Incentive Strategy for Energy Efficiency Programs in Industries Consuming 6 000 TOE/year with Sustainable Energy Performance

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Abstract. This study aims to obtain the incentives strategy that can increase the participation of energy users greater than or equal to 6000-TOE in fulfilling their obligations on energy conservation through energy management with Sustainable Energy Performance (SEP). Several steps need to be carried out. First, data collection on industries that must carry out energy management, and will be analyzed to determine the level of compliance of energy users. Second, ensure that already have carried out an energy-saving program with the SEP. Third, formulating incentive schemes for energy users. Fourth, the interest deduction for the company when they implement the SEP. The results show that only 10.25 % fully comply with the regulation, 36.89 % are partially compliant and 52.87 % are not compliant with energy management activities at all. For industries that have implemented energy conservation and SEP, several benefits are obtained, including capital expenditure (capex) savings when purchasing new imported equipment for creating another energy efficiency, by up to 30 % and incentives in the form of lowering interest rates by up to 4 %.

Keywords: Carbon emission reduction, energy conservation, interest reduction, ratio interest to saving, saving capex

1 Introduction

The global warming of the earth's temperature is caused by several factors such as the use of energy derived from fossils [1, 2], Excessive use of energy and others has an impact on the existence of the earth and its contents in the future. Keeping global temperature rise below 2 °C, and even suppressing it to 1.5 °C [3], is an important thing that must be considered by countries in the world, so that efforts to tackle climate change are an important agenda for countries in the world. One example is the United Nations Climate Change Conference in Paris (The Paris Agreement) [4], which was held on 12 December 2015.

One way to prevent global temperature rise is to reduce excessive energy use [5]. Therefore, activities to utilize energy efficiently and rationally without reducing the use of energy needed to support development need to be carried out appropriately [6, 7]. Preserving energy for future generations is the main goal of energy sustainability [6]. Energy

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production and consumption should promote human development in all social, economic [8], and environmental spheres for a healthy future [9]. Environmental issues and energy shortages have compelled everyone to aggressively promote energy conservation [10].

Pan *et al.* [11] studied the internal dynamic relationship between environmental regulation, technological innovation, and energy efficiency in China. They discovered that market incentives and environmental regulations directly add to energy efficiency and propel it through technical advancement. The command control environmental management, on the other hand, immediately increases energy efficiency. Yang *et al.* [12] analyzed the effect of government subsidies on renewable energy investment and the effects and differences regarding government subsidy types in China. The findings demonstrate, that investments in green energy have a favorable threshold impact on government funding, and the share of government funding to renewable energy investment is considerably increased when energy usage density, bank credit, and degree of economic growth are higher than the benchmark value. Financial subsidies and tax incentive policies can encourage investment in green energy, but tax incentive policies have a more substantial impact. In Indonesia, to get the incentives and subsidies the industries must conduct energy conservation through energy management [13]. Energy management is crucial for sustainable energy performance in various sectors including industry, buildings, and transportation [14]. In recent years, there has been an increasing focus on sustainable energy performance with cleaner production [15], and energy management practices to reduce energy consumption and greenhouse gas emissions [7]. Energy management is an integrated activity to control energy consumption to achieve effective and efficient energy utilization to produce maximum output through structured and economical technical measures to minimize energy use [16]. Including energy for the production process and minimizing the consumption of raw materials and supporting materials [17]. Through the energy audit process, it was found that there were four recommendations including. (i) Recommendations without investment that do not require the usual. (ii) Low Investment Recommendations, namely recommendations that have potential savings of up to 10 % within 2 yr. (iii) Medium Investment Recommendations, namely investments that have a potential savings of between 10 % and 20 % with a return on investment of between 2 yr and 4 yr. (iv) High Investment Recommendations, namely investments that have a savings potential greater than 20 % with a payback period of more than 4 yr. Energy savings can be simply obtained by utilizing wasted energy to be reused for processes such as processing scrap aluminum by utilizing wasted hot gas from the oven [18].

Overall, the studies reviewed here demonstrate the importance of energy efficiency in improving sustainable energy performance in the industrial sector. Energy-efficient equipment [19] and processes, energy management systems, and performance measurement and evaluation can all play important roles in achieving energy efficiency [20] and reducing energy consumption and greenhouse gas emissions in the industrial sector [21, 22].

There has not been much discussion regarding incentives and disincentives regarding the above in more detail. Thomas K Dressen [23], mentioned that only a few industries complied with Indonesian governmental regulation no.70/2009 and no law enforcement or penalties were given. The challenge is that if energy conservation is not carried out, then the opportunity for loss of energy sources will be even greater, and energy security will be threatened. Based on these considerations, the purpose of writing this study is to increase the participation of energy users greater than or equal to 6 000 TOE per year in fulfilling their obligations in energy conservation through energy management with sustainable energy performance.

2 Methods

In this research, several things were done, as follows:

First, the authors analyze compliance with energy management. To find out how much attention energy users have towards PP No.70/2009 article 12 [13], data collection on industries, which must carry out energy conservation through energy management and the locations of these industries, is carried out and analyzed to then determine the level of compliance energy users equal to or greater than 6 000 TOE per year by making energy users compliance categories as in Table 1.

Table 1. The level of compliance of energy users toward energy conservation

Compliance Level	Category	Compliance				
		Certified Manager	Prepare energy program	Internal regular audit	External regular audit	Regular Report
Low	Not obedient at all	x	x	x	x	x
Moderate	Comply with some provisions	v	v	x	x	x
High	Comply with all provisions	v	v	v	v	v

Second, ensure that have carried out an energy-saving program with the energy management control system (EMCS) [24, 25] as part of SEP. In general, energy savings with EMCS can reach around 10 % [25]. The author takes a study on an industry that implements energy conservation, namely the steam power plant industry with a capacity of 100 MW. For the sustainability of savings, it is necessary to have some kind of assessment indicator that refers to savings performance, as shown in Table 2

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Table 2. Sustainable Energy Performance (SEP)

No.	Item	Indicator	Remarks	Reff
1.	Technical sustainability	Resources input	Fossil, Nuclear, or Renewable Energy. Durability/maintenance. Material efficiency.	[26–28]
2.	Energy Efficiency	Energy Consumption	Total average annual energy use intensity index	[29–31]
3.	Management aspects	EMCS	Goal, Plan, Assign, Follow Up, Report.	[32, 25]
4.	Environmental aspects	Carbon Emission Reduction	Carbon intensity. Carbon emission from fuel combustion.	[26, 29]

Third, formulating incentive schemes for energy users. Conduct literature reviews related to incentives for energy conservation and energy efficiency. The incentives given to energy users can simply be stated as follows Equation 1

$$I_{pe} = f\left(F_p + P_d + B_m + B_i + A_u\right) \quad (1)$$

In this study, the incentives that are taken into account are *Fp, Bm*, and *Bi.* So that the Equation 2 can be used:

$$I_{pe} = \sum F_p + B_m \quad (2)$$

Where *Fp* is a tax facility for energy-saving equipment, *Pd* is the provision, reduction, relief, and local tax exemption for energy-saving equipment, *Bm* is an import duty facility for energy-saving equipment, *Bi* is a low-interest rate fund for energy conservation investment, and *Au* is an energy audit partnered with the government and financed by the government. In this paper, the writer focuses on three parts of incentives namely *Fp, Bm,* and *Bi*. Next is to simulate energy users who have Import Identification Numbers (API). The price of the equipment included in this simulation is CIF 110 000 USD.

The amount of costs that must be incurred by energy users in the context of investing in machines or equipment is *Ccapex* (USD) which can be calculated using Equation 3, as follows:

$$C_{capex} = C_{if} \times \left(V_t + I_t + I_d\right) \quad (3)$$

Where *Cif* is the price of equipment (USD), *Vt* is Value Added Tax (%), *It* is Income Tax (%) and *Id* is Import duty (%). Furthermore, to get how much savings can be obtained if it meets the applicable requirements, Equation (4) is used as follows:

$$S_{capex} = \frac{C_{capex} - C_{if}}{C_{capex}} \quad (4)$$

Table 3 shows the components in calculating saving capex. Several categories used are low, moderate, and high.

Table 3. Saving capex categories

Category	Vt (%)	It (%)	Id (%)
Low	11	2.5	Up to 7.5
Moderate	11	2.5	>7.5 up to 17.5
High	11	2.5	>17.5 up to 25

Interest rates (i) that are calculated in this writing are 9 %, 10 %, 11 %, and 12 %. To find out the ratio of interest to saving (RITS) Equation (5) is used:

$$RITS = -\frac{i_{\max}}{S_{capex\max} - S_{emcs\max}} \quad (5)$$

Reduction in interest rates as a result of implementing energy savings (IRITS = Interest Reduction to Savings (%)) after implementing EMCS can be calculated using Equation (6), as follows:

$$IRITS = -\frac{i_{\max}}{3\Delta S_{\max}} \times \left(S_{capex\max} - S_{emcs\max}\right) \quad (6)$$

Where, *imax* is the maximum interest, *S capex,max* is the maximum savings from capex (30 %) and *S emcs,max* is the maximum saving from EMCS 10 % [16].

To get a correlation between the growth rate of energy-using companies that carry out energy management, energy efficiency and contributions to the government, in this case, the reduction in carbon emissions that occurs can be calculated using Equation (7), as follows:

$$S_e = N_c \times 8760\, P_c \times E_e \quad (7)$$

Where *Se* is the energy saved (MWh y^{-1}), *Nc* is the number of companies that conserve energy, *Pc* is the power generated/used (MW) and *Ee* is the energy efficiency carried out (%). Meanwhile, to find out how much carbon emission, CER (T y^{-1}), which is obtained by saving energy, can be calculated using Equation (8), as follows:

$$CER = c \times S_e \quad (8)$$

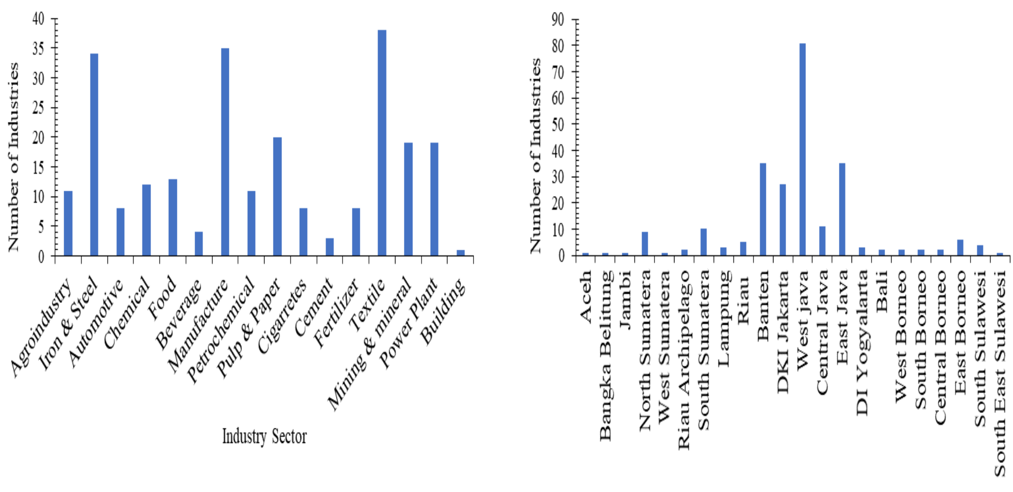
Where c is carbon emission (t CO2e MWh^{-1}), in this case c= 1.013 t CO2e MWh^{-1}).

Fourth, by making a simulation of the growth in the number of companies per year by 65 % that carry out the energy efficiency of 10 %, 20 % and 30 % and their effect on reducing carbon emissions that occur.

3 Results and discussions.

3.1 Industry compliance with energy conservation

Figure 1 shows the energy users that are required to carry out energy conservation through energy management from the type of industry and location. The various industrial sectors that use energy equal to or greater than 6 000 TOE per year in 2017 [33], in this case, is 244. As shown in Figure 1(a), there was the largest and smallest number of industrial users from the textile industry sector, which is 38 industries, and the building industry is one industry. Meanwhile, in Figure 1(b) based on location, the largest industry is in West Java with 81 industries. While the smallest industries are in Aceh, Bangka Belitung, Jambi, and Southeast Sulawesi, each with one industry.



(a) (b)

Fig. 1. Energy users who are required to carry out energy conservation through energy management from the type of industry (a) and location (b).

Figure 2 describes the level of industry compliance with energy management based on the criteria in Table 1. From the 244 industries that are required to carry out energy management, it shows the level of industry compliance with industrial management under government regulation PP no.70 of 2009 is as follows: 25 industries or 10.25 % are fully compliant, 90 industries, or 36.89 % are partially compliant while 129 industries or 52.87 % are not compliance with energy management activities.

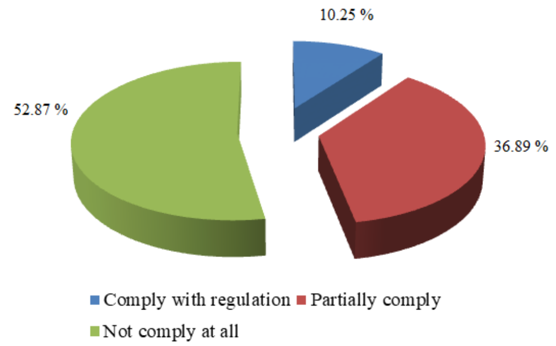


Fig. 2. The level of compliance of energy users with energy conservation obligations.

Table 4 shows a summary of the information obtained from industry, in this case, a 100 MW steam power plant industry that has implemented sustainable energy performance and energy conservation. The Energy Management Control System (EMCS) plays a very important role in pursuing targeted energy efficiency. The role of all parties from the Board of Directors (BOD), Managers, and Supervisors to the staff is the main key to this SEP.

Figure 3 shows the capex savings that can be obtained due to incentives, namely the reduction in the costs of importing goods, using Equation (3) and Equation (4). The goal is to simulate capex savings obtained from incentives as shown in Table 3, that when the obligation to pay import fees is 25 %, we can get a capex saving of 30 %.

Table 4. Summary of findings in SEP implementation

Item	Indicator	Finding	Level	Remarks
Technical Sustainability	Resource Input	1. Coal-based fuel.	-	-
		2. Boiler Turbine Generator Technology.	-	-
		3. Co-firing system.	-	With no additional equipment.
Energy Efficiency	Energy Consumption	4. 36 500 MWh per year.	-	Full load operation.
		5. Mix 5 % biomass-based fuel.	-	Wood and rice husk.
Management Aspects	EMCS	6. Goal (Reducing Energy Consumption/REC compare to the previous year).	Board of Directors	REC 10 % per 2 yr.
			GM and Managers	REC 10 % per 2 yr.
			Supervisors	REC 10 % per 2 yr.
			Staffs	REC 10 % per 2 yr.
		7. Plan (Energy Baseline)	GM and Managers	Weekly & Monthly Energy Consumption Plan.
			Supervisors and Staffs	Daily & Weekly Energy Consumption Plan.
		8. Assignment	GM & Managers	Controlling & Monitoring.
			Supervisors	Controlling & Monitoring.
			Staffs	Execution, record, checklist, equipment preparation, meter reading.
		9. Reporting	GM & Managers	Weekly & monthly report.
			Supervisors	Daily & Weekly report.
			Staffs	Daily report.
		10. Review	Board of Directors	Monthly meetings.
			GM & Managers	Weekly & monthly meetings.
			Supervisors	Daily & weekly meetings.
			Staffs	Daily briefing.
Environmental Aspects	Carbon Emission Reduction	1.013 T MWh^{-1}	-	-

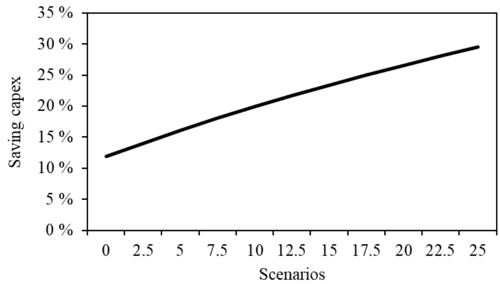
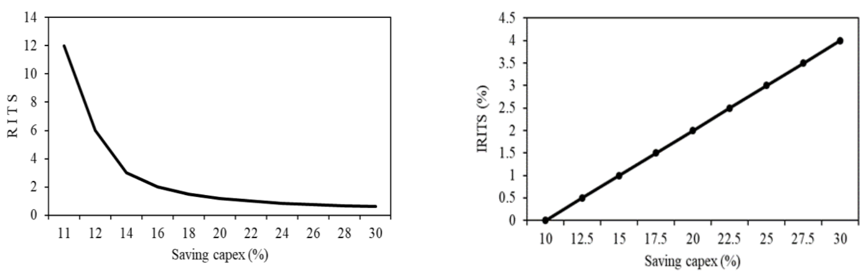


Fig. 3. Saving capex based on several scenarios.

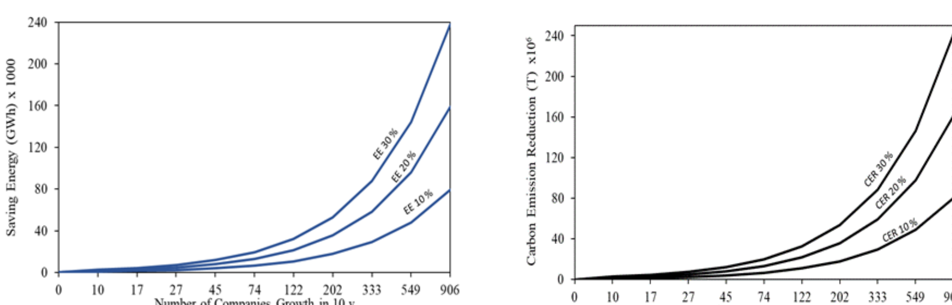
Figure 4 shows the relationship between interest and saving capex. In Figure 4(a) explain the ratio of interest to saving capex (RITS) by using Equation (5) where the best ratio is when saving capex can be done by 30 % with a ratio value of 0.6. Whereas Figure 4(b) by using Equation (6) shows that there is a reduction in interest if energy users can save on capex (IRITS). The maximum decrease that can be achieved is 4 % by achieving a capex saving of 30 %.



(a) (b)

Fig. 4. Ratio interest to saving capex RITS (a) and interest reduction to saving capex IRITS (b)

Figure 5 shows the simulation of the growth of companies participating in energy management while still implementing EMCS. By using Equation (7) and Equation (8), it can be seen in the following Figure 5, whereby implementing energy efficiency of 30 % per year and increasing energy user participants who care about energy management by 65 % yr^{-1}, the energy efficiency of 238 221 000 MWh is obtained in Figure 5(a) with a carbon emission reduction contribution Figure 5(b) of 241 318 × 10^3 T of Co2e emissions in the 10th year.



(a) (b)

Fig. 5. Growth of companies with energy management towards saving energy (a) and carbon emission reduction (b).

Figure 5 shows the simulation of the growth of companies participating in energy management while still implementing EMCS. By using Equation (7) and Equation (8), it can be seen in the following Figure 5, whereby implementing energy efficiency of 30 % yr^{-1} and increasing energy user participants who care about energy management by 65 % yr^{-1}, the energy efficiency of 238 221 000 MWh is obtained in Figure 5(a) with a carbon emission reduction contribution Figure 5(b) of 241 318 × 10^3 T of CO_2e emissions in the 10th year.

From what has been explained above, three things can be discussed further: First, it is necessary to apply disincentives more seriously for industries that do not carry out energy conservation so that the level of industry compliance with energy conservation increases. Second, the application of the base measurement of energy saving (BMES) [25] is combined with sustainable energy performance (SEP) in this energy efficiency program. Third, it takes into account the reduction in carbon emissions that occur as a result of energy efficiency to get incentives from the government.

The practical application of SEP systems can be applied in various industries to increase cost savings with energy efficiency. This study contributes to the development of energy-saving programs implemented by the government nationally. For future research, this study can be continued with the development of related policies with energy savings as well as an assessment system for the progress of energy-saving programs.

Energy-saving programs must involve renewable energy [34–36]. The renewable energy used should be locally available sources, for example from solar energy using a photovoltaic (PV) module to generate electricity [37, 38] or a hybrid photovoltaic and thermal (PVT) collector that produces electricity and heat energy [39, 40]. Biomass and biogas energy should also be applied [41–44]; specifically with a biogas digester, multiple benefits are obtained, i.e., renewable energy, preventing CO_2 gas into the air with the negative effects of global warming, and two kinds of organic fertilizers [45, 46]. In addition, the treatment and utilization of other wastes, such as exhaust gas [47–49]. The same goes for micro/pico hydro [50, 51] and wind energy [52–54].

4 Conclusion

From the 244 industries which are required to carry out energy conservation through energy management, it was found that 10.25 % complied with all provisions, 36.89 % partially complied, and 52.87 % did not comply. For industries that carry out energy conservation, using Sustainable Energy Performance as an incentive strategy for energy efficiency programs will get several benefits, including clear energy efficiency targets, saving on Capex when holding new imported equipment up to 30 %, and incentives in the form of reducing interest rates up to 4 %.

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