# ENERGY MANAGEMENT PRACTICES IN TEXTILE INDUSTRY: A SYNTHESIS REVIEW

**Sandeep Soni** Research Scholar, Faculty of Management Studies, M.L. Sukhadia University Udaipur; Junior Engineer, Rajasthan Rajya Vidyut Prasaran Nigam Limited, Bhilwara, Rajasthan, India, Email: sandeep.k.sony@gmail.com
**Prof. (Dr.) Karunesh Saxena** President (Vice Chancellor), Sangam University, Bhilwara, Rajasthan, India, Email: president@sangamuniversity.ac.in

**Abstract**
*Energy is one of the most important input for any manufacturing process and textile industry is no exception. Textile industry, being energy intensive and least energy efficient, the proper energy management is need of the hour.*
*The present paper is an attempt to review available literature in the field of energy management in textile industry. The total 141 national and international papers have been referred to and out of this 33 papers have been reviewed .The reviewed papers have been divided into three sections, namely studies on overview of energy management, studies on energy management system (EnMS) and studies on energy management practices in textile industry as part of the structure of the paper. The review of literature reveals that the energy management practices growing rapidly to conserve energy, reduce energy cost and limit greenhouse gas emission. The systematic approach of energy management is by implementation of EnMS.*
***Key Words:*** *Energy, Energy Management, Energy Audit, Energy Efficiency Industry 4.0, Energy Management System, ISO 50001, Textile Industry*

*Received 01 September 2021, Accepted 17 September 2021, Published 30 September 2021*
*Correspondence Author: Sandeep Soni*

## 1.0 Introduction

Textile industry is the backbone of the Indian economy. The textile industry of India is one of the largest manufacturer and exporter of textile globally**.** According to **WTO (2019)** India is the third largest exporter in the world only after China and European Union (EU). The abundant amount of raw material availability and strength in manufacturing across value chain makes it unique. The textile industry has shown strength in both hand-woven as well as organized capital intensive textile plants. Hand-woven, handloom and small power looms are major player of textile industry and enormous sources of employment in India. The textile industry accounts for 7% of the industrial output and contributes 15% in total export earning in India in financial year 2017-18 **(Ministry of textiles, 2019)**.

The organized textile industry adapts capital-intensive technologies for large scale production of textile products and comprises of many processes like spinning, weaving, processing, dyeing and apparel manufacturing. The key elements of cost of textile production are raw material, labour, waste, power, auxiliary material and capital. **Ministry of textiles (2010)** compendium statistics on international cost comparison interprets that energy is one of the key cost elements in the textile industry after raw material. Even after the advancement in technology most of the textile mills are still using obsolete technology .It leads to increase in energy consumption and affects input cost of production.

Energy has been renowned as a major and vital input in all spheres of a nation for its viable and continuous economic growth **(Luthra et al., 2015).** India is among the largest energy consumer and largely dependent on fossil fuel for meeting out its energy demand. According to **WEF (2021)** India has shown tremendous improvement in energy transition towards development of sustainable, cleaner and economical energy sources with energy security. However, being one of the largest greenhouse gas emitter, it requires strong commitment towards reduction of greenhouse gas emission and adoption of renewable source of energy.

Renewable energy sources performing key role as conventional sources of energy like coal and fossil

fuel become rarer and costly to import **(Mangla et al., 2019)**.India has shown tremendous growth in inclusion of renewable energy for achieving 175 Giga Watt target by the year 2022. India has energy saving potential of 200 billion US Dollar per year of energy imports and capacity of addition of 300Giga watt newer and cleaner energy up to year 2040 (**IEA, 2020)**.

Energy management is now in the worldwide attention, due to the tempting need to save energy and reduce greenhouse gas emissions. The EnMS normally offers framework and supervision to the organization to accomplish energy related activities in production **(Salleh et al. 2011)**.The requirement for a systematic procedures for energy management has been perceived, given the excessive difficulty of enterprises and their contrary and multiple opinions in terms of refining energy performance **(Backlund et al., 2012)**.EnMS is a continuous improvement system that identifies opportunities of energy saving in energy intensive processes and set targets**,** plans and action to achieve targets of optimize energy saving and improve energy performance continuously **(OECD,2015)** .The ISO50001:2011 ,Energy star of United States of America and European energy standard 160001:2010 are recognized EnMS standards**(Tachmitzaki,2019).**

Textile industry can achieve energy saving and energy cost reduction targets economically. The best approach it can adopt is by adapting standard EnMS and encouraging energy management practices.

## 2.0 REVIEW OF LITERATURE

Extensive review on the proposed subject has been done by the researchers and on this basis the review of literature has been divided into three parts:

(i) Studies on Overview of Energy Management
(ii) Studies on Energy Management System
(iii) Studies on Energy Management Practices in Textile Industry

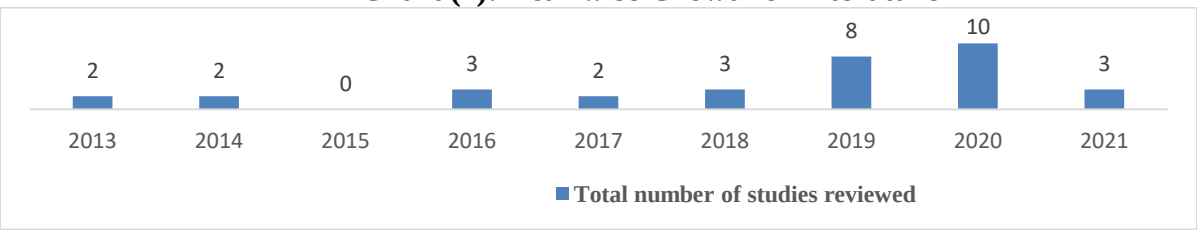
**Table (1): Detail of National/ International Literature Referred and Reviewed**

| **Dimensions** | **Indian** | | **International** | |
|---|---|---|---|---|
| | **Referred** | **Reviewed** | **Referred** | **Reviewed** |
| Studies on Overview of Energy Management | 8 | 4 | 62 | 9 |
| Studies on Energy Management System | 1 | 1 | 44 | 9 |
| Studies on Energy Management Practices in Textile Industry | 9 | 6 | 17 | 4 |
| **Total** | **18** | **11** | **123** | **22** |

Sources: Researchers own compilation

It is inferred from table (1) that most of the studies are international and on the themes of energy management, EnMS and energy management practices. The concept of EnMS is in incipient stage in India. The chart (1) depicts year wise growth of literature reviewed. It can be inferred from the chart that majority of literature is in between 2016-2021

**Chart (1): Year wise Growth of Literature**




Sources: Researchers own compilation

## 2.1 OVERVIEW OF ENERGY MANAGEMENT

**Iqbal et al. (2021)** investigated energy management practices and barriers in construction sector of Pakistan. The fuzzy Delphi method was used for screening barriers identified from previous studies. The study revealed barriers are non communication between various stakeholders, dearth of funding in energy management techniques, no energy management policy for construction, lack of management support and behavioral confrontation to adopt energy management techniques.

**Johansson et al. (2021)** analysed current state of energy strategy in pulp and paper industry of

Sweden. The analysis aims on energy cost reduction by continuous and efficient processes along with exploring opportunity of new energy products. Electricity generated from new sources of energy like biomass and biofuel improves organisation energy sustainability. The majority of studied organisations adopted the strategy of energy security, conservation and reducing energy cost besides developing new bio based energy products. The large organisations are more inclined to develop new energy products. Though it requires building new managerial competencies as most of the company aims at their core businesses.

**Hossain (2020)** analysed energy management practices in the cement industry of Bangladesh. The result interpreted that studied cement industry has significant amount of energy saving opportunity by energy management practices. However due to lack of knowledge and untrained employees and unawareness about energy saving by energy service companies hinders growth. Highlighted drivers are motivated employee, high energy prices, and demand from consumers. Barriers revealed from the study are less government attention, lack of staff awareness. Authors advocates long term and short term energy policy it should be integrated with industry for achieving energy efficiency.

**B.K. et al. (2020)** studied willingness to pay more by industrial energy consumption in the context of Nepal. They found that individual attribute, social context, knowledge and participation has positive impact on willingness to pay more. Willingness to pay more is prime measure for meeting out forecasted energy demand and sustainable economic growth .The study highlighted the need for basic EnMS dealing with willingness to pay.

**Mickovic & Wouters (2020)** studied the availability of energy cost information in non energy-intensive and energy intensive manufacturing industries. The main aim of the study was measurement and allocation of energy cost. The energy cost helps in seeking energy efficiency opportunity and forms accountability towards and the energy management. Authors suggested sub-metering as it provide accurate data of energy consumption and provide energy cost information however still it is not fully exploited.

**Sangroya et al. (2020)** examined the current scenario of green energy management in India. The per capita consumption of electricity of India is quite low compare to global average. The growth of green or renewable energy fuelled by population growth, discontinuous supply, demand and supply gap, increase in urban population, energy security, environmental concern, government policies and support, renewable purchase obligation (RPO) for solar energy, renewable generation obligation (RGO) for power plants running on nonrenewable energy sources. India is rich in solar and wind energy potential that led to introduction of national offshore wind energy policy. Indian green energy markets business model is offering renewable energy certificate (REC), feed in tariff, open access, captive use of green energy.

**Dahlqvist & Söderholm (2019)** discussed reasons of investment decision by management on energy use and energy management practices in Swedish companies. The higher energy price was the main reason for energy management practices in Swedish companies. Analysis of the result showed that hidden cost is correlated with energy intensity, it impacted investment decisions. The hidden cost highlighted are cost of product disruption, inclusion of new staff, training and cost associated with finding energy efficiency improvement (EEI) opportunities. Industries where hidden cost was major concern then the energy intensity reduction, energy management programs were rejected.

**Deshpande & Buke (2016)** studied energy intensive sector and proposed total energy effective management (TEEM) for improving energy efficiency. TEEM is mixed approach of total quality management and total productive maintenance. A case study was carried out on steel manufacturing plants in India that highlighted Indian steel plants energy consumption was double that of world's best energy efficient plant. They found conventional process of making iron and use of coal as fuel and non-reuse of energy are reasons for high energy consumption in Indian steel industry. The study proposed use of efficient processes, energy efficient measures at all level of production, switch to gas from coal as fuel has ample prospect of energy saving in Steel industry in India.

### 2.1.1 Energy Audit

**Joshijevic et al. (2020)** examined energy audit based on the principles of ISO 50002 standards in a Serbian dairy. Multi criteria analysis of ranking was used to rank energy efficiency opportunities.

The energy efficiency opportunity were dealt with energy conservation measures, it ensured considerable amount energy saving in dairy industry. The method is universal and applicable to all types of industry.

**Nagaveni et al. (2019)** in view of that energy audit is a key tool for finding energy conservation opportunities. It accesses all energy inputs and energy flows in a plant .The energy audit tries to balance input and output energy. The study was carried out in textile industry situated in Tamilnadu. The study showed that electricity consumption is major energy source. The considerable energy saving can be achieved by increasing production rate per hour and by installation of capacitor banks for power factor improvement.

According to **Kanase & Patil (2019)** there is gap between energy demand and supply due to fast pace industrial development in India. These gap can be filled by conducting regular interval energy audit .The energy audit is verification, monitoring and analysis of energy usage. It covers submission of technical report covering all recommendation for EEI. The energy audit not only reduces energy losses but also electricity bill.

### 2.1.2 Industry 4.0 and Energy Management

**Wolniak et al. (2020)** established that investment in new technology leads to improvement in energy efficiency. Industry 4.0 era is of smart factory, smart services and smart products using Information and communication technology. Digitalization and networking of production processes using advanced information communication technology tools like internet of things (IOT), cloud computing provides real time access of machines data and compares it with standard data .The auto corrective actions improves productivity reduces waste in different activities including energy waste. The era of industry 4.0 concepts of digitalization and integration of complete value chain lead to improvement in energy efficiency.

**Miglani et al. (2020)** studied applicability of Blockchain in the field Internet of energy (IOE). The IOE integrates different forms of energy and helps in developing smart energy infrastructure. The IOE collects, sequences, maximizes and controls energy data for distributed energy sources. IOE is capable to predict and meet demand supply. The Blockchain technology with its peer to peer security feature can integrate distributed renewable energy network with automatic data exchange, secure for energy trading and automatic load demand management.

## 2.2 ENERGY MANAGEMENT SYSTEM

**Shim & Lee (2021)** investigated selection criteria of energy performance indicators (EnPI) in industrial sector of Republic of Korea. The EnMS helps industries in continuous energy conservation and curbing GHG. It is essential for successful EnMS to measure performance using EnPI. Authors derived EnPI selection criteria from previous studies and for study purpose chosen four EnPI from ISO 50006.The result revealed that ease of use was best selection criteria of EnPI. The most preferred EnPI is ratio between measured values that is countenance of energy efficiency. According to author government should promote digital measurement tool for effective EnMS.

**Maśloch (2020)** studied role of social awareness in EnMS Practices in developed countries. Energy sector has negative impact on environment hence human health. Developed countries have effective energy management but lack of awareness and irresponsibility towards energy saving hinders growth of sustainable EnMS. Authors stressed that with the change in energy policy, it is needed to raise awareness for energy transformation. Highlighted example of Denmark their education and public participation made successful energy policy and competitive energy system.

**Sola and Mota (2020)** analyzed factors influencing energy management in various sectors of Brazilian industry. The variable were divided in to three parts namely drivers in energy efficiency, organisation process and action in EnMS, involvement of middle managers. The Exploratory factor analysis used for specifying main factor. Confirmatory factor analysis used for finding association with main factor analysis. Positive correlation found among all the variables. Drivers are production, economics, competitiveness and environment. The result showed that middle management is key for strategic development with the support of top management. Improvement in production process also leads to EEI.

According to **Zainuddin et al. (2019)** green management system, total quality management, lean manufacturing are being used in Malaysian automotive companies largely due to customer requirement. An integrated system model covering quality, green and EnMS was introduced and classified in terms of level of implementation. The aim of the studied system was to increase energy efficiency, promote green practices and customer satisfaction.

**Tachmitzaki et al. (2019)** identified key determinants of energy management practices in Greek enterprises. The energy management practices are critical for energy resource conservation, to combat with climate change and for gaining competitive advantage over competitors. The key determining factor for EnMS implementation in Greek industry has largely affected by adoption structured integrated EnMS. The other key determinants are commitment of senior management, usage of latest technology, employee participation.

**Yatich (2018)** studied EnMS practices in manufacturing firms in Kenya. The study revealed that regulation related to energy management contributed significantly in firm's competitive performance. The firms implemented energy management and it increased firm's competitive performance by 35.7% and it also provided competitive edge to firms. The regression result also showed that effective energy management regulation, energy policy, EEI and energy access had significant impact on competitive advantage among manufacturing firms in Kenya.

**Matteini et al. (2018)** carried out cost benefit analysis of EnMS implementation. Intending to this purpose a thermal power plant and a construction material unit was selected along with a project site of United Nations industrial development organisation (UNIDO) at Macedonia. EnMS implementation cost includes expert assistance, cost of procuring energy monitoring equipment, staff training and cost of conducting EEI project. The benefits highlighted are in terms energy saving and non energy types. The non energy type benefits are reduction in greenhouse gases emission. The cost and benefits were analysed and compared by a function of payback time. Result showed that window of energy saving opportunity by execution of EnMS. The payback period was also found very small.

**Joshi & Venugopal (2016)** analyzed EnMS in India. Paper highlighted the inclusion of renewable on the power grid inflicts countless challenges to the existing EnMS schemes, as renewable resources are largely of uncertainty and variability in nature. Authors attempted to state various ways of reducing cost of energy consumption using case study on JK Lakshmi Cement LTD. The Company under perform achieve & trade (PAT) scheme of the bureau of energy efficiency (BEE) was given energy reduction target for their major product. The Company achieved more than that of the target. In reward of additional savings, the plant was acclaimed energy saving certificate. Further implementation of ISO 50001 had also initiated major energy saving, reduction in emission as well as addition of green energy.

### 2.2.1 ISO 50001

**Fuchs et al. (2020)** identified drivers, barriers and advantages of EnMS standard ISO 50001 uptake using content analysis. The ISO 50001 uptake drivers are Government policies and regulation, organizational values, top management support for attaining environment sustainability. The benefits highlighted are energy cost reduction, improvement in productivity and operational efficiency. The main barrier of EnMS is absence of organisation culture for energy management.

**Jovanović et al. (2017)** studied the level of implementation of EnMS in Serbian industry. The study found full implementation was abysmal and only 5.8% of all companies fully implemented EnMS. The level of EnMS was checked by using organisation stage in Plan-Do- Check-Act (PDCA) cycle of ISO50001 standard. Authors highlighted top management support is vital for successful EnMS implementation. The EnMS requires less financial support rather it requires engagement of people, incentive for energy saving, training and information awareness.

## 2.3 ENERGY MANAGEMENT PRACTICES IN TEXTILE INDUSTRY

**Hasan et al. (2019)** studied efficiency of energy management practices in the textile industry of Bangladesh. The study revealed that barriers of energy management practices are lack of research and development, training, insufficient technical cost-effective measures, limited capital expenditure. It is needed to policy makers to incentivize energy efficiency measures. The studied textile industry

has potential of EEI but it wants information awareness across industry.

**Purwanggono et al. (2019)** analysed critical success factors of ISO 50001 in a textile company .The critical success factor were divided into four parts viz. management approach, internal and external aspects, energy planning, implementation and operation. These factors further divided into sub factors. The analytical hierarchy process was used; in this method complex problem is divided into parts and given hierarchical order according to their factor weight. The Delphi method was used for developing questionnaire regarding strategies selection for EnMS. The result showed that implementation and operation are critical factors, sub factors like significant energy use desired immediate attention for improvement. Delphi result recommended review of processes, documentation of energy saving and good quality of equipment for EEI.

**Prashar (2019)** studied impact of energy sustainability on shop floor activities of small and medium sized industries. The study was carried out in clusters of foundry and textile units in India. Energy sustainability comprises three steps that are energy management organisation with clear roles and function, imagining of energy saving opportunity and energy sustainability reporting. The implementation of energy sustainability in studied industry resulted in fall in production cost and carbon emission.

**Patravale et al. (2018)** described energy audit of textile industry. The energy audit comprises a survey, inspection and analysis of energy usage of a plant or facility. The purpose of the energy audit is to reduce energy waste and improve performance of the supply system. Energy audit helps in reducing energy cost and encourages efficient use of energy. Authors also emphasized new concepts of zero energy buildings and green buildings. The zero energy building uses net zero electric energy as energy used being compensated by energy produced from renewable energy source at site.

According to **Khude (2017)** textile industry is one of the largest and oldest industries in India. Indian textile industry is still using old technologies for their processes and production. The opportunities for EEI exist by adoption cost effective solution. But most of the textile mill falls under small medium enterprises which have limited access of such type of energy saving information. The Information on know-how of energy saving technologies should be prepared and disseminated in across the textile industry.

**Tunc et al. (2016)** studied dye and print factory of textile industry in Turkey. Authors proposed EnMS after identifying sensitive energy process. The energy management was achieved by optimized fuel distribution such that total energy cost remains minimum. Here it is to mention that fuels used in a textile industry are coal, natural gas and electricity.

**Yacout et al. (2014)** investigated suitable EnMS for textile industry of Egypt. A study was carried out for EnMS ISO 50001 implementation in a textile plant. An ISO 50001 standard works on PDCA cycle of continual improvement. A number of energy saving activities was recognized and related costs were calculated. The action plan for energy saving activities was prepared and implemented for continual improvement. The activities like efficient lighting system, fixing compressed air leaks, retrieval of steam condensate and replacement of unproductive machines resulted in reduction in energy cost and power consumption.

**Sharma (2014)** described textile industry as energy intensive and it uses electricity, liquefied petroleum gas and coal as prime source of energy .The textile industry has lowest efficiency in terms of energy utilization. Textile products are produced in small volume to suit market trend such type of multiline production led to increase in energy consumption. Energy conservation can be attained by adopting advanced energy efficient production technologies and process optimization.

In the opinion of the **Bhaskar et al. (2013)** Indian textile industry is mostly unorganized and its modernization process is very sluggish. The energy conservation act, 2001 recognizes textile industry as fifth most energy intensive industry. The BEE, India has introduced PAT scheme for EEI and to reduce energy intensity. Some of the major player of textile sectors are also being covered under PAT scheme. The PAT Scheme helping textile sector saves an ample amount of energy as well as reduction in carbon emission. The PAT scheme can be extended further by reducing threshold limit of energy consumption in the textile sector.

**Dhayaneswaran & Kumar (2013)** are in the view of that electricity consumption is increasing in the

textile industry. Energy cost has large portion in cost of production after raw material. This trend is due to continuous processes, inefficient machinery and their nonstandard operating parameters. The authors focused on optimization of processes and machines for energy conservation in the textile industry. Most of the textile plants have not included renewable energy source in their energy mix. Smart inclusion of renewable can play vital role for energy saving in the textile industry.

**3.0 SYNTHESIS**

The reviewed literature presented here brought to light the issues of energy and energy management in global as well as Indian context. Many authors depicted current scenario of energy .These studies revealed that energy resources are scarce and fast depleting. The large scale use of non-conventional energy resources raised environmental concern. The energy management practices are growing rapidly due to scarce resources, to save energy and reduce energy cost.

The many authors described conventional and renewable energy sources. The main conventional or nonrenewable energy sources are coal and fossil fuel. The conventional sources are limited and gradually depleting .The conventional sources are greenhouse gas emitter and fiercely polluting environment .The solar energy, wind energy, hydro energy are renewable energy sources which are non-polluting, none depleting and ever available by nature if used judiciously.

The studies reveal that systematic approach of energy management is by implementation of EnMS. The EnMS works on continuous improvement principle for improving energy efficiency and also searches energy saving opportunity. The EnMS implementation has positive impact on energy cost reduction and energy saving by following energy saving goals clearly mentioned in energy policy.

Different EnMS standards have been explored and most of the studies highlighted that the ISO50001 standard as prominent system for reducing energy cost and achieve energy saving. The studies also revealed drivers, barriers of implementation of EnMS standard. The uptake of ISO 50001 gradually increasing with the increased environmental concern.

The studies provide overview of energy management scenario in the context of India. The Government policies and initiatives are intended to fill energy demand supply gap, achieve energy saving and EEI in energy intensive industry.

The reviewed studies on energy management in Indian textile industry states it is highly energy intensive and energy cost is high as well in overall production cost. The energy saving and energy cost reduction goals largely derived from energy audit and government schemes in textile industry.

Some of the studies have shown that use of latest technology and predictive decision making has positive effect on energy management in the evolutionary era of Industry 4.0. The industry 4.0 is the era of smart factory, smart machine, smart products and automation integrated through latest technologies like internet of things and Blockchain. If applicability of these latest technologies and trends in energy management is established then it will surely be helpful for addressing energy issues of textile industry.

**4.0 Conclusion**

It can be concluded from review that there are many studies on energy and its management. The Energy management practices are burgeoning in all types of industries. These are largely derived from energy cost reduction and environmental concern. Energy management activities like optimization of processes, machines and use of modern technology lead to energy conservation in the textile industry. Most of the textile plants has not included renewable energy source of energy in their energy mix. Smart inclusion of renewable and digitalized monitoring of energy with auto corrective actions can play vital role for energy saving in the textile industry. The systems approach of ISO 50001 is in nascent in India as well as in studied textile Industry. Reviewed studies on latest technologies and trends in energy management will be helpful for addressing energy issues of textile industry.

## References

Backlund, S., Thollander, P., Mikael, & Palm, J. (2012). Extending the Energy Efficiency Gap. Energy Policy, 51, 392-396. doi:10.1016/j.enpol.2012.08.042

Bhaskar, M., Verma, P., & Kumar, A. (2013). Indian Textile Industries Towards Energy Efficiency Movement. International Journal of Environmental Science: Development and Monitoring (IJESDM), Volume 4 (3 ), 36-39.

B.K.,A.,Devkota, N., Gautam, N., & Paija, N. (2020). Industry Willingness to Pay for Adequate Electricity Supply: A Discourse on Sustainable Industrial Development. Quest Journal of Management and Social Sciences, 1(2), 251–259. doi:10.3126/qjmss.v1i2.27443

Dahlqvist, A., & Söderholm, P. (2019). Industrial Energy Use, Management Practices and Price Signals: The Case of Swedish Process Industry. International Journal of Energy Economics and Policy, 9(3), 30–45. doi:10.32479/ijeep.7451

Deshpande, S., & Buke, M. (2016). Total Effective Energy Management: The Must Need for Indian Industry. International Journal of Mechanical Engineering and Technology, 7(2), 282–287.

Dhayaneswaran, Y., & Ashokkumar, L. (2013). A Study on Energy Conservation in Textile Industry. Journal of The Institution of Engineers (India): Series B, 94(1), 53–60. doi: 10.1007/s40031-013-0040-5

Fuchs, H., Aghajanzadeh, A., & Therkelsen, P. (2020). Identification of Drivers, Benefits, and Challenges of ISO 50001 through Case Study Content Analysis. Energy Policy(142). doi: 10.1016/j.enpol.2020.111443

Hasan, A. S. M. M., Hossain, R., Tuhin, R. A., Sakib, T. H., & Thollander, P. (2019). Empirical Investigation of Barriers and Driving Forces for Efficient Energy Management Practices in Non-Energy-Intensive Manufacturing Industries of Bangladesh. Sustainability (Switzerland), 11(9). doi:10.3390/su11092671

Hossain, S. R., Ahmed, I., Azad, F. S., & Monjurul Hasan, A. S. M. (2020). Empirical Investigation of Energy Management Practices in Cement Industries of Bangladesh. Energy, 212, 118741. doi:10.1016/j.energy.2020.118741

IEA. (2020). India's Energy Policy:Key Findings of the IEA's In-Depth Review 2020. IEA. Retrieved from https://iea.blob.core.windows.net/assets/2bb811d9-2de6-4e7e-84e8-546111762f21/India-2020-Launch-Presentation.pdf

Iqbal, M., Ma, J., Ahmad, N., Hussain, K., Usmani, M., & Ahmad, M. (2021). Sustainable Construction through Energy Management Practices in Developing Economies: An Analysis of Barriers in the Construction Sector. Environmental Science and Pollution Research. doi:10.1007/s11356-021-12917-7

Johansson, M., Broberg, S., & Ottosson, M. (2021). Energy Strategies in the Pulp and Paper Industry in Sweden: Interactions Between Efficient Resource Utilisation and Increased Product Diversification. Journal of Cleaner Production, 1-10. doi: 10.1016/j.jclepro.2021.127681

Joshi, A., & Venugopal, S. (2016). Energy Management Systems in India . International Research Journal of Engineering and Technology (IRJET), 03(11), 288-298.

Joshijevic,M.,Sustersic,V.,Gordic,D.(2020). Ranking Energy Performance Opportunities Obtained with Energy Audit in Dairies.Thermal Science, 24(5A), 2865-2878.doi: 10.2298/TSCI191125100J

Jovanović, B., Filipović, J., & Bakić, V. (2017). Energy Management System Implementation in Serbian Manufacturing–Plan-Do-Check-Act Cycle Approach. Journal of Cleaner Production, 162, 1144–1156. doi:10.1016/j.jclepro.2017.06.140

Kanase, D.,& Patil,V.B. (2019). An Energy Audit of An Industry : A Case Study. International Journal of Electrical and Electronics Engineering Research, 9(1), 23–28.doi: 10.24247/ijeeerjun20193

Khude, P. (2017). A Review on Energy Management in Textile Industry. Innovative Energy & Research, 6(2), 1-5. doi:10.4172/2576-1463.1000169

Luthra, S., Mangla, S., & Kharb, R. (2015). Sustainable Assessent in Energy Planning and Management in Indian Perspective. Renewable and Sustainable Energy Reviews, 47, 58-73. doi:10.1016/j.rser.2015.03.007

Mangla, S., Luthra, S., Jakhar, S., Gandhi, S., Muduli, K., & Kumar, A. (2019). A Step to Clean Energy-Sustainablity in Energy System Management in An Emerging Economy Context.Journal of Cleaner Production,242,1-12. doi: 10.1016/j.jclepro.2019.118462

Maśloch, G. (2020). The Role and Importance of Social Awareness in Energy Management in Highly Developed Countries. Journal of Economics, Business and Management, 8(2), 80–85. doi:10.18178/joebm.2020.8.2.617

Matteini, M., Pasqualetto, G., & Petrovska, A. (2018). Cost-Benefit Analysis of Energy Management Systems Implementation at Enterprise and Programme Level. Energy Management: The Nuts and Bolts (pp. 353-364). ECEEE.

Mickovic, A., & Wouters, M. (2020). Energy Costs Information in Manufacturing Companies: A Systematic

Literature Review. Journal of Cleaner Production, 254, 119927. doi: 10.1016/j.jclepro.2019.119927

Miglani, A., Kumar, N., Chamola, V., & Zeadally, S. (2020). Blockchain for Internet of Energy Management: Review, Solutions, and Challenges. Computer Communications, 151, 395–418. doi:10.1016/j.comcom.2020.01.014

Ministry of Textiles, Government of India. (2019). Annual Report 2018-19. Retrieved from http://texmin.nic.in/sites/default/files/Textiles-AnnualReport2018-2019%28English%29.pdf

Ministry of Textiles,Government of India. (2010). Compendium of International Textile Statistics 2009-10.Ministry of Textile. Retrieved from http://texmin.nic.in/sites/default/files/ intcost.pdf

Nagaveni, P., Siva Ram Kumar, M., Nivetha, M., Amudha, A., & Emayavaramban, G. (2019). Electrical Energy Audit –An Experience in A Small Scale Textile Mill. International Journal of Innovative Technology and Exploring Engineering, 8(10), 4102–4107. doi: 10.35940/ijitee.J9623.0881019

OECD. (2015). An Introduction To Energy Management Systems: Energy Savings and Increased Industrial Productivity for the Iron and Steel Sector. Retrieved from https://www.oecd.org/sti/ind/DSTI-SU-SC(2014)14-FINAL-ENG.pdf

Patravale, Tardekar, Dhole, Morbale, & Datar. (2018). Industrial Energy Audit. International Research Journal of Engineering and Technology (IRJET), 5(3), 2021-2025.

Prashar, A. (2019). Towards Sustainable Development in Industrial Small and Medium-Sized Enterprises: An Energy Sustainability Approach. Journal of Cleaner Production, 235, 977–996.doi:10.1016/j.jclepro.2019.07.045

Purwanggono, B., Ferastra, K., & Bachtiar, A. (2019). Critical Success Factors Evaluation of the ISO 50001 Energy Management System Implementation (Case study: PT. APAC INTI CORPORA, Bawen, Semarang Indonesia). IOP Conference Series: Materials Science and Engineering, 598(1). doi:10.1088/1757-899X/598/1/012115

Salleh, Kasolang, & Jaffar. (2011). Lean TQM Automotive Factory Model System. World Academy of Science, Engineering and Technology, 79(7), 627-633.

Sangroya, D., Kabra, G., Joshi, Y., & Yadav, M. (2020). Green Energy Management in India for Environmental Benchmarking: from Concept to Practice. Management of Environmental Quality: An International Journal, 31(5), 1329–1349. doi:10.1108/MEQ-11-2019-0237

Sharma, S. (2014). Energy Management in Textile Industry. International Journal of Power System Operation and Energy Management, 2(1,2), 45-49.

Shim,S. & Lee,S. (2021). Investigating the Use of Energy Performance Indicators in Korean Industry Sector. Journal of the Korea Academia-Industrial cooperation Society, 22(3), 707-725. doi:10.5762/KAIS.2021.22.3.707

Sola, A. V. H., & Mota, C. M. M. (2020). Influencing factors on Energy Management in Industries. Journal of Cleaner Production, 248,119263.doi: 10.1016/j.jclepro.2019.119263

Tachmitzaki, E., Didaskalou, E., & Georgakellos, D. (2019, December). Energy Management Practices'Determinants in Greek Enterprises.Sustainability,12(133),1-18. doi:10.3390/su12010133

Tunc, M., Kaplan, K., Sisbot, S., & Camdali, U. (2016, January). Energy management and optimization: case study of a textile plant in Istanbul, Turkey. World Journal of Engineering, 13(4), 348-355. doi:10.1108/WJE-08-2016-046

WEF. (2021). Fostering Effective Energy Transition. World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2021.pdf

Wolniak, R., Saniuk, S., Grabowska, S., & Gajdzik, B. (2020, June). Identification of Energy Efficiency Trends in the Context of the Development of Industry 4.0 Using the Polish Steel Sector as an Example. Energies, 13(2867), 1-16. doi:10.3390/en13112867

WTO.(2019). World Trade Statistical Review 2019. WTO. Retrieved from https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019chapter08_e.pdf

Yacout, D. M. M., El-Kawi, M. A. A., & Hassouna, M. S. (2014). Applying Energy Management in Textile Industry, Case Study: An Egyptian Textile Plant. International Energy Journal,14, 87–94.

Yatich,H.K. (2018). Realizing Energy Management Practices as A Competitive Strategy Among Manufacturing Firms in Kenya: An Alternative Outlook. African Journal of Business Management, 12(12), 372–380. doi:10.5897/ajbm2018.8557

Zainuddin, A., Kuzaiman, Salleh, Kasolang, & Hoffmann. (2019). Quality Green Lean Energy Leadership Management Practices in Malaysian Automotive Companies. Journal of Mechanical Engineering, 16(1), 149-158.