



## Analysis of energy efficiency and consumption in South African Steel Foundries

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### ABSTRACT

Efficient energy use, sometimes simply called energy efficiency, is the goal to reduce the amount of energy required to provide products and services. Lack of efficient process skills, education and training has become a major issue in recent years regarding the up-stepping of energy efficiency in steel industries. This paper highlights the overview of the current state of energy efficiency in South African foundries, improvements made and challenges faced by the foundry industry in South Africa upon implementation of energy efficiency. In this paper we acknowledge the need for studying the current energy consumption and the improvement that has been done in order to analyse the problems of implementation. Barriers studied are: lack of capital, resistance to change, uncertainties and attitude. An active interaction between the academia and foundry industry (men) will further enhance suitable skills to move South African steel foundries in to an energy efficient industry.

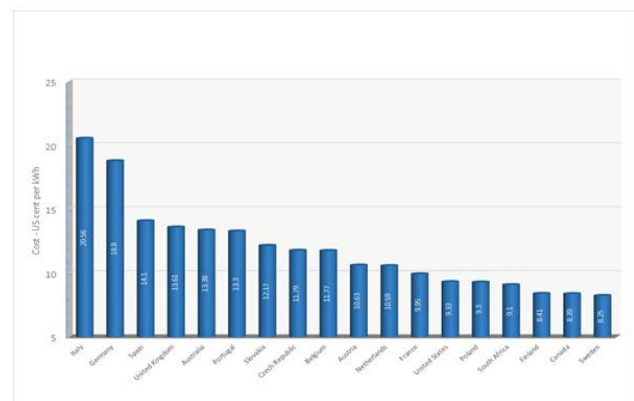
**Key words:** energy efficiency, South African Steel foundries

### INTRODUCTION

Energy efficiency improvement is of significant, yet an in direct way of increasing the country's economy and growth. This paper emphasises on the overview of energy efficiency , new developments and challenges

faced upon implementing new methods to combat energy use and the improvement of energy efficiency.

In South Africa energy is not taken in to serious consideration, with the consequence that this country's energy consumption is higher than it should be. Furthermore, the South african's economy is largely dependent on minerals extraction and processing which is by its nature very energy-consuming. Whilst historically low electricity price has contributed towards a competitive position, it also means that there has been little incentive to save electricity [10]. The figure below shows the electricity price survey for 2013, with South Africa being the least in the cost of electricity per kwh. This figure also shows that due to low electricity price , countries like South Africa and Sweden lack motivation to save on energy as the negative effect of high energy use is not evident to them.





**Figure 1: Electricity price survey graph (NUS Consulting Group International Electricity & Natural Gas Survey, 2013)**

The Industrial and Mining Sectors are the heaviest users of energy, accounting for more than two-thirds of the national electricity usage. Here lies the potential for the largest savings by replacing old technologies with new, and by employing and implementing best energy management practice [10]. Challenges facing the energy sector and crucial to economic development are dealing with the problem of negative externalities associated with energy production and consumption [11]. Factors added by stating the factors that are analysed as challenges [5], Factors such as:

- attitude
- Resistance to change
- lack of capital
- Perception

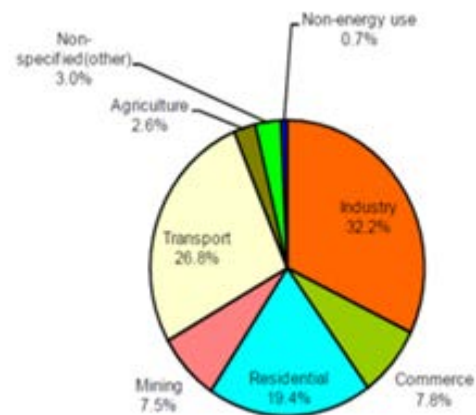
These factors contribute to challenges faced on trying to implement energy efficient practices to combat excessive energy consumption and CO<sub>2</sub> emission in iron and steel industries. The high cost of capital prevents projects that could increase energy efficiency but require large capital expenditure from being followed through [4]. Strong incentives exist for energy efficiency improvement in South African industry, in particular, the potential for increasing profit, the need to reduce greenhouse gas (GHG) emissions, the need to maintain economic competitiveness, and the need to delay the cost of new peak-load electricity generation facilities [5].

## AN OVER VIEW OF ENERGY EFFICIENCY IN S.A FOUNDRIES

South Africa's energy consumption per capital is high compared with global average. The iron and steel sector is the largest industrial carbon oxide emitter and energy consumer in the world. Energy efficiency is the key to reduce energy consumption and greenhouse gas emissions [8]. To understand future developments of energy use and efficiency in the steel sector, it is very important to analyse the energy usage and consumption thereof. Figure 2 shows the energy consumption in different sectors in

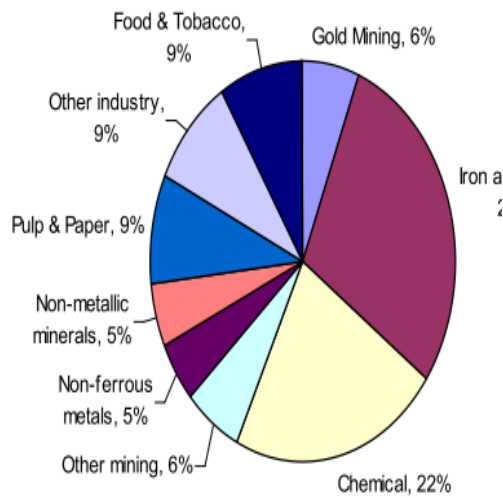
South Africa [6] thus industry consume of 32.2% energy consumption.

Steel production involves many heating, cooling, melting and solidification cycles and makes it the country's most energy consuming. It is estimated that greater energy efficiency could save between 10% and 20% of current consumption. Low energy efficiency is driven by inappropriate economic signals; lack of awareness; information and skills; lack of efficient technologies; high economic return criteria and high capital cost [5].



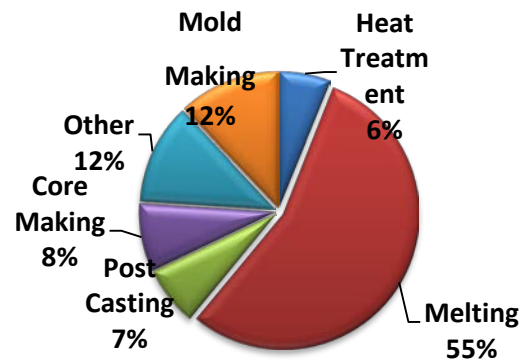
**Figure 2: South African Energy consumption by sector [7]**

Steel is made from the iron by removing impurities and adding carbon and other alloying elements. The reduction of iron ore to liquid iron and directly reduced iron has high energy intensity as seen in figure below. The iron and steel consumes about 29% of energy which is the highest comparing to other sub-sectors in the pie chat.



**Figure 3: Energy consumption by sub-sectors departments [6]**

Studies have been made and projects have been place to combat the high energy consumption in foundries. Many studies covers the past and current work that has been done regarding the improvement in energy efficiency of foundries, particular in melting shops since it is said to consume 55% of energy consumption as shown in the figure below. Foundry is one of the most Energy intensive metallurgical industries. The major part of the energy consumed in a Foundry is in the melting units. Energy also contributes to the major cost input to the production of castings. Besides it, high energy consumption is bringing the threat of climate change and global warming. Various sections of foundry namely Pattern making, molding, melting, core making, compressed air etc; consume energy in the form of electricity or through burning of fuel. Among these, largest amounts of energy around 65– 70 % of the total Foundry energy is consumed in melting operation [12].



**Figure 4: Energy consumption by foundry [1]**

There are several standards of energy efficiency measures that could be implemented to the energy demand sectors to improve the current energy intensities. A key barrier to improving energy efficiency is the lack of knowledge and understanding of energy efficiency, knowledge of what the energy is costing or what the potential savings could be and how to achieve them. Whilst the unit cost of energy is low, and the cost of capital remains high. Modernization of manufacturing processes is an important step towards improving energy efficiency. Optimization of existing processes, regular maintenance, good housekeeping and the adoption of new technologies as they become available will improve energy efficiency significantly. Energy efficiency will also improve with process improvements and reduction in the defective articles and waste [4].

### THE IMPROVEMENTS OF ENERGY EFFICIENCY

Energy efficiency standards have been successfully applied overseas and have brought about significant improvements in efficiencies. South Africa has a well-developed system of standards and codes of practice that in some cases may be amended to include efficiency aspects without the need to established completely new standards. The Draft Energy Bill, 2004 gives the Minister of Minerals and Energy substantial authority to make standards compulsory [2].



Mandatory energy efficiency standards will be an important and integral part of the Strategy [2]. These strategies include the following:

#### APPLIANCE LABELLING

Energy labelling of appliances is an internationally implemented and tested tool to build awareness and raising capacity about energy consumption. Potential savings with labeling or higher efficiency standards are estimated at 3 PJ in 2012. The adoption of European Union standards for labeling can be considered, as this has already been tested and is widely approved [2].

#### CERTIFICATION AND ACCREDITATION

The Strategy makes use of several instruments where inspectors or auditors will be expected to carry out certain technical functions, or studies. These functions will necessarily require a minimum level of technical competence on behalf of the party concerned. Examples include the certification of energy auditors for buildings and the accreditation of inspectors for Efficiency Standards. The outline requirements of relevant accreditation procedures will be specified by the DME, professional associations and the certification made by SABS [2].

#### EDUCATION, INFORMATION AND AWARENESS

Information and generic awareness are key elements to achieve success in terms of changing South Africa into a more energy efficient society. Awareness-raising starts with pre-schooling education and runs through all learning fields into the adult education system, under the National Qualification Framework (NQF) up to level 8 [2].

#### RESEARCH AND TECHNOLOGY

Technological options represent significant potential for energy efficiency improvements and in many instances, are well researched and already developed. However, the majorities of these technologies are not manufactured locally and require importation. At a later stage, this will present a challenge for the

Government, particularly as the drive to promote energy efficiency as it gains momentum [2].

#### REGULATION

The historically low unit price of energy, coupled with limited awareness on energy savings potential, may result in only modest success arising from voluntary measures and other non-legislative instruments. For this reason, regulatory means will be applied to achieve further improvements where necessary [2].

#### ENERGY AUDITS

Energy audits have been internationally used across all sectors to identify efficiency measures that can be implemented in a cost-effective manner. However to be effective, it has often required both the audits as well as the implementation of measures to be compulsory or to be supported by subsidies. The Strategy will promote energy audits as a means of improving efficiency. Studies will be undertaken to design ways in which audits will achieve the greatest impact [2].

#### ENERGY MANAGEMENT SYSTEMS

Energy management enables the formalisation of monitoring, evaluating and targeting energy consumption as well as providing sector-specific benchmarking information. Within industrial and commercial applications, the concept of energy management must also embody other key areas, including Training, Motivation & Awareness, Green Accounts (where companies audit the environmental performance of their operation, as well as its economic performance), and Energy Policy and formalised Monitoring & Targeting[2].

#### CHALLENGES FACED ON THE IMPROVEMENT AND IMPLEMENTATION OF ENERGY EFFICIENCY IN S.A FOUNDRIES

Challenges facing the energy sector and crucial to economic development are dealing with the problem of negative externalities associated with energy production and consumption. The energy-intensive sectors of the economy emit carbon emissions that are higher than those of most developed economies [11]. The Choice of appropriate policy instruments



minimizes the negative impact of externalities. Such an instrument should incentivise carbon intensity reduction, encourage investment in energy saving measures and generate revenue for the economy. A most effective way to encourage adoption is to improve technologies, which may be much more efficient, more economically and to improve society's well-being. Factors such as attitude, Resistance to change, lack of capital contribute to challenges faced on trying to implement energy efficient practices to combat excessive energy consumption and CO<sub>2</sub> emission in iron and steel industries.

- Attitude: The fear of appearing incompetent if outsiders identify savings that have not been seen by management.
- Resistance to change: Fear of trying on new technology and methods, some may be due to lack of skill.
- Assumptions: Many users see energy as a minor input cost, relative to raw material and labour, and tend to concentrate on these.
- Uncertainty regarding the future: Investors are sometimes reluctant to commit resources to long-term projects, given the financial instability both internationally and within regions.
- Lack of capital: Some energy efficiency measures involve the installation of expensive capital equipment [5].

The high cost of capital prevents projects that could increase energy efficiency but require large capital expenditure from being followed through. Due to the decreasing value of the rand, and the low cost of energy, imported energy saving technologies often have a payback period beyond the lifetime of the equipment and are not feasible. The longer the payback period the less likely a product is to be implemented [4].

Mr Davies, CEO SAIF stated that alternative ways of generating power require high capital costs upfront as illustrated in figure 5 and once in operation if they are no longer viable, the foundry cannot return the product. He mentions that, while alternative power sources, such as solar and wind energy, are available for generating power, these options are not always reliable. For example, in Gauteng, the use of wind

energy will be impossible, as there is insufficient wind to sustain the full 24-hour operation of foundries. This form of energy will have to be used in conjunction with other forms of energy, which is said to be too costly. Solar energy is also seen as a challenge, as it also needs to be provided in conjunction with other energy forms to be viable, and this limits the production and functionality in steel industries [1].

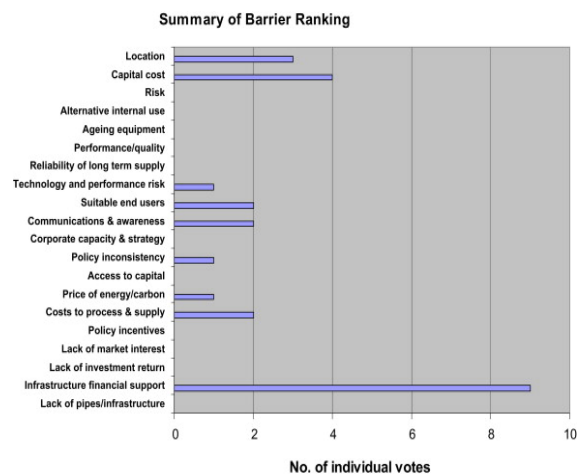


Figure 5: Summary of barrier ranking regarding energy efficiency [5]

## CONCLUSION

An analysis of energy efficiency on South African foundry can serve as an alarm or awareness to South African foundries on energy saving. This has been done by looking at the overall energy usage, the current development and challenges faced on implementing energy saving method. Therefore, by so doing it will enhance better understanding and highlighting the importance of energy efficiency in the foundry industry thus results in reduction of cost of energy.

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