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ENERGY MANAGEMENT SYSTEM IMPLEMENTATION THROUGH ISO 50001(EnMS) IN PAKISTAN OIL REFINERIES TO ENHANCE PROFITABILITY

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ABSTRACT

Nations around the globe face crucial Energy decisions today that may have noteworthy ramifications for a long time to come. Financial development and future thriving are tested by quickly expanding Energy needs around the world. The worldwide press need to save energy, increment business benefit, secure nature, and decrease ozone depleting substance emanations worldwide has urged the refining facilities to apply a progressively deliberate way to deal with, improve the general processing plant's Energy execution and individual Energy sparing measures.

Energy Management is turning into a need as refining part endeavor to lessen Energy costs, fit in with administrative necessities, and improve their corporate picture. The Management of Energy related issues in a methodical way and an increasingly coordinated way, to guarantee persistent enhancement for their Energy productivity is an encouraging sign for the refineries. A gap is still persists between energy management literature and current implementation practices despite of the increasing interest in energy management standards. The associations can create sound Energy Management Systems and efficient process-based energy management configuration that could be perceived through outsider affirmation by the assistance of the ISO 50001 universal standard. Expanding on the energy management writing and energy management standards, the present paper exhibits the basic advances the refineries should take to for all intents and purposes structure a sustainable energy management system. Additionally, by utilizing different contextual investigations of endeavors that have executed an ISO 50001 Energy the board framework, it presents an organized methodology that processing plants can use to adequately build up their energy planning and improve energy performance.

The key parts of the refinery's energy saving and increment in processing plant benefits by execution of Energy Management System through the ISO 50001standard are talked about, as well as practical examples of energy objectives and performance indicators from a case study of a refinery is advertised. The paper demonstrates that by actualizing a successful Energy the executive's framework, this will proficiently fulfill needs for accomplishing Energy execution markers and universal accreditation and along these lines improved the association's benefit.

BACKGROUND

Energy Management refers to all the administrative activities such as planning, organizing, directing, staffing, coordinating and budgeting with respect to energy resources consumed / generated. Energy costs constitute about 40 to 50% of the total operating cost in a refinery. Hence each calorie of Energy saved by efficient operation will increase the profit margin.

Energy Management is a term used for saving energy in the organizations, community, government organizations and in residence area. It is the art of using optimum energy to maximize profits and minimize costs thereby improving the monetary competitiveness. Energy management can also be defined as the discipline involving arrangement and calculating the supply and utilization of energy to enhance the production and comforts of the community and to reduce the energy costs and contamination with mindful and efficient use of energy.

Sector	Potential of Energy saving
Industry	**25%**
Transport	**20%**
Agriculture	**20%**
Power	**30%**
Average	**24%**
Possible Savings for Pakistan by EC US $ 2 Billion/Year	

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Energy Management (EM) program is one of the best and financially savvy approaches to achieve Energy effectiveness upgrades and how Energy is overseen by executing an association wide program. A developing nation like Pakistan would find it more cost effective to increase its energy supply through efficiency and conservation efforts.

SCOPE

The core of the study is to bring out solution to optimize the energy consumption inside the refining sector in Pakistan. The solution will be for a developing nation like Pakistan would find it more cost effective to increase its energy supply through efficiency and conservation efforts as compared to acquiring technological advancement that will led to huge investment.

KEY WORDS

Energy Management System (EnMS), ISO 50001, Competitiveness, Profitability, Green Environment

NOMENCLATURE

Energy Management System

An energy management program allows a company to understand and manage its use of energy. It involves the examination of all the systems, processes, procedures, personnel and equipment to determine those that have a significant impact on its energy use, consumption and efficiency. Philips (2016)

ISO 50001 Standard

ISO 50001 is an Energy Management System that when correctly implemented will lead to increased energy efficiency, reductions in energy consumption and costs and reductions in greenhouse gas emissions and other environmental impacts. Philips (2016)

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Competitiveness

For the company, to be competitive in the market it should be able to provide products and services as or more efficiently and effectively than its competitors in the market

Organization Profitability

Profitability is the most important objective of all business organizations. Business will not survive in the long run without the profitability. Profitability measurement for the past and present and projecting for the future is very important for the firms. Profitability is measured with returns and operating cost.

Green Environment

Energy streamlining adds to decrease in carbon dioxide outflow, cleaner creation, decrease in the nursery gasses discharge, decrease in biological impression, supportable development, diminish Energy destitution and increment access to quality Energy which leads towards the green and clean condition.

INTRODUCTION AND LITERATURE REVIEW

There are different sources of energies .e.g. Sustainable resources of energy which include drift, solar, Hydro, air energy, geothermal, biomass, nuclear and Deplete able Sources of Energy which include Electrical Energy, chemical energy, Coal, petroleum and Natural gas (Hayati 2018). Critical Energy Choices is essential for the Countries around the world today that may have momentous affect for the countries in the coming years. Now-A-Days Courtiers around the world are challenged by ever rising power needs thus impact the economic growth and future prosperity. The worldwide power manufacturing is based on indefensible fossil fuels such as gas, coal and oil in massiveness. Being rely heavily on the indefensible fossil fuels, it creates an alarming for the community living in these unhygienic areas and as well as for the future age group.

Organization of Energy execution is a major test for the Organizations around the worldwide and modern division are at present going through this immense defy regarding power supervision. These incorporate raising need of reasonable power usage, decrease of intensity cost, decrease in greenhouse gases (GHG) discharge and protecting the environment, advancing the Energy use and to ensure the exactness, and edifying recognition with power laws. Associations are anxious to distinguish the most cost-slicing procedures to be increasingly proficient and safe as far as Energy use (Vikhorev et al., 2013).

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The universal difficulties and weight have asked the modern segments to pick and execute Energy sparing occasions both at individual level and further sorted out system to advance the general association's Energy introduction and to be progressively focused over the globe (Lee & Cheng, 2016; OGP / PIECA, 2013; Schneider electric, 2012).

Because of money related or ecologically decided highlights, the focus on Energy keeps on granulating in around the world, Energy Management Systems (EnMS, for example, the ISO 50001 are viewed as sound by associations as they encourage them to proficiently direct their influence utilization, use, capability and introduction (Dene, 2015; Brown and Desai, 2014). ISO 50001(EnMS) is a globally recognized structure for power the board, giving general Energy the board conspire necessities and technique for mechanical parts to enhance the Energy utilization, increment Energy fitness, chop down the costs, and to consent to the natural legitimizations and commitments in a superior and improved way (ISO50001:2011). The procedure for receiving the ISO 50001 is still moderate in spite of the many assembling offices has officially actualized the ISO 50001 worldwide standard (Javied, 2015).

Enterprises economic performance on the longer run will be improved continually by the accomplishment of ISO50001 official recognition (Majerník et al., 2015; Pham, 2015).The oil refining business is one of the biggest energy utilization sector of the energy. The Refining sector is major sink of energy resources as to compare with the other industries. The followings are the major energy components which are being utilized in the refining sector;

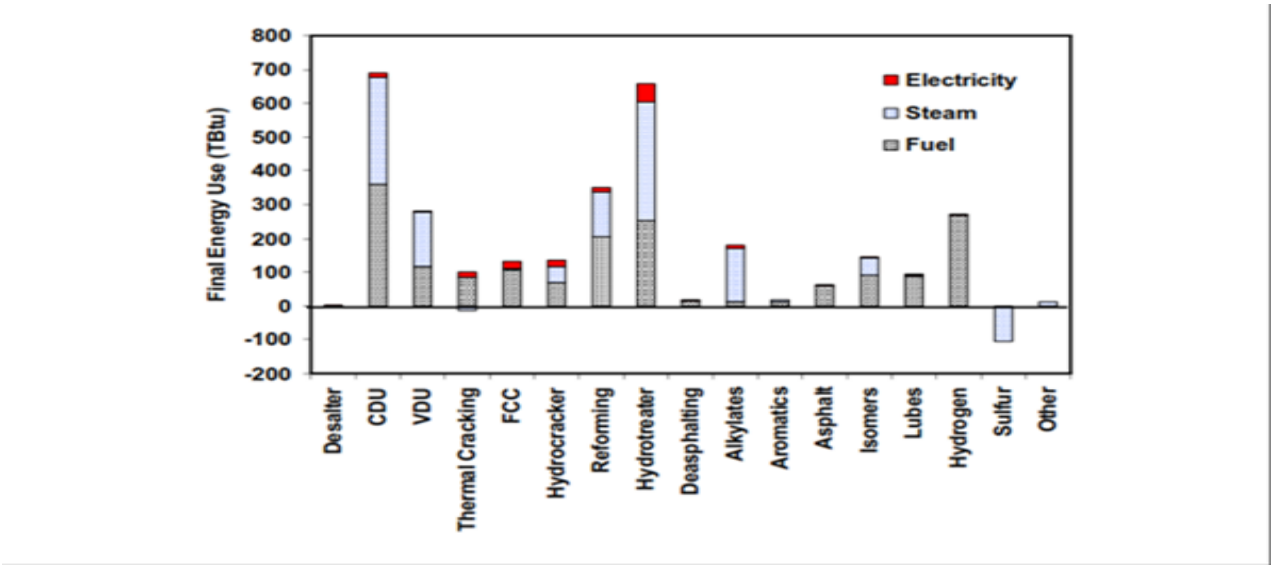
- ✓ The Raw Material (Crude Oil and Essential Chemicals)
- ✓ Environmental regulations
- ✓ Water
- ✓ Steam
- ✓ Electricity
- ✓ Natural gas
- ✓ Furnace Fuel oil (FFO)
- ✓ Instrument air and plant air

Crude oil refineries around the globe are producing different petroleum products based on the type of installations they have.

REFINING PROCESS BY by Dave Hirshfeld, MathPro, Inc

The Refinery Profit margins influenced by the Energy Management (EM) straightforwardly as the energy-savings go directly to the substructure, in a highly challenging environment, less expense production facilities will be most of the times come on top. Around the World a study was carried out for the US refineries to check their energy uses in different criteria's, energy shares include for working expense @ 45%, followed by repairs (22%), other (16 %), and human resources (17%). Consequently, a petite fraction in savings can interpret into billions of dollars. Refining limitations are very narrow now-a –days so, and are quite trim in the recycling, expenditure lessening via energy enhancement may turn defeat into an income for a refinery. Industrial Energy Technology

Conference (IETC) in New Orleans, Louisiana (US) held in June 2012, Lyondellbasell is one of the largest plastics, chemicals and refining companies in the world presented by the Energy prize for dipping the power utilization in the Houston, texas (US) plant by 12 % via execution of an energy competence agenda



Estimated Energy Use by Refinery Process

Energy efficiency improvement in the petroleum refining industry

2005 ACEEE Summer Study on Energy Efficiency in Industry

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The refinery saved 42 Trillion Btu since 2007 by implementing this program, with the flare optimization alone savings over 500B Btu/yr. By implementing the energy efficiency program in the refinery at an assumed energy cost $5.5/MMBtu, the refiner saved an average of $46.75MM a year. (Worrell & Galitsky, 2005).

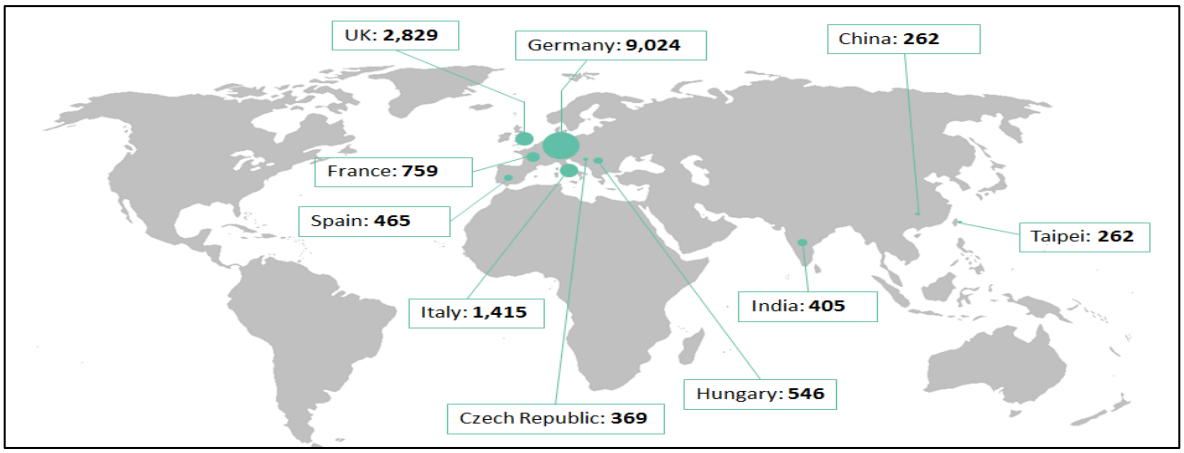
ISO 50001 (EnMS) standard genuine execution will demonstrate the best approach to enhanced Energy viability, decreases in Energy use and expenses and diminishing in ozone depleting substance outflows and other ecological effects. (Corporation& ISO 50001 a triumphant mix Philip Thomas A1 arrangements)

An Energy Management program enables an organization to perceive and manage its utilization of Energy. This ISO standard includes the evaluation of the considerable number of procedures, techniques, frameworks, staff and hardware to finish up those that momentously affect its assets use, utilization and ability. (Dzene, 2015; Brown and Desai, 2014)

In 2007 the United Nations Industrial Development Organization (UNIDO) as a reaction to the expansion of National benchmarks solicited ISO to consider the advancement from an International Energy Standard. U.S. Branch of Energy (D.O.E.) and the American National

Standards Institute felt that a unified and coordinated exertion was required in handling the across the board wasteful aspects in industry.

Energy-related challenges are being faced by Organizations across the world which including those related to energy source, resources consistency and changes in the ambient conditions. Companies across the global manage their energy systems and plan better to save energy and to reduce pollution as well as cost with the help of ISO 50001 frameworks. Global energy consumption can be reduced to 60% by the estimates of these standards. (Bsr-Energy-Management-Handbook)



Top 10 countries in 2016 by the number of ISO 50001 certificates
Source: Understanding the 2016 ISO 50001 certification trends
(September 7, 2017/by Oli Stall man)

The maximum split of the ISO 50001 certificates is detained within Europe, which accounts for 90% of the total and seven out of the 'Top 10' countries for number of ISO-50001 certificates as shown in the results.

The companies who have already put a management model into practice can easily implement ISO 50001 in their vicinity. The one integrated Management system should be implemented which is more logical from the point of view of efficiency to integrate the requirements of various management systems instead of introducing them separately.

Consequently, the endeavor ought to show that it makes an Energy approach which agrees to material enactment and different necessities identified with Energy use, utilization and effectiveness to which it buys in. Likewise, the endeavor should record and keep up an Energy survey with certain reported strategy and criteria. As consequence of the Energy survey, a venture will make its Energy profile (a model is given in Figure 6). The Energy profile gives valuable data

to the advancement of the Energy standard and the distinguishing proof and determination of Energy execution pointers.

DATA ANALYSIS:

The major components which are being monitored regarding the energy management system (Quantitative value or measure of energy performance) are

- ✓ Electricity
- ✓ Fuel gas
- ✓ Fuel oil
- ✓ Steam
- ✓ Compressed air
- ✓ Cooling water
- ✓ "Total Energy Consumed / Feed Processed"
  - o "MMBtu/bbl of feed processed"

Monthly Energy Consumption and EnPIs

Reporting Month:			November-18		
DESCRIPTION					
Crude Charge				M.Tons/Mont	Barrels/Month
				11,699	115,531
Utilities / Sources of Energy		Consumption/Mont	MMBTU	Energy Baseline (MMBTU)	
Fuel Gas to Heaters -FI-123	M³	145,314	5,178	Energy/M.Ton	Energy/bbl
L.P Gas to Heaters FI-105	M³	-	-		0.099
Fuel Oil to Heaters FI-124	M³	69	2,727		
Steam Consumption	M.Tons	1,548	4,087		
Electricity	KWH	17,470	175		
Cooling Water	M³	135,000	650		
Instrument Air	M³	-	-		
Total Energy Consumed			12,817		
Net Energy/ M.Ton (MMBTU/M.Ton)			1.10		
Net Energy/ bbl (MMBTU/bbl of crude)			0.111		
Energy Review:					
Energy consumption is high as compare to previous month and baseline due to high calorific value of mix gas, higher steam consumption at offsite area and plant lower throughput.					

Monthly Energy Consumption is calculated on the basis of the values that are being fed daily into the system. The final Figure is compared with the energy baseline which is set for the targeted year to compare with the actual values on the month basis. If the value is more than the targeted value then the reason should be find out and it should be written in the

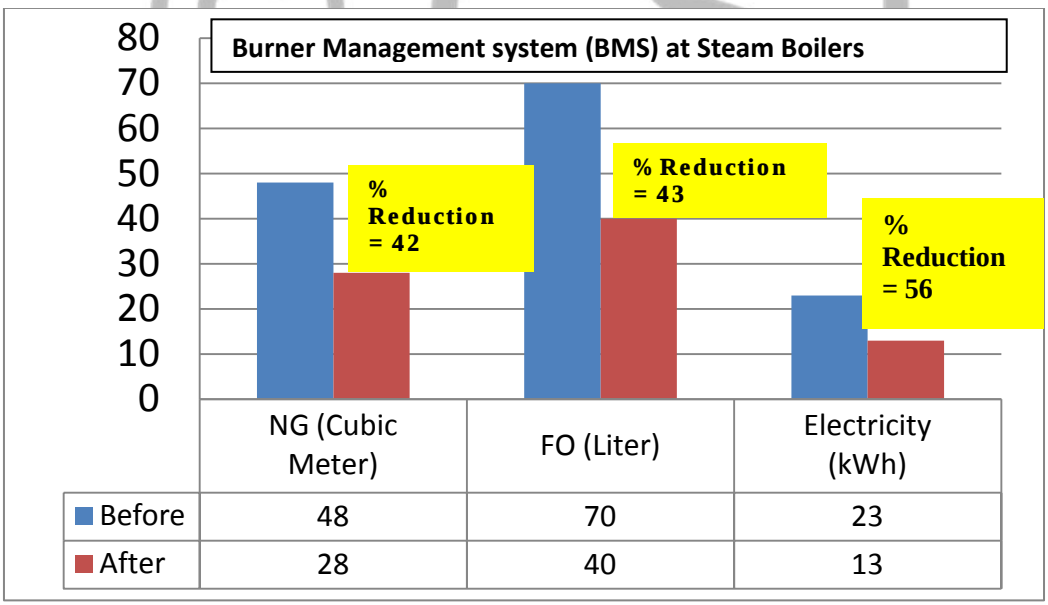
comments column. The month Figure is also compared with the previous month and with the last year same month value.

ADVANCED EQUIPMENT FOR ENERGY CONSERVATION:

The Highest energy consuming areas are focused as per Pareto analysis. The following areas are included in the first phase for bending towards the energy saving

- Installation of Burner management System (BMS) for steam Boilers
- Installation of 110 KW on Grid Solar Panel
- VFD motors Impact on Product Pumps Electric Consumption

1- A new BMS (**Burner Management System**) was installed at Boiler house (steam production area) for the Reduction in the energy consumption. This scheme is implemented on the fired heaters and steam boilers in the organization to optimize the Energy Consumption. The consumption of Fuel oil, Natural Gas and Electricity in the process is compared after the implementation of the BMS and it shows how much energy has been saved after the Implementation of the Burner Management system



Financial Analysis

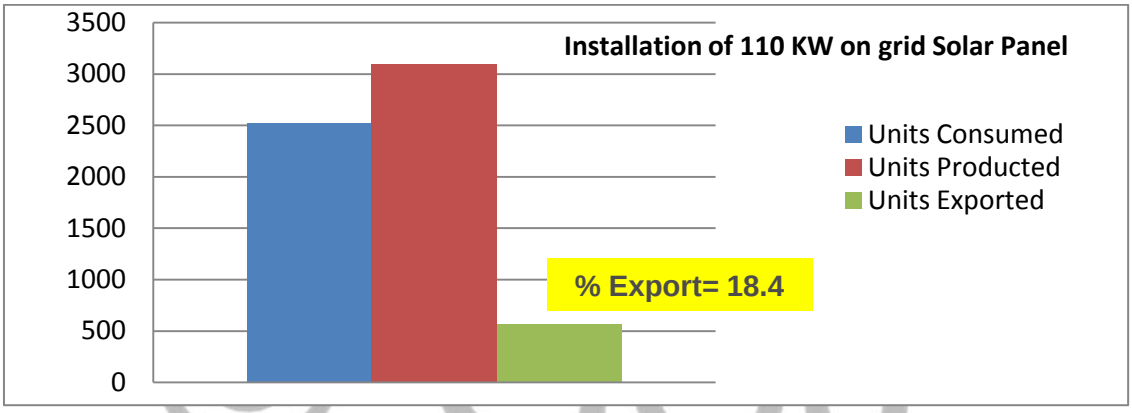
- Burner Management System (BMS) Price 23.06 Million Rupees
- Net Saving in case of Fuel Gas 8.3 Million- 4.871 Million
  3.428 Million /Year
- Net Saving in case of Fuel oil 18.75 Million- 10.71 Million

8.032 Million /Year

- Net Saving in case of Electricity 3.1- 1.79 = 1.30 Million/Year

Pay Back period of BMS = 2.5 Years

2- A **NEW SOLAR SYSTEM OF 110 KW** was installed to power up the offices with solar system to promote the green environment and hence the carbon footprint (GH emission) is reduced. This project is one of the distinct projects which crowned the General Offices of ARL to be green offices based on renewable energy resource. This state-of-the-art, Solar Project, is generating 110 KW power, which meets the substantial energy requirements.



Total Cost of Installing 110 Kw solar panel = 14.2 Million

Electricity Consumption

Unit Produced = 3200 kWh = 3200 * 16 = 40000 Rs

Unit Consumed = 2500 kWh = 2500 * 16 = 51200 Rs

Unit Exported = 700 kWh = 700 * 16 = 11200 Rs

Net Saving of Electricity per Year = 3.57 Million

Pay Back period for the 110 Kw solar panel = 4 year

3- VFD motors Impact on Product Pumps Electric Consumption

Two Pumps installed at the Product Metering station are having motor capacity 132 kWh and 160 kWh respectively.

These pumps are being used to dispatch the finished refinery products to different OMC's. Initially these pumps are installed without Variable frequencies derive and the required power is vary to dispatch the finished products to different companies depending upon the

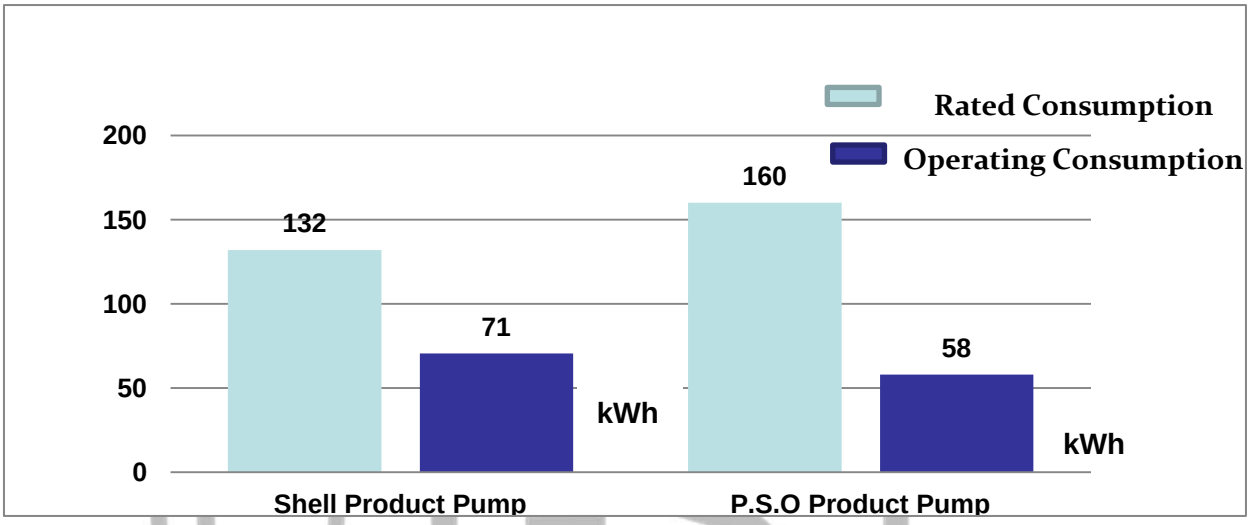
flow requirement. Therefore, to conserve the energy the variable frequencies (VFD) are installed with the motor to reduce the motor rpm as required. These VFD's motors have reduced the power consumption by 47% and 64 % respectively.

132 KW VFD motor Price = 11150$ = 1,594,450 Rs

Net saving after the Installation of VFD motor = 10980/ day

160 KW VFD motor Price = 13250$ = 1, 921, 250 Rs

Net saving after the Installation of VFD motor = 18360 /day



Overall Summary

Existing total bills- Rs = 4.13 million Rs/Month

Purchases of New Energy saving equipment's = 60.5Million Rs

Pay Back Period of New equipment's = 4-5 years

Current bill with the deployment of New Equipment's = 3.1 million Rs/month

Net saving per month = 1.03 Million Rs /Month

Net saving per year = 1.03 * 12 = 12.36 Million Rs/Year

CONCLUSION

Results of this research study suggest that The Energy management system implementation helps organization to save a lot of capital by saving the precious money in the form of energy which is being utilized in the process. Energy Management System influences the organization profitability, organization's competitiveness and to acquire the Greener environment within the organization and its surrounding and ISO 50001 has the Moderating effect on the relationship between EnMS, profitability, competitiveness and reduction of the

greenhouse gases (GHG). It can be concluded that Adaptation of Energy Management system in Pakistan will boost the refineries' profit and will also help in optimizing the energy consumption and energy resources in the country which are being depleted day by day due to higher demand of the energy in the country.

Some of the other areas which will automatically be improved due to adaptation of Energy Management systems are;

- Improvement in reduction of greenhouse gasses.
- Cost Reduction
- Sustainable Management
- Improvement of public image
- Use of financial incentives
- Energy conservation represents least-cost 'supply' option It's a win-win for all.
- Green Energy and environment
- Projection of climate policies
- Provision of resources to maximum users
- Reduction in import bill
- Helps to manage energy price volatility, and
- Enables planning to minimize the impact to service interruptions
- Increase credibility and meeting shareholders requirements
- Reduce carbon footprint

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RECOMMENDATION

Results of this study are valuable and useful for the stakeholders involved in the oil refining operation in the Country as this system will provides the benefits in terms of cost reduction, sustainable Management, Improvement in the Public Image, privilege in the financial incentives, Green Energy and environment and reduction in the country import bill. This study emphasizes on the adaptation of the ISO 50001 standard as a key to understand and manage its use of energy and it involves the examination of all the systems, processes, procedures, personnel and equipment to determine those that have a significant impact on its energy use, consumption and efficiency. With this fulsome picture the company can then accurately manage its existing operations and plan future developments. Company can then able to identify, prioritize potential energy saving opportunities, Schedule future

opportunities as per cost and benefits and Explore new possibilities in light of potential cost benefits.

Though the research is limited to ISO standard implementation in the Pakistan's refining sector only to enhance the organizations profitability, Standard and Energy management system implementation can be studied and explored in other organizations of the country to gain the benefit of this standard. Effect of reduction in the energy usage which impacts the reduction in the Import bill could be analyzed. Greenhouse gases emissions under the research could be studied. Latest Energy monitoring equipment's under the research could be explored. This study is based on the case study and this can be implemented to the other refineries of Pakistan and other organization's to gain the benefit of Energy management.

REFERENCES

- ✓ Jovanović, B., & Filipović, J. (2016). ISO 50001 standard-based energy management maturity model–proposal and validation in industry. Journal of Cleaner Production, 112, 2744-2755.
- ✓ Păunescu, C., & Blid, L. (2016). Effective Energy Planning for Improving The Enterprise's Energy Performance. Management & Marketing, 11(3), 512-531. doi: 10.1515/mmcks-2016-0013
- ✓ Worrell, E., & Galitsky, C. (2005). Energy efficiency improvement in the petroleum refining industry.
- ✓ Hayati | May 20, 2018 Different Types of Energy Resources: Overview, Uses
- ✓ (International Organization for Standardization, 2015; The Hong Kong Electronic Industries Association–HKEIA, 2013).
- ✓ Dr. Muhammad Nawar Khan, ISBN:978-969-8535-05-6, Publication, Date: 2005, Publisher: Total Quality Management (TQM)
- ✓ Policy issues and options in energy conservation & efficiency
    - o K.M Zubair, chief (ENERCON)
- ✓ Păunescu, C., &Blid, L. (2016). Effective Energy Planning for Improving The Enterprise's Energy Performance. Management & Marketing, 11(3), 512-531. doi: 10.1515/mmcks-2016-0013

- ✓ ARL Energy Manual
- ✓ Understanding the 2016 ISO 50001 certification trends
    - o September 7, 2017/by Oil Stallman
- ✓ Konstantin Vikhorev (2013) An advanced energy management framework to promote energy awareness
- ✓ Implementing Energy Management System to Increase Energy Efficiency in Manufacturing Companies javeid, 2015
- ✓ Malik, S. R., &Maqbool, M. A. (2017). Energy Potential of Pakistan. NFC IEFR Journal of Engineering and Scientific Research, 1.
- ✓ Saunders, M., Lewis, P., & Thornhill, A. (2009). Research Onion. Research methods for business students, 136-162.
- ✓ Nelson, W. L., & Nelson, W. L. (1969). Petroleum refinery engineering. Series in chemical engineering, Chapter 2, Petroleum Products Pg. No-41
- ✓ Green, D. W., & Perry, R. H. (1999). Perry's chemical engineers'

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