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Introduction to Energy Accounting in Higher Education: A Theoretical Discussion

Komang Adi Kurniawan Saputra

Faculty of Economics and Business, Warmadewa University

ABSTRACT

This review discusses the importance of energy accounting in the curriculum of accounting study programs at universities in Indonesia. Commitment to energy conservation in industry is important to get attention because it has become a commitment from the Indonesian government. Energy conservation has the form of efficiency, savings, and energy management. In the context of higher education, energy accounting discusses energy audits, environmental accounting, green accounting, energy saving measures, as well as other energy cases such as greenwashing and others. Energy accounting learning needs to be followed up to be included in the curriculum of the accounting study program as a form of the commitment of the younger generation to energy conservation. So far, energy accounting has not been specifically discussed. Several universities teach energy accounting in the sub-chapters of social and environmental accounting, sustainability accounting, and green accounting. The next hope is that energy accounting will become a separate subject by getting the full portion of the lesson. The contribution of this review is to improve the accounting study program curriculum so that it has benefits for future accounting developments.

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Keywords:

energy accounting, energy conservation, energy efficiency, energy audit, energy management, sustainability accounting.

INTRODUCTION

Based on Government Regulation Number 70 of 2009 concerning Energy Conservation, energy conservation is defined as a systematic, planned and integrated effort to preserve domestic energy resources and increase the efficiency of their utilization (Olatomiwa et al., 2016). Government Regulation No. 70 of 2009 can be called the "bible" of the energy conservation movement in Indonesia. Another definition, energy conservation is any behavior that results in the use of less energy, or any behavior that ultimately consumes less energy (Dong et al., 2014). Energy conservation is focused on the behavior of human energy users**.** However, the reduction in energy consumption must be carried out in rational ways without reducing the use of energy that is really needed; or without compromising safety, comfort and productivity. Energy conservation can be done starting at no cost to requiring large costs (Saputra et al., 2022).

Corresponding Author: Komang Adi Kurniawan Saputra

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Energy conservation is related to attitude or behavior to use less energy but remain rational. Meanwhile, energy efficiency is related to using less energy to get the same or even more benefits, or using the same energy but producing more benefits (Saputra, Manurung, et al., 2021; Saputra et al., 2022). Energy conservation or energy saving itself is an action to reduce the amount of use of new, renewable and non-renewable energy for the sake of the sustainability of human life and the surrounding environment (A. H. Almagtome et al., 2020). Saving energy means not using electrical energy for something that is not useful. Energy savings can be achieved by using energy efficiently where the same benefits are obtained by using less energy, or by reducing consumption and activities that use energy (Bellosa et al., 2003; Frischknecht et al., 1998).

Energy savings can lead to reduced costs, as well as increased values for the environment, national security, personal security and convenience (Backlund & Thollander, 2015; Saputra et al., 2022). Organizations as well as individuals can save costs by saving energy, while commercial and industrial users can increase efficiency and profits by saving energy (Alajmi, 2012; Lara et al., 2015). One form of energy saving in industry is the implementation of energy accounting to limit unnecessary energy

consumption, and also calculate other energy needs and uses (Moriarty & Honnery, 2010; Stathopoulos et al., 2008). Therefore, the review in this article discusses the importance of energy accounting being introduced in formal education in universities so that energy conservation is instilled from an early age before entering the world of work (Georgiou et al., 2014).

LITERATURE REVIEW

Energy Conservation

Energy saving is an important element of an energy policy. Energy saving reduces energy consumption and energy demand per capita, so that it can cover the increasing energy demand due to population growth (Kim et al., 2018; Omune et al., 2021). This reduces rising energy costs, and can reduce the need for energy generation or energy imports (Saputra et al., 2023b). Reduced energy demand can provide flexibility in choosing energy production methods. In addition, by reducing emissions, saving energy is an important part of preventing or mitigating climate change (Saputra et al., 2023a). Energy saving also makes it easier to replace non-renewable sources with renewable sources. Energy conservation is often the most economical way to deal with energy shortages, and is a more environmentally friendly way than increasing energy production (Puntí, 1988).

Energy Efficiency

Energy efficiency or energy efficiency is a business that is carried out with the aim of reducing the amount of energy needed, in using an equipment or even an energy-related system (Y. Zhang et al., 2015). Improvements in energy efficiency are generally achieved by adopting more efficient technologies or production processes or by generally accepted application methods to reduce energy expenditure (Ahmad et al., 2020). There are many motivations for increasing energy efficiency (Saputra, Atmadja, et al., 2021). Reducing energy use, reducing energy costs and can generate financial savings for consumers if the energy savings do not exceed the additional costs for implementing energy-efficient technology applications (Saputra et al., 2022). Reducing energy use is also seen as a solution to reducing the problem of greenhouse gas emissions (Aman et al., 2013). According to the International Energy Agency, increasing energy efficiency in buildings , industrial processes and transportation can reduce the world's energy needs by a third by 2050, and can help control global greenhouse gas emissions Energy efficiency and renewable energy are also known as the twin pillars of energy policy (Saputra, 2020; Saputra et al., 2023b). Sustainable and is a top priority in the sustainable energy hierarchy. In many countries, energy efficiency is also seen to have benefits for national security as it can be used to reduce the rate of energy imports from foreign countries and can slow the rate at which domestic energy resources are depleted (Aman et al., 2013; Georgiou et al., 2014; Stathopoulos et al., 2008).

Energy Accounting

Energy accounting is a system used to regularly measure, analyze and report the energy consumption of various activities (Frischknecht et al., 1998; Moriarty & Honnery, 2010; Y. Zhang et al., 2015). This is done to improve energy efficiency, and to monitor the environmental impact of energy consumption (Lee & Cheng, 2016; Lefurgy et al., 2003). Energy accounting is a system used in energy management systems to measure and analyze energy consumption to improve energy efficiency in an organization (Moriarty & Honnery, 2010; Puntí, 1988). Organizations such as the Intel company use this system to track energy usage (Lee & Cheng, 2016).

DISCUSSION

Efficiency Commitment : Energy Accounting or Energy Audit

Energy efficiency has been proven to be a cost efficiency strategy for building the economy without increasing energy consumption. For example, the state of California began implementing energy efficiency measures in the mid-1970s, including building codes and standard tools with strict efficiency requirements (Lefurgy et al., 2003; F. Zhang et al., 2019). Over the following years, energy consumption in California remained flat on a national per capita basis, while the nation's (United States) consumption doubled (Lee & Cheng, 2016; Moriarty & Honnery, 2019). As part of the strategy, California implemented a " loading order " for new energy sources that placed energy efficiency first, renewable electricity supply second, and new fossil fuel power generation last (Saputra, Manurung, et al., 2021). Other states such as Connecticut and New York have created quasi-public Green Banks to help owners of residential and commercial buildings finance energy efficiency improvements that reduce emissions and reduce consumer energy costs (Saputra et al., 2022).

The first step in carrying out energy efficiency is an energy audit. An energy audit is a process of collecting and analyzing data that is carried out jointly with energy conservation activities (Bellosa et al., 2003; Frischknecht et al., 1998). The provision of an energy audit is based on the necessity of fulfilling objectives in an effective energy management process with clear and detailed actions (Saputra et al., 2023a). The scope of energy audit activities includes all kinds of records regarding the type of energy and the amount of energy used at each level of the manufacturing process (Moriarty & Honnery, 2010; Stathopoulos et al., 2008) . Recording is done systematically and continuously. During the energy data collection process, analysis and understanding of each energy conservation activity are carried out simultaneously (Dong et al., 2014; Olatomiwa et al., 2016). Energy audit is needed in improving energy efficiency in various industries and technological processes.

The purpose of conducting an energy audit is to reduce energy losses and use energy reserves (Hirst et al., 1981).

The responsibility for conducting an energy audit is given to the energy auditor. Energy audit activities start from a simple data survey to detailed testing of the data that is already available (Moriarty & Honnery, 2019). The old data is then analyzed and the results of the analysis are used to obtain new data (Neugebauer & McAuley, 2001). The acquisition of new data is the result of combining old data with specific factory trials (Saputra, Manurung, et al., 2021). An energy audit requires information on the size and type of manufacturing facility to determine the length of time to conduct the audit (Saputra et al., 2022). The implementation of an energy audit is also determined by its objectives (Roberts, 1978).

Energy audit is an inspection activity, data collection, and analysis of energy use in a building, in a process or system with deep understanding of the object of study (Hirst et al., 1981) . The energy audit process includes several stages as following : 1) analyze the company's energy usage data, 2) perform data collection of operating conditions in field, 3) understanding of company characteristics and interaction with energy based on occupancy rate and time operations, 4) evaluating energy conservation, 5) estimating existing energy saving opportunities, and 6) identifying services and consumer needs (Lai et al., 2012) . By looking at historical studies, a basis can be established for identifying sectors with high energy use and their influence on energy use maps (Lara et al., 2015) . This information is useful for determining energy saving priorities as well as for providing an overview of energy use patterns in hotels. Since more than 75% of a hotel's energy expenditure is in the form of electricity, the analytical approach in the following section places greater emphasis on electricity. The following are the key steps in conducting an energy audit.

Energy audit is needed because we need measurable energy use, in energy management we know energy accounting, which is an activity to record and link between energy use and costs incurred. In addition, to monitor energy use on a time scale. Lara et al (2015) state that implementing an energy audit can increase management's knowledge about the amount of energy and costs incurred, so that it will improve environmental performance. Zanardo et al (2018) state that energy audit is an important activity in the context of implementing energy conservation, and the purpose of an energy audit is to find out historical data on energy use and look for opportunities to save energy consumption for the purpose of improving environmental performance. Efforts to save energy in a commercial building such as a hotel can only be carried out if it is known what the energy is used for and how much energy is used in each hotel building. This is done with the aim of conserving energy and improving environmental performance (Fleiter et al., 2012) .

Energy Accounting = Energy Audit = Energy Management

Energy management is an integrated program that is planned and implemented systematically to utilize resources energy and energy effectively and efficiently (Pathak et al., 2012). The purpose of holding energy management is to save energy and save costs due to rising energy prices , scarcity of energy resources and awareness of the negative effects of over-exploitation of energy for the environment (A. Almagtome & Abdlazez, 2021; Bellosa, 2000). Since the 1970s, industrial management has made energy management a key industrial function. Factors that determine the quality level of energy management include the supply chain , production costs , energy quality and production environmental sustainability (Predana et al., 2020; Sara et al., 2021). Energy management is used in the energy transformation process by applying general principles that have verifiable validity (Sara et al., 2023).

Technological factor of energy users is not taken into account in energy management (Aman et al., 2013). Effective energy management procedures include data analysis stages energy history , energy audits and accounting, engineering analysis and feasibility studies for business and investment proposals , as well as training and information provision to personnel executing the work (F. Zhang et al., 2019). Implementation of energy management is carried out by internal consultants or external consultants from a company (Bellosa, 2000; Puntí, 1988). Energy management is managed according to the company's budget for energy costs and according to the scientific performance index of energy (A. Almagtome & Abdlazez, 2021; Pathak et al., 2012).

Initial energy audit includes activities of energy management survey and energy survey. The implementation time is determined by the type of factory and its facilities (Lee & Cheng, 2016). A modest factory can conduct and complete a day or several initial energy audits. Meanwhile, factories with complex facilities require a longer time (Moriarty & Honnery, 2019; F. Zhang et al., 2019). The energy management survey includes activities to understand ongoing energy management, particularly decision-making in energy conservation project investments. While the activity in the energy survey is to make a review of the condition of the equipment while it is being used by important energy users (Aman et al., 2013; Lefurgy et al., 2003). These types of energy users are in particular boilers and steam systems. Instrumentation capable of producing energy efficiently is also included as important equipment. Initial energy audits using a small amount of portable instrumentation (Aman et al., 2013; Georgiou et al., 2014). Initial energy audits are conducted by energy auditors who are experienced in making observations and collecting data that are interconnected with one another . The results of the initial energy audit are used to quickly diagnose a plant's

energy situation (Moriarty & Honnery, 2019; Neugebauer & McAuley, 2001; F. Zhang et al., 2019).

Energy Accounting: In College

Various energy transformations are possible. An energy balance can be used to track energy through a system (Georgiou et al., 2014). It becomes a useful tool for determining resource use and environmental impact. How much energy is required at each point in a system is measured, as well as the form of that energy (Georgiou et al., 2014; Moriarty & Honnery, 2010; Stathopoulos et al., 2008). Accounting systems track energy in, energy out, and energy dissipation versus work performed, and transformations within a system. Sometimes, work that is not useful is often the cause of environmental problems (Lefurgy et al., 2003). Therefore , energy accounting needs to be introduced early on in formal education in Indonesia (F. Zhang et al., 2019).

In the higher education curriculum, energy accounting has not been specifically taught. Some universities insert knowledge about energy accounting in sub-chapters of environmental accounting, environmental management accounting or other accounting courses (Frischknecht et al., 1998; Y. Zhang et al., 2015). Based on Indonesia's commitment to energy conservation, energy accounting is increasingly needed. Definition of Energy Accounting One part of the energy management system functions to process input data (energy consumption and actual and reference production) to be processed and provide output in the form of reports per activity time period (A. H. Almagtome et al., 2020; Olatomiwa et al., 2016). The output obtained will provide an indication for conducting research on energy cost centers that use excess energy. Purpose and Benefits of Energy Accounting Useful in formulating plans, targets or budgets energy Assist in calculating the energy consumption per unit per month (Georgiou et al., 2014; Lefurgy et al., 2003). Provides a record of actual energy consumption. Facilitate comparison of energy consumption performance actual against standards and targets (Puntí, 1988; Stathopoulos et al., 2008). Explain variations in energy consumption and consumption trends every month. Facilitate performance investigation and reporting (A. H. Almagtome et al., 2020; Bellosa et al., 2003).

Zhang et al. (2015) mentioned that energy accounting needs to be introduced since university so that the graduates produced are more understanding and aware of energy saving. As previously stated, saving energy is an obligation for all industries or households. The energy we use today is limited, so it is necessary for efficiency to ensure sustainability for the next generation (Moriarty & Honnery, 2010). The energy we use today needs to be accounted for and conserved. If the energy saving commitment is not carried out, then over time it will run out and the energy crisis will be passed on to our next generation. Georgiou et al. (2014) conveyed that, there is an urgency at this time regarding the introduction of energy accounting in universities. Stathopoulos et al. (2008) Also mentions that energy accounting should specifically have been taught in education today. The matter of combining learning energy accounting with other subjects is only a technical strategy by universities in Indonesia. However, the goal is actually very noble, namely energy conservation and efficiency for the next generation.

CONCLUSION

Policies are made so that each implementer can play an active role in achieving energy management goals. Determination of energy management policies provides greater opportunities in achieving energy management goals. The scope of energy management policies includes policy statements and energy management strategies. The policy statement contains a general statement regarding the objectives of implementing energy management. While the management strategy contains steps to achieve its goals. The existence of an energy management policy will focus its implementers on a single frame of mind in achieving its goals. This policy also establishes a systematic work program and demonstrates a commitment to energy management. Determination of policies is also used as a form of monitoring changes in the behavior of energy management implementers and providing adequate resources. Another benefit of establishing an energy management policy is building energy awareness among the implementers. The effectiveness of energy management policy implementation is determined by the level of integration with information systems, technical standards, marketing and financial management.

Part of energy management in the educational context is energy accounting in the field of accounting. The commitment to energy conservation in education is manifested by accommodating energy accounting courses taught in the accounting higher education curriculum in Indonesia. There are many things that can be adopted in learning energy accounting courses in tertiary institutions. Some of these things are energy audits, energy conservation, energy efficiency, environmental management accounting, green accounting, and others. The learning techniques are adjusted to the characteristics of the university or study program of each tertiary institution. The learning character of energy accounting courses is usually juxtaposed with environmental accounting, green accounting, and sustainability accounting courses.

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