing energy efficiency. Referring to the National Energy Conservation Master Plan (RIKEN), the potential energy savings from the industrial sector is 10 - 30% with an energy saving target of 17% by 2025.

In line with the issue of energy crisis where fossil fuel is an energy source that requires millions of years to be renewed and its current existence is depleting, the Indonesian government seeks to ensure that the need for energy is maintained and reserves of fossil energy resources are not quickly depleted.



This effort is carried out by implementing new and renewable energy creation programs and implementing energy conservation programs. Energy conservation is a systematic, planned and integrated effort to conserve domestic energy resources and improve the efficiency of its utilization [4]. The implementation of energy conservation covers all stages of energy management which include energy supply activities, energy exploitation, energy utilization, and conservation of energy resources. The main objective of the energy conservation program in Indonesia is to realize national sustainable development, realize national energy security, and play an active role in reducing GHG emissions.

Through the Government Regulation No. 70 of 2009, the Indonesian government encourages the implementation of energy conservation and requires users of energy sources and energy users who use energy and/ or energy sources greater than or equal to 6,000 TOE or equivalent to 251,400 GJ (Giga Joule) or 69,780 MWH (Mega Watt Hour) per year must carry out energy conservation through the implementation of energy management. Energy management is an integrated activity to control energy consumption in order to achieve effective and efficient energy utilization to produce maximum output through structured and economical technical actions to minimize energy utilization including energy for production processes and minimize consumption of raw materials and supporting materials [5]. Energy management is carried out by appointing energy managers, developing energy conservation programs, carrying out energy audits on a regular basis, implementing audit recommendations, and reporting the implementation of energy management annually to the government [5].

The international standard on Energy Management Systems (EnMS) was introduced in 2011 with the issuance of ISO 50001. In line with the government program on energy conservation through the implementation of energy management, in 2012 the National Standardization Agency (BSN) adopted it into SNI ISO 50001. SNI ISO 50001 provides specific guidelines for the requirements needed to develop, implement, maintain and improve EnMS [6]. EnMS helps an organization or industry to save energy so that it can reduce energy costs, minimize negative impact on the environment, improve work comfortability, enhance positive image for the company, increase productivity and competitiveness of the company [7]. The main objective of EnMS is to increase control over energy consumption [8]. EnMS is done through several stages, namely:

Built energy policy

Built energy planning

Implementation and operation

Monitoring and checking

Conducting management review

(BSN, 2012)

Implementing EnMS to an organization is an effective and cost-effective way to improve energy efficiency, provided that the potential for energy efficiency to be identified and implemented continuously in the process of improving energy performance [9].

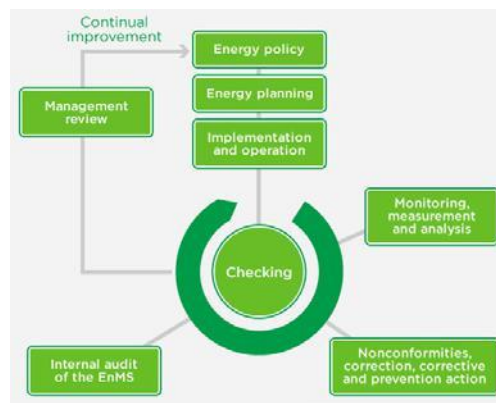


Figure 1. ISO 50001 cycle.

The United Nations Industrial Development Organization (UNIDO) as one of the international institutions that play a role in the made of ISO 50001 in cooperation with the Indonesian government through the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Industry (MOI), and BSN, conducted socialization and supported Indonesia industries in EnMS implementation based on SNI ISO 50001. These efforts are carried out through EnMS training activities to the industry, training to made national experts in the field of EnMS, as well as providing assistance to the EnMS implementation for the industry through a pilot company program. This activity took place in 2012 - 2015 and has resulted 28 industries as pilot companies on EnMS implementation [10]. This research was conducted to determine the sustainability of the EnMS implementation in industries that have participated in a pilot company program organized by UNIDO in cooperation with the Indonesian government.

2. Method

This research is a quantitative research using survey method. The survey was carried out by giving a questionnaire to the research object. The object of research is industries that have been pilot companies in the EnMS implementation through cooperation between UNIDO and the Indonesian government, namely MEMR, MOI and BSN, in the Industrial Energy Efficiency project that took place in 2012 - 2018. The research object consisted of 28 industries from 1 glass and ceramic sector, 16 textile and garment sector, 2 pulp and paper sector, 3 food and beverage sector, and 6 chemical sector. The sampling technique used in this study is saturated or total sampling method, which is the technique of determining the sample where all the research objects are sampled. This technique is often used if the number of objects is less than 30, or the researcher intends to make generalizations with very small errors [11].

In this research, primary data was obtained from the survey results in the form of questionnaires that had been filled by the pilot company, and secondary data obtained from various sources, related to the implementation of EnMS in Indonesia and literature studies from various journals or scientific reports. The questionnaire which is used for the survey, firstly tested the validity and reliability using statistical methods. Validity test is done by Pearson Correlation Product Moment, which compares the value of r - counted with r - table. If the r - counted value is greater than the r - table value, then the questionnaire used is valid. If the r - counted value is smaller than the r - table value, then the questionnaire used is invalid. Reliability test is done by comparing the Cronbach's Alpha coefficient with r - table value or 0.6. If the Cronbach's Alpha coefficient is greater than the r - table value or 0.6, the questionnaire used is reliable in research. If the Cronbach Alpha coefficient is smaller than r - table value or 0.6, the questionnaire used is not reliable or unreliable to be used in research. The data used for validity and reliability test are the results of a survey conducted by UNIDO in 2016 to the industries that have attended EnMS training, using the same questions used in this study [12].

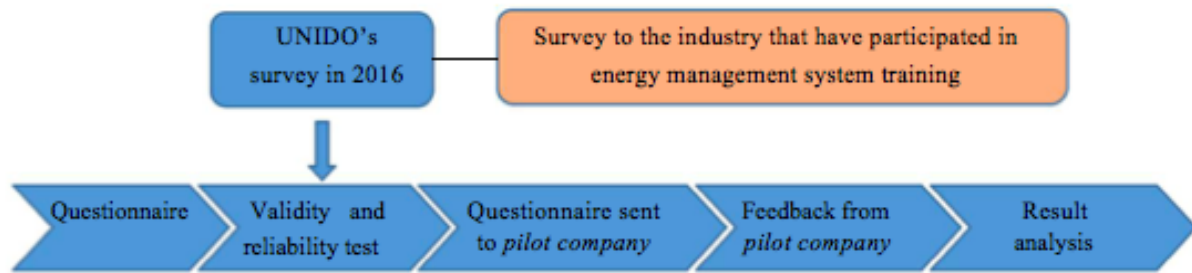


Figure 2. Research implementation

The questions of questionnaire refer to the guideline for the EnMS implementation published by UNIDO where there are 9 questions related to variables that influence the EnMS implementation [13].

3. Results and Discussion

3.1. Validity test

This study uses the Pearson Correlation Moment Product validity test with the principle of correlating or connecting between each question score with the total score obtained in the study [14]. A question can be said to be valid if it has strong support for the total score [15]. This test is done by using SPSS software. To test whether the correlation (r - value) on all questions is significant to the total score, the results of the r - test are compared with r - table with maximum significance level of 5% as shown in Table 1.

Table 1. Comparison of r - counted with r - table values

Variable	r - counted	r - table with maximum significance level		Conclusion
		5%	1%	
Accept potential	0.745	0.261	0.281	valid
Management commitment	0.878	0.261	0.281	valid
Roles and responsibilities	0.868	0.261	0.281	valid
SEU	0.895	0.261	0.281	valid
Baseline	0.864	0.261	0.281	valid
EnPI	0.841	0.261	0.281	valid
Objective and target	0.873	0.261	0.281	valid
Action plan	0.898	0.261	0.281	valid
Internal audit	0.879	0.261	0.281	valid

The Product Moment r - counted (Pearson correlation) is greater than the r - table value, both at the significant level of 5% and 1%, so it can be concluded that the questionnaire that will be used is valid or all questions can be used and can be trusted to collect the data needed [16].

3.2. Reliability test

This study conducted a reliability test referring to the Cronbach's Alpha coefficient generated from the SPSS output. The results of this reliability test are shown in the Table 2.

Table 2. Result of reliability test

Reliability Statistics	
Cronbach's Alpha	N of Items
0.792	10

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Accept potential Management commitment	25.82	271.686	0.717	0.776
Roles and responsibilities	26.63	259.700	0.860	0.763
SEU	26.22	264.587	0.851	0.768
Baseline	26.07	260.507	0.879	0.763
EnPI	26.33	262.954	0.845	0.766
Objective and target	26.31	267.169	0.822	0.771
Action plan	26.20	264.433	0.857	0.768
Internal audit	26.25	264.289	0.885	0.767
EnMS	27.14	264.857	0.864	0.768
	13.94	74.033	1.000	0.956

Reliability test results indicate that the questionnaire will be used reliably for using in this research. This is shown in the value of Cronbach's Alpha 0.792 greater than minimum value of 0.6 so that it can be concluded that the instrument used in the study was consistent and reliable, even though the study was repeated with the same instrument.

3.3. Survey result

The questionnaires that have been tested for validity and reliability are then used in conducting surveys. Due to confidentiality datas, the name of pilot companies are shown in code.

Table 3. Company status and its certification of ISO 50001

Company sector	Code	Company status	ISO 50001 Certification
Glass and ceramic 1	G1	Still operating	Not yet
Textile1	T1	Still operating	Certified
Textile 2	T2	Still operating	Certified
Textile 3	T3	Still operating	Not yet
Textile 4	T4	Officially closed in 2014	-
Textile 5	T5	Still operating	Certified
Textile 6	T6	Still operating	Certified
Textile 7	T7	Still operating	Not yet
Textile 8	T8	Still operating	Not yet
Textile 9	T9	Still operating	Not yet
Textile 10	T10	Still operating	Certified
Textile 11	T11	Still operating	Not yet
Textile 12	T12	Still operating	Not yet
Textile 13	T13	Still operating	Not yet
Textile 14	T14	Still operating	Not yet
Textile 15	T15	Still operating	Not yet
Textile 16	T16	Still operating	Not yet

Pulp and paper 1	PP1	Still operating	Certified
Pulp and paper 2	PP2	Officially closed in 2015	-
Food and beverages 1	M1	Still operating	Certified
Food and beverages 2	M2	The company was acquired by others	-
Food and beverages 3	M3	Still operating	Certified
Chemical 1	K1	The company has changed its name and business field	-
Chemical 2	K2	Still operating	Certified
Chemical 3	K3	Still operating	Not yet
Chemical 4	K4	Still operating	Certified
Chemical 5	K5	Still operating	Not yet
Chemical 6	K6	Still operating	Not yet

Table 4. Score for each questions

Kode	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Average score (per company)
G1	5	5	4	4	3	3	5	3	3	4
T1	5	5	5	5	5	5	5	4	5	5
T2	5	5	4	4	4	4	5	5	5	5
T3	4	4	2	4	3	3	4	2	2	3
T4	0	0	0	0	0	0	0	0	0	0
T5	5	4	4	5	4	4	5	5	4	4
T6	5	5	4	5	4	5	5	5	3	5
T7	5	4	4	5	5	4	4	4	4	4
T8	5	5	5	4	4	5	5	4	5	5
T9	5	5	5	5	5	5	5	5	3	5
T10	5	5	5	5	5	5	5	5	5	5
T11	4	2	2	3	2	2	2	1	1	2
T12	5	4	5	5	5	3	5	5	3	4
T13	4	4	3	4	3	2	3	3	2	3
T14	5	5	3	4	5	4	5	5	3	4
T15	2	5	0	1	2	1	3	1	3	2
T16	4	4	3	5	4	3	4	4	1	4
PP1	5	5	5	5	5	5	5	5	5	5
PP2	0	0	0	0	0	0	0	0	0	0
M1	5	5	5	5	5	5	5	5	5	5
M2	0	0	0	0	0	0	0	0	0	0
M3	5	5	5	5	5	5	5	5	5	5
K1	0	0	0	0	0	0	0	0	0	0
K2	5	5	5	5	5	5	5	4	5	5
K3	5	5	5	5	3	5	5	4	0	4
K4	5	5	5	5	5	5	5	5	5	5
K5	2	3	2	5	3	3	3	4	0	3
K6	5	5	2	2	4	4	5	4	4	4

Remark:

Q1 means question 1, ask about accept potential

Q2 means question 2, ask about management commitment

Q3 means question 3, ask about roles and responsibilities

Q4 means question 4, ask about SEU

Q5 means question 5, ask about baseline

Q6 means question 6, ask about EnPI

Q7 means question 7, ask about objective and target

Q8 means question 8, ask about action plan

Q9 means question 9, ask about internal audit

Based on the average score for each industry, the sustainability of EnMS implementation can be divided into:

1. Average score 0 – 1, this mean that the industry no longer implement EnMS, there are 4 industries.
2. Average score 2 – 3, this mean that the industry is still implementing EnMS, but not fully implemented in accordance with the guidelines contained in SNI ISO 50001, there are 5 industries.
3. Average score 4 – 5, this mean that the industry is fully implementing EnMS in accordance with the guidelines contained in SNI ISO 50001, there are 19 industries. Ten of 19 industries has obtained certificate of ISO 50001.

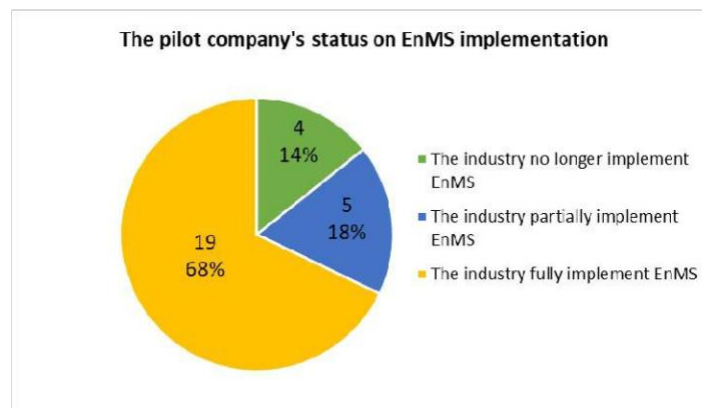


Figure 3. The sustainability of EnMS implementation

Based on figure 3, four industries or 14% from the total number of pilot companies are no longer implementing EnMS. This is because:

- The companies were officially closed. It is happened in one textile industry (T4) and one pulp and paper industry.
- The company has changed its ownership and most of the previous employees have resigned, so it is assumed that the EnMS implementation is no longer continuing. This was happened in one food and beverage industry (MM2).
- The company no longer runs production activities, and changed its business to become a chemical supplier. This was happened to one of chemical industry (K1).

Five industries with an average score of 2 - 3 are still implementing EnMS, but they are not fully implemented in accordance with the guidelines contained in SNI ISO 50001. This happens because there are still facing some barriers, such as:

- Management is still more focused on production activities than energy efficiency.
- There is still lack of support from experts in the EnMS implementation, especially in energy data analysis. The lack of awareness of employees to participate in the EnMS implementation, even though the company provides monthly training for EnMS implementation to employees. This is because the company is labor intensive with a level of education in the middle to lower employees.
- The number of personnel or energy team is limited, because the company also implements several other management systems and it is not yet integrated.

- The reward system for employees who are directly involved in EnMS implementation does not work, so employees are lazily involved in energy efficiency activities.
- The purchasing department has not considered energy efficiency aspects in the procurement of goods and services.
- In implementing an action plan, the maintenance department is faced with the problem of time and cost for its repair.
- ECO lists are difficult to obtain anymore because of the easy things already done, while what might be done next is a saving step with large investments, for example replacing an old motorbike with a motor that has high efficiency or modifying the main engine (paper machine). This is still not done because the company's financial focus is still being used for other things.
- The dynamic of industrial conditions, related to the technical side, such as changing equipment and changing product types.

Nineteen industries or 68% of the total number of pilot companies are still fully implementing EnMS, in accordance with the guidelines in SNI ISO 50001. Ten of 19 industries have obtained ISO 50001 certificates so that they must carry out surveillance audit of ISO 50001 regularly. The aims of surveillance audit on ISO 50001 are to ensure that EnMS activities meet the requirements in ISO 50001 and energy performance is constantly increasing. The surveillance audit on ISO 50001 is carried out by certification body or external parties of the company in order to maintain the quality and fairness of audit result. The industries that are still implementing EnMS but have not yet certification of ISO 50001 then guarantee their continual improvement of their energy performance through internal audit activities which are part of the EnMS implementation cycle. The internal audit is carried out by the internal auditor of company itself. The internal auditor comes from other department which have other functions and responsibilities in their daily activities. The internal auditor has attended special training on internal audit and EnMS implementation.

The key success for industries that are still implementing EnMS and maintaining its sustainability, whether those who have or have not certified ISO 50001, are :

- Top management commitment in supporting EnMS implementation, so that the problems faced during implementation can be overcome
- The opportunities for all employees to be involved in EnMS implementation.
- The savings value is also shared with the employees so that they are more enthusiastic in supporting the implementation of EnMS.
- The determination of objective and targets in EnMS implementation makes all activities related to energy management more directed.
- The improvement of understanding of energy savings and the latest technology updates help the energy team carry out their energy saving activities.

4. Conclusion

Based on the research which was conducted by survey to the pilot's company industry of EnMS implementation, 68% of industries still carry out EnMS in their entirety and 10 industries of them have obtained ISO 50001 certificates. 18% of industries still implement EnMS even though they are partially implemented, so that in total 86% of industries that have participated in the pilot company program are still implementing EnMS. This is showing that the pilot company program was successful in socializing and assisting the industry for EnMS implementation.

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