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The Exploration of Energy Management and Its Practices in Pulp and Paper Industries

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Abstract

Energy management is an integral part of industrial production, including the logistics and environmental management system. The cost reduction in operational management is the primary motivation to incorporate energy management into practice at the industries. Energy management can be characterized as the proceedings to work specifically on energy-related issues of industry and considered as one of the key in-house activities for cost-effectiveness and energy efficiency improvement. This paper examines energy management and the need to perform work strategically on energy in a company such as the pulp and paper industry (PPI). A large energy efficiency potential in an industry is still left unexploited. One of the most promising means of reducing energy consumption and related energy costs is implementing energy management. An internal energy management program is a key means by which an industrial company can improve its energy efficiency and overcome barriers. By definition: "Energy management applies to resources as well as to the supply, conversion and utilization of energy. Essentially it involves monitoring, measuring, recording, analyzing, critically examining, controlling and redirecting energy and material flows through systems so that least power is expended to achieve worthwhile aims''. Also, energy management can be defined as the procedures by which a company works strategically on energy, while an energy management system is a tool for implementing these procedures; these two concepts are often mixed or used interchangeably. Furthermore, the paper provides a discussion on why industrial companies need to work on energy management while empowering the individuals within their organizations. An industrial company that takes a strategic approach to energy management may reduce its energy use by up to 40 %. Energy management concerns the ability to combine strong leadership with delegated authority as concerns energy issues. Energy management research can be developed by complementing existing internal or external audits. This study conclusively highlights the critical role of Top Management Commitment as a mediator in the relationship between Energy Management Practices (Energy Awareness, Energy Efficiency, and Energy Knowledge) in pulp and paper industries.

Keywords: Energy Management, Energy Management System; Energy Management Practices, Energy Efficiency; Pulp and Paper Industry; Knowledge-Based Framework.

1 INTRODUCTION

Energy management is an integral part of industrial production, including the logistics and environmental management system (Abbas et al., 2018). The cost reduction in operational management is the primary motivation to incorporate energy management into practice at the industries (Thollander et al., 2020). Energy management can be characterized as the proceedings to work specifically on energy-related issues of industry and considered as one of the key in-house activities for cost-effectiveness and energy efficiency improvement (Thollander and Ottosson, 2010). Enhancing energy efficiency and reducing the consumption of raw materials, water, and waste byproducts are pivotal strategies. These efforts not only lead to a reduction in GHG emissions but also result in lower operational costs while maintaining the desired output levels.

The pulp and paper industry (PPI) presents an energy-intensive sector, which accounted for approximately 6%

of global industrial energy consumption in 2017 (International Energy Agency (IEA) 2020a; International Energy Agency (IEA), 2020b). The pulp and paper industries consume a lot of energy. A large energy efficiency potential is still left unexploited. One of the most promising means of reducing energy consumption and related energy costs is implementing energy management. An internal energy management program is a key means by which an industrial company can improve its energy efficiency.

Energy management has been described and interpreted in various ways (Schulze et al. 2016). In their review of energy management literature, Schulze et al. (2016) found that the definition of energy management varied depending on the scope and to what degree and level (strategic, operational, or tactical) energy management was integrated into the company (cf. Abdelaziz et al., 2011; Bunse et al., 2011; Kannan and Boie, 2003). However, Schulze et al. (2016) identified that the elements of industrial energy management could be structured into five key areas: strategy/planning, implementation/operation, controlling, organisation, and culture. The area of strategy and planning included strategy and policy for energy, operational energy planning and strategic energy risk management. Furthermore, Schulze et al. (2016) divide the implementation and operation area of energy management into energy audits, energy efficiency measures/activities and investment decisions. The controlling area, according to Schulze et al. (2016), constitutes energy accounting, performance measurement and benchmarking, whereas organisation consists of energy manager, integration, and standardization. The last area, culture, includes education and training, staff motivation and internal communication. Based on their review results, Schulze et al. (2016) propose to define energy management as follows: 'Energy management comprises the systematic activities, procedures and routines within an industrial company including the elements strategy/planning, implementation/operation, controlling, organization and culture and involving both production and support processes, which aim to continuously reduce the company's energy consumption and related energy costs'. Energy management is sometimes used in the same sense as energy management systems, but the terms are not the same. Energy management, as described above, basically refers to companies' strategic and continuous procedures on energy issues, while an energy management system comprises the tools for energy management (Thollander and Palm, 2013).

Rising energy prices, stricter environmental law restrictions, new supply and demand policies as well as energy end-use efficiency policy programs have created increased demand for reducing energy consumption and related energy costs in industrial organizations. To position themselves as market leaders within their business in the long run, the management and operation of a company's energy system are of great importance, especially for energy-intensive industries such as pulp and paper. Although the industrial sector across all branches has made continuous and successful improvements concerning energy efficiency in the last three decades (International Energy Agency, 2007), a significant share of the potential to improve energy efficiency remains untapped (International Energy Agency, 2012). This gap between the actual level of energy efficiency and what theoretically could be reached, given that all cost-effective technologies are implemented, is referred to as the energy efficiency gap (Hirst & Brown, 1990).

Previous research on the strategies of pulp and paper companies regarding energy has predominantly focused on energy efficiency measures (see e.g. References (Corcelli et al., 2018; Haider et al., 2019; Kähkönen et al., 2019; Fleiter et al., 2012; Backlund et al., 2012; Paramonova et al., 2015; Lipiäinen et al., 2021; Blomberg et al., 2012; Fracaro et al., 2012; Peng et al., 2015; Diaconescu et al., 2017; Martin et al., 2000; Zeitz, 1997; De Beer et al., 1994; Hubbe, 202; Dai et al., 2023).

Some studies discuss resource efficiency (see e.g. References (Johansson et al., 2021; Mandeep et al., 2020; Mongkhonsiri et al., 2020; Mongkhonsiri et al., 2018; van Ewijk et al., 2018; IEA, 2017). There is also research on greenhouse gas emissions (GHG) (see e.g. References (IEA, 2023; IEA, 2016; IPCC, 2018; IPCC, 2014; Dai et al., 2024; IEA, 2017; Furszyfer et al., 2022; World Bank, 2022; Davis et al., 2018; Ritchie, 2020; Martin et al., 2000; Griffin, 2018; Wang et al., 2016; Szabó et al., 2009; Wang and Mao, 2013).

Publications on the topic of Energy Management, for pulp and paper industries, are lacking in the literature. With a scarcity of research and publications on Energy Management in industries, this paper aims to contribute

to the literature by adopting the exploration of Energy Management and its Practices in Pulp and Paper Industries. This paper examines energy management and the need to perform work strategically on energy in companies such as the pulp and paper industries and provides a discussion on the need to work on energy management while empowering the individuals within the organizations.

2
NERGY MANAGEMENT AS A SUPPORT FUNCTION IN INDUSTRIAL COMPANIES

Energy management as a support function in industrial companies has developed considerably within the last twenty years. Historically, energy as an input factor within the industrial production process had low or even zero priority for corporate management in industrial companies as energy costs were only a small part of total production costs since energy prices were low and relatively stable then (Schulze, 2016). Therefore, energy costs were in most cases only treated as overhead rather than as a cost category for which managers were directly accountable (Caffal, 1995). This situation has changed with the considerably rising energy sourcing prices in Europe within the last decade, exemplified by the development of electricity prices for industrial consumers in Germany which increased by more than 80% between 2000 and 2015 (German Federal Statistical Office, 2015). As a result, the number of organizations addressing energy-related issues has risen in recent years and increasing activity concerning energy management can be determined in business practice. Industrial companies have seemed to realize that energy management can be an effective lever for enhancing their production systems and operations towards improved energy efficiency and thereby reducing energy use and related energy costs. The ISO 50001 standard, released in June 2011 by the International Organization of Standardization (International Organization of Standardization, 2011), additionally enforces energy management activities of companies and other organizations globally as it provides practical guidance and specifies minimum requirements for implementing a formal energy management system. By May 2014, 7.346 company sites worldwide had already been certified according to the ISO 50001 standard (German Federal Environment Agency, 2014). Despite the increasing activity regarding energy management in business practice, so far there is no consistent understanding of energy management in academic literature (Backlund et al., 2012).

3
NOWLEDGE DEMANDS FOR ENERGY MANAGEMENT IN THE MANUFACTURING INDUSTRY

The study designed a knowledge-based framework consisting of the main forms and attributes of knowledge (Andrei et al., 2022). To improve industrial energy efficiency, the traditional model revolved mainly around technology diffusions [Jaffe et al, 1999], where an energy audit is an initial step for increased diffusion of more energy-efficient technologies by providing targeted information on improvement measures (Paramonova et al., 2021).

However, recent studies have shown that by including energy management practices, e.g. more efficient operations, and implementing energy-efficient technologies, the energy efficiency potential may be even higher (Paramonova et al., 2021; Backlund et. Al., 2012; Schulze et al., 2016; Trianni et al., 2019). The number of industrial companies working with energy management or implementing an energy management system (such as ISO standard 50001:2011) has increased since the introduction of the standard in 2011 (Andrei et al., 2022). Energy management is seen by many companies as an effective tool for enhancing their production systems and operations in pursuit of improved energy efficiency (Schulze et al., 2016). However, improving industrial energy efficiency is a difficult task, due to the high complexity of the industrial energy systems (6), especially in the current context of industry requiring a fundamental transformation to achieve the goal of carbon neutrality by the middle of this century. Industry transformation can be achieved through different incremental and radical innovations in how companies work with energy management and improved energy efficiency (Andrei et al., 2022). Radical and incremental innovations consist of distinct types of technological process innovations. Radical innovations are root changes that constitute revolutionary changes in technology, while incremental innovations are minor improvements or simple adjustments in current technology (Dewar and

Dutton, 1986). These modes of innovation differ in several ways, such as complexity, risks, and degree of novelty in knowledge use (Dewar and Dutton, 1986; Smith, 2009; Li and Huang, 2019; Gobble, 2016).

Throughout the years, successful radical innovations have had a remarkable impact on the development of companies. However, at the same time, the role of incremental innovations in enhancing and sustaining the profit streams of successful radical innovations cannot be neglected (Varadarajan, 2009). Incremental innovations are described by Refs. (Dewar and Dutton, 1986; Smith, 2009), among others, as gradual and continuous improvements of existing technologies, processes and the organization, containing a low need for new knowledge, and a strategy with low risks and low returns [Li and Huang, 2019]. Some examples of incremental innovations that industrial organizations implement to improve energy efficiency are: i) adopting new routines that lead to behavioral changes, ii) using tools that increase awareness about the organization's production processes, and iii) implementing an energy management system.

Advanced Information Technologies (AITs)-enabled Energy Management is of tremendous importance as implementing Energy Management (EnM) is a complex task that must first integrate and consider multiple parameters, conditions, and data and control the use and cost of energy in manufacturing. Addressing current industrial transformation requires moving beyond traditional knowledge towards new forms of knowledge that maximize the potential of adopting new and radical innovations. Doing so requires, first, an understanding of the knowledge model that has developed industrial energy efficiency to current levels, and an analysis of the model in the current context of transition, but also for the future (Andrei et al., 2022). Recent review studies, e.g., Refs. (Schulze et al., 2016; Trianni et al., 2019; May et al., 2017) have conducted a comprehensive analysis of research literature on Energy Management in Manufacturing Industries (EnMMI) and developed frameworks providing a consistent understanding of energy management regarding definitions, practices, and objectives. Elaboration of definition or understanding of industrial energy management.

Elaboration on the definition/understanding of industrial energy management is provided by (Schulze et al., 2016) with the authors' addition of (Caphert et al, 2003; Anderson and Newell, 2004; BEE, 2004; Schulze et al. (2016). Table 1 provides a selection of different definitions of energy management and displays the existing diversity of interpretation. As a result, those definitions possess a different scope regarding the strategic, operational, or tactical level of a company, highlight dissimilar aspects of what composes energy management and aim for a diverse set of possible objectives.

Table 1 Selection of definitions of energy management in the literature

Source	Definition
O'Callaghan & Probert, 1977, pg. 128	"Energy management applies to resources as well as to the supply, conversion and utilization of energy. Essentially it involves monitoring, measuring, recording, analyzing, critically examining, controlling and redirecting energy and material flows through systems so that least power is expended to achieve worthwhile aims."
Kannan & Boie, 2003, pg. 946	"Energy management is the judicious and effective use of energy to maximize profits and to enhance competitive positions through organizational measures and optimization of energy efficiency in the process."
Association of German Engineers, 2007, pg. 3	"Energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet the requirements, taking into account environmental and economic objectives."

Caphert et al, 2003	"The judicious and effective use of energy to maximize profits, minimize costs, and enhance competitive positions''.
Capehart et al., 2008, p. 1	"To us, energy management is: The efficient and effective use of energy to maximize profits (minimize costs) and enhance competitive positions."
German Energy Agency, 2010, pg. 9	"Energy management is considered as the proactive and systematic coordination of procurement, conversion, distribution and use of energy within a company, aiming on continuously reducing energy consumption and related energy costs."
Abdelaziz et al., 2011, pg. 154	"Energy management is the strategy of meeting energy demand when and where it is needed. This can be achieved by optimizing energy using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems."
Bunse et al., 2011, pg. 668	"In our research, we define 'energy management in production' as including control, monitoring, and improvement activities for energy efficiency."
German Federal Environment Agency, 2012, pg. 16	"Energy management comprises the total of planned and executed actions in order to ensure a minimum of energy input for a predefined performance."
Ates & Durakbasa, 2012, pg. 81	"Energy management (EM) is considered a combination of energy efficiency activities, techniques and management of related processes which result in lower energy cost and CO2 emissions."
Schulze et al. (2016)	"Energy management comprises the systematic activities, procedures and routines within an industrial company including the elements strategy/planning, implementation/operation, controlling, organization and culture and involving both production and support processes, which aim to continuously reduce the company's energy consumption and related energy costs.''
Anderson and Newell, 2004; BEE, 2004	"The strategy of adjusting and optimizing energy, using systems and procedures, to reduce energy requirement per unit output while holding constant or reducing total costs of producing the output of the system".

5 ENERGY MANAGEMENT CHARACTERISATION

Energy management is an integral part of industrial production, including the logistics and environmental management system [Abbas et al.,]. The cost reduction in operational management is the primary motivation to incorporate energy management into practice in the industries (Thollander et al.,). Energy management can be characterised as the proceedings to work specifically on energy-related issues of industry and considered one of the key in-house activities for cost-effectiveness and energy efficiency improvement (Thollander and Ottosson 2010). In this study, energy management is considered as applying to resources, conversion and utilization. It involves measuring, monitoring, logging, analysing, and controlling the energy flows through a

system of an industry.

Multiple factors are needed to be incorporated for successful energy management (Schulze et al., 2016) and energy optimisation (Kaab et al., 2019). The requirements to implement a meaningful and effective energy management system in the industries are articulated in academic literature. The minimum requirements are sustainable tactical planning, energy auditing, planning and implementing projects related to energy, identifying the key point indicators (KPIs), scrutinising the energy consumption, reporting to management, ensuring support from the upper management, establishing the provision of a dedicated energy manager, formulating policies that are friendly towards energy efficiency and so on. Figure 1 illustrates the essential activities for a successful energy management system.

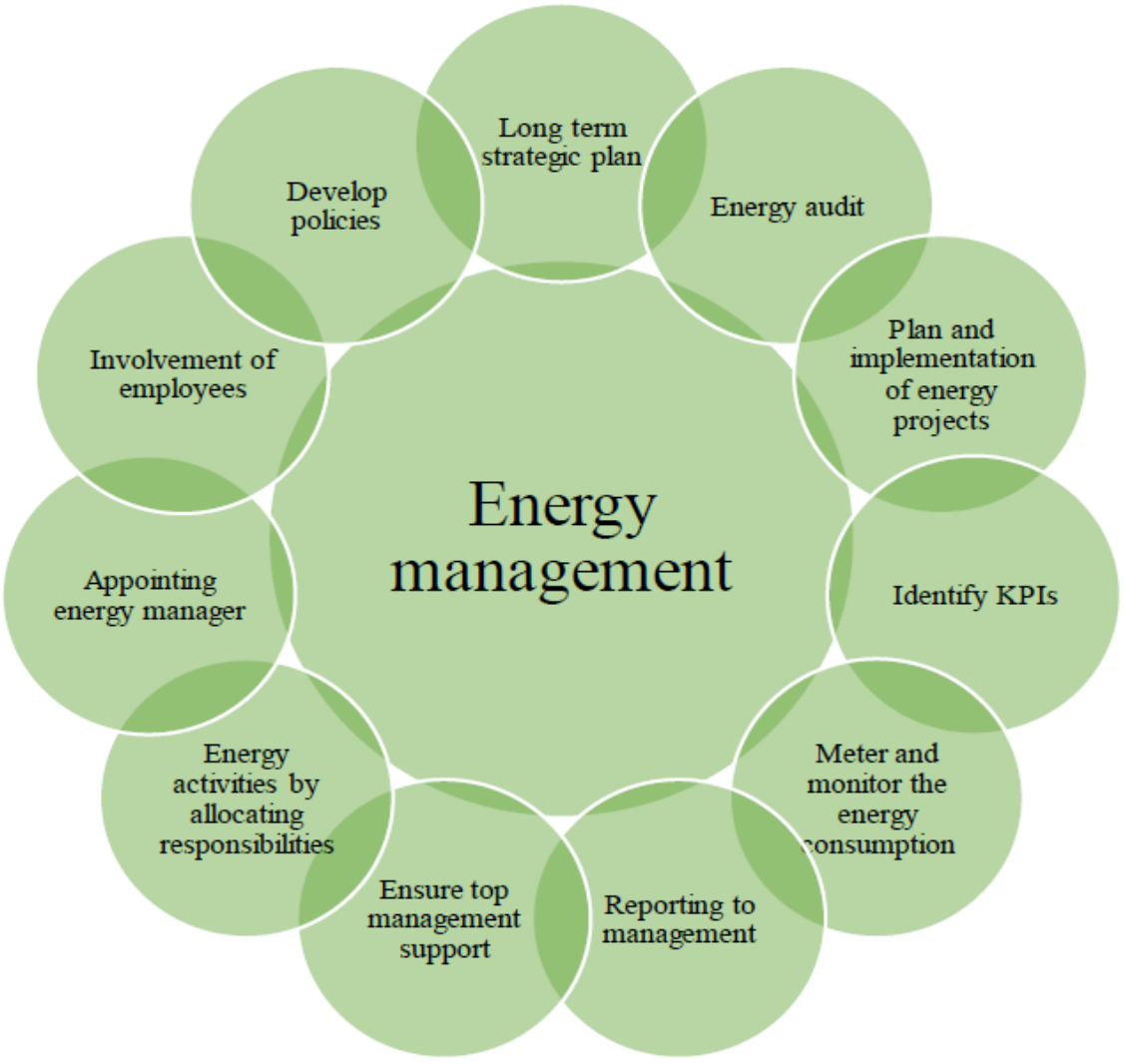

Figure 1: Key factors for a successful energy management system (Thollander and Ottosson 2010; Brunke et al., 2014; Christoffersen et al.; Ates and Durakbasa, 2012).

6 BJECTIVES OF ENERGY MANAGEMENT

The objectives of energy management are:

- To achieve and maintain optimum energy procurement and utilization throughout the organization.

- To minimize energy costs/waste without affecting production and quality.
- To minimize environmental effects.

Energy management is effectuating organizational, technical, and behavioral actions in an economically sound manner to minimize the consumption of energy, including energy for production, and to minimize the consumption of basic and added materials.

7 ONTRIBUTE TO PROTECTING THE ENVIRONMENT

The pulp and paper industry is an important contributor to global greenhouse gas emissions. Country-specific strategies are essential for the industry to achieve net-zero emissions by 2050, given its vast heterogeneities across countries. All countries can achieve net-zero emissions for their pulp and paper industry by 2050, with a single measure for most developed countries and several measures for most developing countries.

Energy management will contribute to protecting the environment by using less energy or at least improve energy efficiency and hence combat climate change by reducing CO_2 emissions. Even a corporation that is already, for example, buying green electricity will help to contribute if they reduce their electricity use as the electricity supplier will then have more green electricity available for other customers who currently buy electricity produced from fossil fuels. The environmental improvement factor is a particularly strong factor due to the urgency to reduce global warming and high awareness in the public and hence also among the employees. This high awareness among employees can be important when communicating about the energy management initiative and in trying to get improvement suggestions coming in.

8 EFINING THE ENERGY MANAGEMENT PROGRAM

One of the most successful and cost-effective ways to bring about energy efficiency improvements is to fundamentally change how energy is managed by implementing an organization-wide energy management program. Continuous improvements to energy efficiency typically only occur when a strong organizational commitment exits. A sound energy management program is required to create a foundation for positive change and to provide guidance for managing energy throughout an organization. Energy management programs help to ensure that energy efficiency improvements do not just happen on a one-time basis, but rather are identified and implemented in an ongoing process of continuous improvement. Without the backing of a sound energy management program, energy efficiency improvements might not reach their full potential due to lack of a systems perspective and/or proper maintenance and follow-up.

Setting up an effective energy management program follows proven principles of establishing any management system. These principles fit any size and type of organization. As defined by Deming, the process should have four steps: These steps, broken down, require several essential activities are shown in the Figure 2 below.

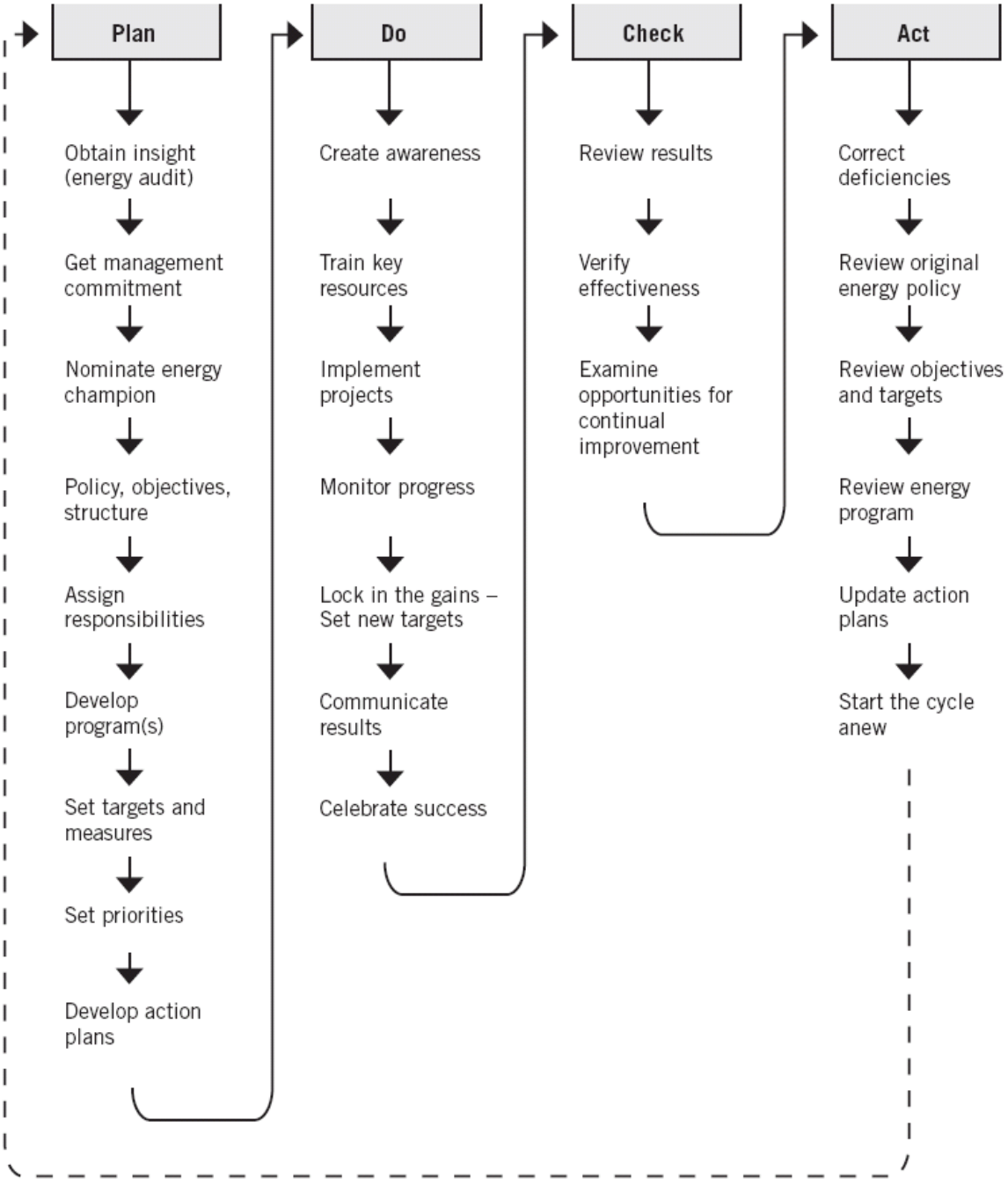

Figure 2: Essential Activities of Energy Management Source: CIPEC (2002, p. 12).

According to Lackner and Holanek (2007), energy management refers to structural attention toenergy with the primary objective of continuously reducing energy consumption and maintaining the achieved improvements. It ensures that an organization continually passes through the cycle of making policy, planning actions, implementing actions and checking results, based on which policy is made. This cycle makes continuous improvement possible as reflected in Deming's Circle shown in Figure 2.

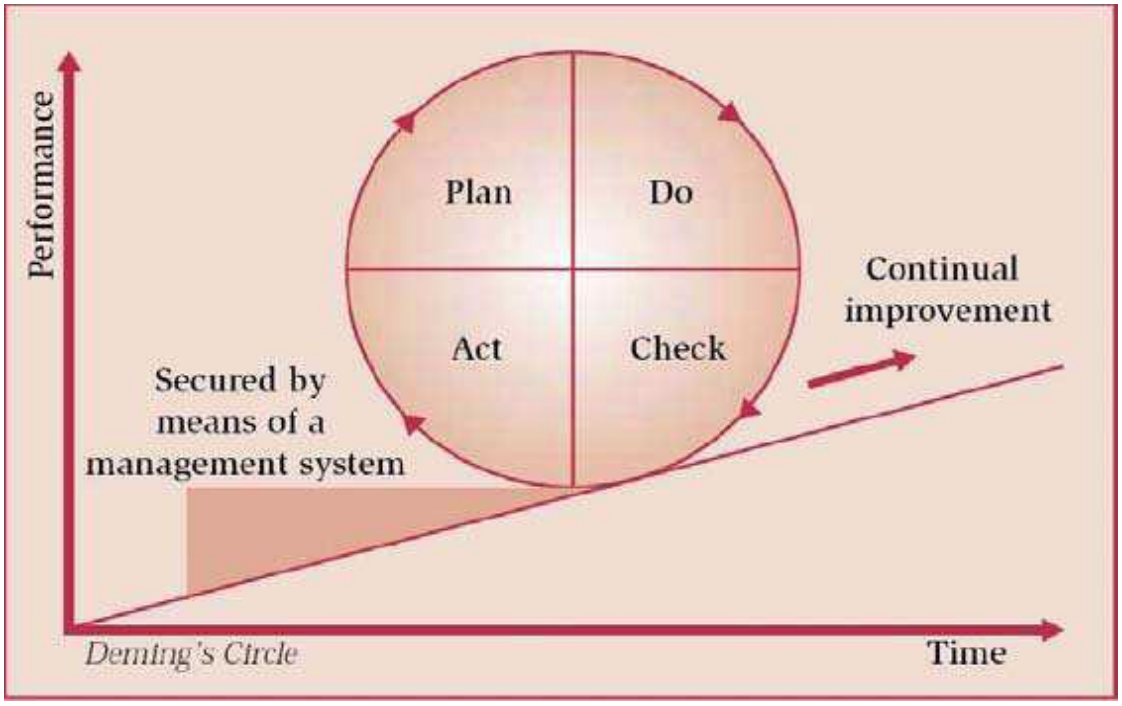

Figure 2: Deming's circle (Lackner and Holanek, 2007)

The implementation of an energy management system is not objective. What matters is the results of the system. Whether an energy management system works is dependent on the willingness of the (relevant) organization to manage energy consumption and energy costs. Thewillingness needs to find expression in their deeds whatever their main reasons are: controlling costs, environmental considerations, legal requirements, social agreements and image.

Organizations seeing the financial returns from superior energy management continuously strive to improve their energy performance. Their success is based on regularly assessing energy performance and implementing steps to increase energy efficiency. No matter the size or type of organization the common element of successful energy management is commitment.Organizations commit to allocating staff and funding to achieve continuous improvement. Changing how energy is managed by implementing an organization-wide energy management program is one of the most successful and cost-effective ways to bring about energy efficiency improvement (McKane et al, 2007).

9
NERGY AUDITS OF PULP AND PAPER INDUSTRIES

One of the most promising means of reducing energy consumption and related energy costs Is implementing energy management in an organization (Schulze et al., 2016). Research concerning energy management has been conducted in the area of energy audit practices (e.g. Shen et al., 2012), evaluation of energy audit programs (e.g. Fleiter et al., 2012a; Fleiter et al., 2012b), energy system or process optimization by statistical modeling (e.g. Giacone & Mancò, 2012), development and evaluation of energy end-use industry policy programs and measures (e.g. Tanaka, 2011), as well as performing energy efficiency benchmarking (e.g. Saygin et al., 2011). A comprehensive review of published scientific articles on energy management practices in the industry is currently lacking, calling for such a review to be conducted. Energy Management Practices (EMPs) are strategies aimed at reducing energy consumption and enhancing energy efficiency. The area of energy management that constitutes implementation and operation is divided by Schulze et al. (2016) into energy audits, energy efficiency measures/activities and investment decisions.

Many opportunities still exist for energy conservation and cost optimization in industries with complex infrastructure, particularly through energy audits (Kluczek and Olszewski, 2017). The energy audit, a well-known tool for analyzing energy flow and assessing energy-saving opportunities is demonstrated in this paper as one of the steps in an energy efficiency initiative. Energy auditing is one of the most comprehensive methods of achieving energy savings in the industry so that wasteful consumption of energy will be minimized. With a selection of the appropriate type of audit (Cagno et al., 2010), different depths of analysis into the production operations can be performed by the given facility. The energy audit which can assist in the achievement of improved energy performance, also identifies energy conservation measures and mitigates greenhouse gas emissions (GHG) in industries. Energy auditing is one of the most comprehensive methods of achieving energy savings in the industry so that wasteful consumption of energy will be minimized. With a selection of the appropriate type of audit (Cagno et al., 2010), different depths of analysis into the production operations can be performed by the given facility.

Articles about energy audits at pulp and paper mills have been previously published by researchers (see e.g. References (Sweet, 1991; Kong *et al.* 2016; Reese 2018; Reese and Deodar, 2018; Gilbreath 2019; Reese *et al.*, 2020). The largest and quickest savings in energy in pulp and paper mills usually are achieved because of system audits. During such audits, emphasis is placed on finding deviations from the intended functioning of operations. Independent measurements are made of flows and other parameters, often using portable flow meters (Reese *et al.* 2020). Such independent checking routinely reveals problems with meters, valves, pumps, and even with improper settings of devices. Audits of pulp and paper mills, which often involve a team of specialists, can reduce energy usage by about 20%. In typical cases, about a quarter to a half of the identified energy savings can be achieved without capital expenditures (Reese *et al.* 2020). In general, the energy audit can be performed with different depths of analysis, according to the needs of the firm, easily referable to three categories: walk-through, mini-audit, and maxi-audit. Consequently, with a selection of the appropriate type of audit for the given production plant, it is possible to perform the best analysis with the available effort of both time and budget. Below is a brief description of three types of audits as provided by (Cagno et al. 2010).

a) Walk-through audit: alternatively called simple audit, screening audit or preliminary audit, it is the simplest and quickest type of audit; it involves minimal interviews with site operating employees, a brief review of the facility bills and other operating data, and a walk-through of the facility to become aware of the possible areas of energy waste or inefficiency.

b) Mini-audit: alternatively called single-purpose audit, it can be considered as an expansion of the walk-through audit described above, by collecting more detailed information on facility performances and for a more detailed evaluation of energy savings opportunities, including a financial analysis of the needed investments.

c) Maxi-audit: it provides a dynamic and detailed energy project implementation plan for a given firm. This type of audit uses computer models to simulate buildings and equipment operations based on weather, equipment set points, hours of operation, etc.; one of its key elements is the energy balance, using an inventory of energy-using systems, assumptions of current operating conditions and calculations of energy use, then compared to the firm bill charges. The effort in more accurate estimates of energy savings is paid by higher audit costs.

A summary of the Energy auditing is as follows: The pulp & paper industry energy auditing process is used to establish the overall energy consumption in the industry, estimate the scope for saving, identify the easiest areas for attention, identify immediate improvements and savings, set a reference point, identify areas for more detailed study and measurements. Such an industrial energy audit will help to keep focus on variations that occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment, etc.

10
NERGY MANAGEMENT PRACTICES

***Definition of energy management practices*:** There is no single, unique and cohesive definition for energy management practices (EnMPs) as it can be seen from different perspectives. Different researchers have different point of view about what EnMPs are. For instance, Caffall (1995) defines it as "relevant savings without capital or with limited investment (short payback time compared to that of a technical measure), and such savings could be immediately reapplied to finance subsequent investment in energy-efficient technologies". However, from Christoffersen et al. (2006) point of view EnMPs have so far mainly consisted in replacing inefficient equipment and then using different methods to estimate the obtained savings. As mentioned above, some authors consider an EnMP as a technical procedure while other believes it is more managerial. However, we define EnMPs as total continuous or frequent managerial and technical actions in a company which aim primarily to reduce energy cost or secure energy supply and secondary to reduce pollution. Some authors believe that there is overlapping between EnMPs and Energy Efficiency (EE) measures. But apart from the existence of some overlaps it is possible to differentiate EnMPs from EE measure Trianni et al., 2013. It is useful to list all EnMPs and group them based on where and how they improve the EE. Characterization of EnMP through the EnM definition can be a light to better understand what EnM is. Turner et al., (2007) clustered EnM strategies into five dimensions: Reliability, Efficiency, Low cost/No cost, Funding, and Awareness. In this study we try to group EnMPs in these five dimensions, inspired by Turner et al., (2007).

There are standards and guidebooks in the industry and academia addressing energy management. However, most of them cover only the technical and building perspectives. The ISO 50001 is a significant standard, though, it generically covers energy management issues. Comprehensive guidebooks on industrial energy management featuring technical perspectives as well as policy, managerial, and other issues are still lacking. Dusi and Schultz (2012) suggest that clear and measurable energy efficiency targets are a majortool to kick-start energy management programs. It should also be noted that an organization should be always aware of its energy efficiency improvement potential (Antunes et al., 2014).Furthermore, achievable target setting must be well documented, and a policy must be prepared andcommunicated to make the whole organization aware of the policy (Antunes et al., 2014); (Ates and Durakbasa, 2012). According to Antunes et al. (2014), "the energy policy must provide a clear definition of energy objectives and targets, to ensure sufficient resources and the commitment to maintain an energy strategy". This requires training of staff, communication and performing regular reviews, among other activities. In addition to that the energy policy should guide the organization in the procurement of energy-related equipment, services and resources (Antunes et al, 2014).

Another important practice is to create an action plan or energy strategy for energy management (Antunes et al., 2014); (Dusi and Schultz, 2012). After setting an energy policy an action plan is created for defining how to achieve the proposed goals and prioritizing and assigning action plans to employees, including responsibilities, time and budgets (Antunes et al., 2014). A long-term strategy is also required to practice successful energy management (Thollander and Ottosson, 2010). According to Thollander and Ottosson (2010), the existenceand duration of a long-term energy strategy in energy management is especially important for industrial companies. Reducing energy use and energy costs could be one of the many goals included in the strategy (Thollander and Ottosson, 2010). Achieving the set goals of energy management requires careful planning and thorough implementation. Creating an action plan and or energy strategy may help in reaching these goals. Regarding implementation of actionplans various practices need to be considered. One of the most essential practices is metering the energy consumption of main processes (Antunes et al., 2014); (Ates and Durakbasa, 2012) and identifying the main consumers of energy in the organization. Naturally one of the minimum requirements is to implement energy efficiency projects according to the targets set (Ates and Durakbasa, 2012).

Other important energy management practices are setting payback criteria for energy efficiency investments, careful allocation of the company's energy efficiency investments costs and screening of various information sources for energy efficient technologies (Thollander and Ottosson, 2010). Finally, Dusi and Schultz (2012) suggest that energy management requires benchmarking, audits, reporting and communication. An organization should check and take corrective action when needed, review and improve the system continually.

According to Antunes et al. (2014), the management is responsible for reviewing all implemented measures. Regarding personnel, it is essential to have addressed dedicated team or individuals in charge of energy management in an organization (Antunes et al., 2014); (Dusi and Schultz, 2012). Theresponsibilities regarding energy management should be determined within the organization (Kannan and Boie, 2003). Ates and Durakbasa (2012) suggest that having an official energy manager is necessary for energy management. Many scientists argue that one of the required energy management practices is to ensure management commitment (Antunes et al., 2014); (Thollander and Ottosson, 2010). According to Thollander and Ottosson (2010), successful energy management practices require commitment from senior management. The most important practices in any organization seem to include setting energy-saving goals or targets, creating an energy policy, establishing an action plan, metering energy consumption defining the main energy users, ensuring management commitment and addressing a team responsible for energy management.

11
NERGY TEAMS

Commitment to energy management success requires the formation of an energy team. This is themajor step that is undertaken to energy efficiency strategies that are discussed and policy formulation drafted. The energy team's main responsibilities are to enhance regular monitoring, evaluation and organization of the energy management program. Other duties of the energy team may include employee training and recognition and reporting on energy performance to management (Thollander and Ottosson, 2010).

The roles and responsibilities of each member of the energy team should be clearly defined to enhance the smooth undertaking of the duties involved. Top management should also recognize the energy team's responsibilities as part of their core business roles. This requires the delegation of one member from the senior management to be involved in supporting the energy team and reporting their progress and addressing their concerns at a corporate level. Representation of each business unit in the energy team is key in ensuring a diversity of views.Normal budget allocation will also be a major step in allowing the smooth flow of energy projects as opposed to special budget allocation during the year.

Before launching the energy management team, several strategic meetings must be organized aimed at discussing potential energy efficiency projects and reporting methods. Energy surveys should be conducted throughout the pulp mill so that the energy team has a clear picture of the energy consumption of the mill. This will enhance the easy identification of projects and aid in monitoring and energy tracking mechanisms for the whole mill, providing a perspective on overall energy consumption in the mill. Monitoring and evaluation tools must be discussed before the energy program launches.Reporting progress garnered from energy programs and transfer of the knowledge gained from energy surveys should be discussed during meetings held before launching the program to reduce the problems that might evolve as the energy management programs are underway. Companies need to hold energy fairs and generate awareness of energy efficiency programs to educate the whole organization about its energy policy, objectives and targets. Most organizations should aim to have their own best practice database and benchmark targets for comparing their past and present performance against set goals.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of the present study was to explore Energy Management and its Practices in Pulp and Paper Industries. Energy management and its practices, together with energy auditing have been largely overlooked so far. One of the most promising means of reducing energy consumption and related energy costs is implementing energy management in an organization.

Energy management is a continuous process and participation of all employees is a must for its successful implementation. It is an obligation to have an energy management program in an energy-intensive industry like pulp and paper. Energy management refers to a company's strategic and continuous procedures on energy

issues, while an energy management system comprises the tools for energy management. One of the most promising means of reducing energy consumption and related energy costs is implementing energy management in an organization.

This study conclusively highlights the critical role of Top Management Commitment (TMC) as a mediator in the relationship between Energy Management Practices (Energy Awareness [EAW], Energy Efficiency [EE], and Energy Knowledge [EK]) and the pulp and paper industry. To educate people at all levels, and to create awareness, energy management programs should have better educational plans in place. It is clear from the literature that there should be strategic energy planning in place and it should be integrated with the business strategy. The corporate management has a big role to play in the education and training of employees, employee involvement and awareness and institutional capacity building for energy management. The energy management team should work with all employees to develop ideas for energy conservation initiatives.

The energy audit, a well-known tool for analyzing energy flow and assessing energy-saving opportunities, is also covered and demonstrated in this paper as one of the steps in an energy efficiency initiative. An energy audit is an inspection, survey and analysis of energy management. It helps any organization to analyze its energy use and discover areas where energy use can be reduced and waste can occur, plan and practice feasible energy conservation methods that will enhance their energy efficiency. The primary objective of energy auditing in the Pulp and Paper industry is to determine ways to reduce energy consumption per unit of product output or to lower its operating costs.

RECOMMENDATIONS FOR THE FUTURE

Management needs to integrate energy management into the business strategy of the company rather than merely focusing on regulatory compliance. They should use the industry's capabilities and resources responsibly and sustainably. Energy Management Practices should be adopted by Pulp and Paper Industries with the assistance of detailed or maxi-audit Energy audits since Energy audits can indicate potential energy and non-energy benefits. Energy-saving opportunities for this industry can also be identified.

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