

# Challenges and Strength of Current Industrial Energy Efficiency Management Practices in Steam Industries

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**Abstract.** The aim of this study is to achieve greater output by examining the existing way of coordinating the determined attempts of Steam Industries in South Africa to successfully reach a sustainable industrial development by using energy source adequately in a more competent way. Furthermore into the study we look at obstacles that prevent and those that leads to maximum utilization of energy management measures and also highlights the effects of implementing cheap available energy source in South Africa. The investigation and analysis have shown that energy is not well managed in Steam Industries and that the use of energy is minimized and not fully utilized due to poor management and lack of knowledge. Another detection was that lack of government structured and strategic measures of implementing and motivating the use of energy effectively. The effective and rational use of available power by Steam Industries in South Africa is a key player in developing a sustainable industrial development. The use of energy efficiency management strategies has contributed an increase in economic and improve environmentally friendly in the industrial sector. The slow pace adoption of energy saving and cost effective management programmes are negatively impacting on the benefits to Steam Industries in South Africa. In conclusion the study finds that the economy can be boosted by implementing energy efficiency management programmes and environmentally friendly. These will also stabilize the negative impact of energy raising prices.

## 1. Introduction

Energy is inseparable from matter. All material phenomena are associated with energy. Energy is therefore essential to life and the quality of energy consumed per capita can be used as one indicator of a country's development level. No thought was given to this in the past but today it is being included in energy efficiency management activities. Energy supply and demand must be treated with both a macro-economic and a micro-economic approach. There are different aspects in planning energy demand, whether for country, a factory or a household, but each must still be investigated individually given the particular characteristics involved [1]. Energy efficiency management is by definition the most cost effective, efficient use of energy. The term Energy Efficiency Management is relatively new and is a sign of our time. Until recently the efficient use of energy in all its forms was the tacit responsibility of many people in an organization. Now, in many companies, the responsibility for the



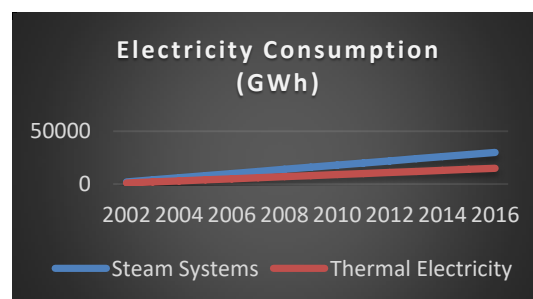
overall management of energy and its widest contexts is focused formally on the Energy Manager. It is the Energy Manager's duty to optimize energy usage not only in individual items of equipment but within the total limits of his specified area [1]. If this area is a net exporter or importer of energy he will have to look beyond the horizons of his own area to investigate the optimization of energy at a company or even inter-company level. Thus a hot effluent stream from an adjacent area may be harnessed to provide process, factory or office heating.

## 2. Background

The backbone of the country's economy is the extraction and processing of minerals. To date an estimation of 93% of South Africa's power is generated from coal – fired power stations, while 5% is nuclear and hydro - electric, whereas 2% is for pumped storage and gas turbines [2]. Current statistics indicate that South Africa is lagging behind in the implementation of energy efficiency management systems.

### 2.1. Energy use and Market in Steam Industries in South Africa

Depending on the size and variables of the Steam Industry; the energy cost and utilities consumes between 3% and 8% of a Steam Industry's general budget. As it can be seen in figure 1, that Steam Industries consumes much of thermal and electric energy. Thermal energy is used to heat water in boiler house and in steam turbines. The process of steam system is typically the largest consumer of electric energy but the boiler-house, turbines and waste water treatment plant can account for substantial electricity demand [2].



**Figure 1.** Trends of Electricity Consumption by Steam Industries

Energy is the most essential resource to South Africa's economy as to the rest of the world. Success of systems and strategies in the organizational and sectorial levels will be more successful if they be embedded in a broad based and long term national environmental programme. More especially granting energy prices to take after external environmental costs will prove to be more energy efficiency and cost efficient and promote awareness among higher administration [3]. In South Africa similar policies introduce preservation of the ecological tax reform. The increment of tax rate on fuels and electricity diminishes financial risk linked with investments in energy utilization and grants long-term planning [3]

### 2.2. Challenges facing the Steam Industries in South Africa

Issues of energy security constantly threaten South Africa's economy; these issues stem from challenges facing the steam industries of South Africa. With rising energy costs and prices around the

world, the Steam Industry continues to seek innovative solutions to these problems. The demand for Steam worldwide continues to rise faster than supply, and the shortage has created a demand for Steam and that will require Steam producers to be more efficient [4].

### **3. Industrial Energy Management**

#### *3.1. Effective features of energy efficiency management systems*

Energy management made based on Plan-Do-Check Act model, which serve as an organizational culture of stable advancement in energy efficiency. The culture of stable advancement assures that the set of objectives are obtained in a progressive manner. It also assures that those set of objectives are practical, obtainable and accommodates the available resources of the firm.

##### *3.1.1. Plan Phase*

Planning has been defined as (1) outlining a course of action to achieve an objective, (2) devising a method to attain a defined goal, and (3) developing a specific way to obtain a desired result. Each definition contains two elements: Knowing what is wanted to be accomplished and deciding how to accomplish it. The energy planning process consists of three steps:

- deciding what is wanted to be accomplished, or setting objectives
- deciding how to accomplish the objectives, or outlining procedures
- deciding how to apply the skills needed to meet objectives, or assigning responsibilities. This step is necessary because the manager does not carry out plan singlehandedly. It is the manager's job to get other people to do this.

##### *3.1.2. Do phase*

To gain the maximal conceivable savings capability, the investigated action plan should be prioritized and restated into a work plan. And also involve the accountabilities and timeframe for different processes, the work plan must very time contain the essential resources. Highlight the energy aims and short-comings, but it will only be successful if there is enough funds and availability of resources. In addition, Energy Manager must note the achieved targets and analysis the benefits in terms of cost saving. The achieved cost saving and reduction in environment pollution should be demonstrate to motivate the employees.

##### *3.1.3. Check Phase*

Check phase aims to supervise the performance (by handling energy audits) in the expressions of energy saving and analyse the set targets. Whenever encounter any loss, it is then important that the root causes are investigated and determined to form correction in order to recognize set objectives. Hence, it is necessary that set objectives are significant to promote the appraisal development.

##### *3.1.4. Act Phase*

This phase mostly involves management analysis of audit, internal and external reports referring to the achievement of the energy management program. This information plays a huge part for the organization to spot any loss and act up on it to provide continuous progress.

### **4. Environmental, Economic And Social Benefits Of Industrial Energy Efficiency**

#### *4.1. Environmental*

The use of environmentally damaging fossil fuels as a primary energy source has provided to be a difficult issue for the Steam Industry to address. As known that, oil-based fuels have some built-in convenience, density, and portability features that make them particularly easy to transport and especially suitable as a form of energy to power transportation activities. The Steam Industry has taken some important measures to minimize the impact of fossil fuel energy on the environment.

#### *4.2. Economic*

The principal aim of any energy conservation project is to save money using limited energy or using energy more efficiently. The economic assessment of energy projects can often be complicated since it involves the engineering techniques needed to classify the magnitude of energy savings, together with the economic principles associated in checking in case that capital investment in the project is supported. The utilization of the energy plant is important because if it is pushed beyond the rated flow-sheet capacity, the variable costs may rise rapidly, because of inadequate time for preventive maintenance, resulting in excessive wear or breakdowns and high labour costs for weekend and holiday maintenance work. These are called super-production costs.

### **5. Energy Efficiency Gap**

One of the major problems that Steam Industry faces in relation to energy is an inability to balance energy demand with energy supply. The nation will not get very far with its efforts to conserve fuel and improve energy efficiency as long as demand for energy continues to increase and even surpass energy supply. The real problem with energy thus reaches beyond oil reserves, gasoline prices, fuel efficiency, and similar issues, it is a problem based in a way of life, one in which convenience, speed, and technologies have driven Steam Industry attitudes about energy and lifestyle.

### **6. Economic Barriers Non-Market Failure Related**

#### *6.1. Hidden costs*

Hidden costs are the most essential and dominant statement for the 'efficiency gap'. "The engineering economic studies fail to stand for their reduction in utility connected with energy efficient technologies or the additional costs connected with their use" [5].

#### *6.2. Organizational Barriers*

Organizational barriers in this concept refers to those organizational factors that can withhold a range of possible energy efficiency investments. This factors include power, culture and awareness of the firm. These factors are related to the structure, size and available infrastructure of the organization [5].

#### *6.3. Culture and Awareness*

The standard of energy awareness among employees was found to be very poor. All grounds had used different awareness campaigns – like posters and information stands – but all reported that these were inefficient. Awareness rising could potentially be helping through responsibility for energy costs, using the environment impact of energy use to motivate staff, and moves towards 'team – working'

and higher accountability for energy costs centre performance. But all grounds lacked a high standard champion for energy efficiency and all reported that awareness of energy efficiency was low within the 'Steam Industry Culture' [5].

#### 6.4. *Credibility and Trust*

The credibility of expertise and trustworthiness are the core significant aspect of information that interfere with the energy efficiency improvement. Hence the successful circulation and absorption of information rely on the trustworthiness as a source. Whenever the credibility of the information source is doubtful, firms may hesitate to invest in energy efficiency based on that information.

#### 6.5. *Values*

In additional to the financial incentive for improving energy efficiency, individuals and Steam industry may be motivated by a desire to improve the Steam Industry's environmental performance. In some case, this may have (or be expected to have) an influence on shareholder value.

Steam Industry must have a robustly driven culture to environmental values, either on the part of respondents or of senior management. Respondents must implement significant energy efficiency measures that exhibited a higher level of environmental concern and emphasized the importance of management commitment. The MD must raise the profile of energy in the organization, through emphatically for cost-savings reasons, and the new emphasis on the environmental agenda. However, 'energy is not seen to be as significant as the environment', apparently, so that intention turns to be directed more towards broad-based environmental improvements rather than energy efficiency.

#### 6.6. *Advantages of an energy efficiency management (EnEM)*

An explanation to energy efficiency management needs systematization on energy saving methodologies. In the long run, this consequences in certain size of energy savings and cost – related improvements, as well as efficiency in process. At the lower standard, it widely procurer and the supplier, an energy efficiency management [5-6]. The main reasons are discussed below:

##### 6.6.1. *Cost reduction*

EnEM's introduction can save up to 10% of energy costs in the first years of implementation by systematically identifying the weak points of your energy usage and addressing them with basic measures. Investments in compressed air, refrigeration, ventilation systems, pump systems, materials handling technology will see a 5 – 50% reduction in power usage, and payback time of less than two years [6-7].

##### 6.6.2. *Environmental protection*

Climate change is one other major catastrophe and not overlooking its effect of on the environment. The result of increasing temperature gives rise to flooding of Coastal regions and low lying Island nations; increasing desert areas and melting glaciers. White climate change is a universal challenge stern measures have to be taken to reduce the green- house effect. An efficient energy management is therefore an important element as it can contribute considerably to reducing greenhouse gas emissions [8].

##### 6.6.3. *Improvement of public image*

An ISO certification, grants your company credibility to public and that you are operating in respect to energy efficiency and hence, taking good care of the environment. Environmental requirements are progressively a significant aspect in public proportions in South Africa, inclusive of atmospheric-friendly purchasing. Both from the perspective of the procurer and the supplier, an energy efficient management support the measurement of CO<sub>2</sub>-emissions.

#### *6.6.4. Use of financial incentives*

Lack of energy saving seems to be problematic impeding the development and success of Steam Industries in South Africa. Consequently, the Power Generation Sector (Eskom) deficient the capacity to sufficient invest to meet the increasing demand of energy in the country; this challenge is caused by the energy pricing, since the sector is not cost effective. Again South African energy service organizations have a very poor financial scheme when it comes to the energy market to make profits [8].

## **7. Results**

In general, energy efficiency management had a very low status compared to research and teaching. However, the study results suggested a correlation between the statuses granted for implementation of energy efficiency management and its activities. An assessed status was based on the subjective judgment of the people interviewed, the extent to which top administration were interested in energy issues and whether were environmental or energy guidelines. According to this ranking, Power Generation sector was the only organization on energy efficiency management status rated relatively high. At this organization, more weight was attached to energy efficiency management when it came to prioritizing investment decisions within the given budgets. A general lack of awareness of energy performance and energy costs was prevalent in all Steam Industries and awareness raising activities were limited and uncoordinated. Where energy savings programmes did exist, energy efficiency management staff tended to abstain because they had 'better things to do'. Motivating staff was also difficult because they were only temporary part of the system and had little incentive to get involved. While reward schemes for staff were not seen as an efficient means to generate new ideas, they could play some role in raising awareness.

### *7.1. Current energy efficient technology adoption in Steam Industries in South Africa*

Improvements in technology adoption in steam generator efficiency result primarily from reductions in waste heat energy losses in the stack gases and expelled water. Procedures that reduce the mass flow and energy content of these flow streams directly benefit unit performance. Other losses occur from surface heat transfer to the atmosphere and incomplete combustion of the fuel.

### *7.2. Barriers to energy efficiency improvement in Steam Industries in South Africa*

Basically at the industry level, incentive to save energy costs was not allowed to be used for savings due to the reductions in future budgets. And the basic cause of that is public accounting which limits the transferability of funds. The unspent money budgeted for a certain cannot either be used on other task and not either hand – over to budgeting periods. For example, savings in energy costs may not be used on investment in energy efficiency, steam systems maintenance or heating equipment. Previously, this was the instance in all Steam Industries. At the time the interviews were conducted, budgeting principles were in the process of being changed in most federal states. However, the policies and

future plans on how to allocate savings differed across organizations. For most Steam Industries, limited negotiability of retained funds to other functions with the same budgeting period was actual planned for the upcoming connection with the initiation of 'global budgeting' [9]. Similarly, for savings at the industrial level, some type of cost sharing arrangements with the organization administration were being planned, but not all the saving made in the past will remain at the Steam Industries for future periods. Thus, incentives for the industry to save energy costs are likely to improve, but remain constrained.

### *7.3. Benefits of energy efficiency measures in Steam Industries in South Africa*

Energy is a direct reflection of cost, the more energy is saved the more cost is reduced. The first stage of raising energy saving awareness can be achieved without financial capital. On the other hand equipment repairs like broken insulation and conductors can save energy. Maintaining proper combustion, conditions of boilers and furnaces and equipping the operators with skills and knowledge will contribute in energy saving in industries [10].

Energy efficiency management is an effective way of saving the in short supply of energy and material resources. Take a brief on boiler operations, a 3mm diameter hole on a pipeline carrying 7 kg/cm<sup>2</sup> steam would waste 32, 650 L of Fuel oil per year. A good housekeeping measure that fixes the hole saves that amount of resources [11-12]. The ability to implement energy saving measures in industrial and residential sectors is a cause for concern. The lack of awareness to start by no cost awareness and followed by cost saving low cost awareness measures of preserving and saving energy has been largely ignored by managers.

## **8. Discussion of Findings**

### *8.1. Challenges of current industrial energy efficiency management practices in Steam Industries in South Africa*

Currently there are policy instruments opposing the development of industrial energy efficiency management in steam industries in South Africa. South Africa's energy market is characterized as a regulated market, hence, government is trying to ease the heavy load on energy prices (certainly with electricity and petroleum products) by subsidizing energy. Such subsidies misrepresent the actually cost of energy supplied to industries and inefficient send the energy prices signals to the industries.

#### *8.1.1. Lack of policy framework*

The ignorance of policy and regulatory plays an important role in poor improvement of energy efficiency measures in steam industries in South Africa. In the occasion of policies, these both cover the national and local government policies. In a number of steam industries, predominantly in South Africa, there is directly none policy or, if there is, it can be unconcerned about the energy efficiency. Regulations that hold up indecorous tariffs can resist the curiosity in energy efficiency. For instance, it is standard to see tariffs that provide for diminishing energy prices for incremental energy consumption by considerable customers. This in turn reacts as a discouragement for such customers that engage or commit themselves to the activity of energy efficiency. Empowering policy and regulatory environments for energy efficiency comprise with setting targets, either binding or discretionary should be considered, from which strategies, for giving support towards increasing levels of energy efficiency, can be developed. The legislation must be enacted within the framework of a national energy policy that has continuity and is not allowed to become a football for party politics. This consistency must apply to any Steam Industry measure that has a potential effect on energy.

Legislation concerning energy must be both self-consistent and more readily comprehensible than in the past.

### *8.1.2. Lack of access to Capital*

Lack of financial injection for investment was a significant barrier to upgrading energy efficiency at the Steam Industries. Access to capital proved to be a problem at the industrial level as well as within individual Steam Industries. While business risk and low profitability proved to be the major reasons for lack of capital in the Steam Industries in South Africa. Hence, the monetary support for digger investment is provided by the state, of which is very rigid. The circumstance is really heavy due to the fact that, previously, Steam Industries were not allowed to lend on the capital market. As indicated that taking up a credit for investment in energy efficiency has not been a solution, however profitable may the investment be.

### *8.1.3. Lack of management awareness*

In the work place energy saving between staff and management was found to be very poor. As a consequence, the general level of housekeeping (for example, turning lights and computers off) was also poor. Factors contributing to this included the relative insignificance of energy costs, the lack of responsibility for energy costs and the dominance of production and other priorities. While a number of Steam Industries had undertaken limited awareness campaigns (for example, stickers, exhibitions) these were generally considered to be ineffective. The environmental consequences of energy consumption were considered to be of little help in motivating staff, owing to their relative invisibility compared to problems such as waste. Partly as a consequence of this, estates departments preferred to concentrate on improving energy efficiency through better controls, rather than improved housekeeping.

## *8.2 Strength of current industrial energy efficiency management practices in Steam Industries in South Africa*

Disregarding the present odds of energy efficiency management rules in steam industries within South Africa. There is recent feasible information aimed for the supplementation of energy efficient practices within Steam Industries, involving the manner of industrial framework for activity development, promotion and coordination. This plan of action provides for the urgent supplementation of low – cost and no – cost interventions, and again to those higher – cost measures with deficient payback periods. These with be undertaken by medium – term and long – term investment opportunities in energy efficiency. The action plan recognizes that there exists indicative possibility for energy efficiency improvements across all sectors of Steam Industries.

## *8.3 Bridging the industrial energy efficiency gap in Steam Industries in South Africa*

Political intervention is of great significance to energy efficiency improvement and this has been provided with the evidence as a proof for its existence. The political impact will subsequently take part in the bridge of the industrial energy efficiency gap steam industries among South Africa. Based on the results found, the management of steam industries in South Africa has the responsibility to establish a wide ranging substructure to accelerate the refinement of industrial energy efficiency. The drive of the substructure has to aim its focus in modifying the inefficient energy use among South African Steam Industries, again establish political instruments of market economy that will express correct energy fare significance to industrial customers. The application of the discretionary industrial energy efficiency management plan with irresistible financial advantages can also be a useful



mechanism in developing industrial energy efficiency management in Steam Industries in South Africa. South African Steam Industries can prescribe energy efficiency in their territory by developing the coherence towards departmental facilities and operations, and sustaining energy efficiency developments for its employees, equipment and Industrial machines.

## 9. Conclusion

The conclusions of this research cover a generic analysis of the energy efficiency management practices in the Steam Industries in South Africa. South Africa's energy system can be defined as consolidated system with Steam Industries as the dominant steering body. The review has acknowledged that, the Steam Industries over the years have made powerful efforts to upgrade energy efficiency management in South Africa; by developing policy instruments and commencing energy efficiency systems and curriculums. Nonetheless, an extensive efficiency gap still stands in the Power Generation Sector and the logic behind is that, government's efforts to develop energy efficiency has been aimed towards residential and commercial sectors of the economy.

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