



IMPLEMENTING ENERGY MANAGEMENT SYSTEM TO INCREASE ENERGY EFFICIENCY IN MANUFACTURING COMPANIES

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Abstract

One of the main pillars of the modern industry is the uninterrupted supply of energy with a reasonable price. The energy production is based mostly on non-renewable energy resources that are getting more expensive progressively. This increase in energy cost consequently leads the companies to a more expensive production of goods. Therefore it has been established that energy efficiency is not only very important for the environment but also for the sustainable production in the manufacturing companies. Effective energy management plays an important role in the necessary increase of energy efficiency in industry. Next to the expansion of regenerative energies, it establishes a further pillar at closing the energy supply gap resulting from the energy transition. This paper presents the current energy situation in Germany and its impact on the German industry. Furthermore this paper presents a methodology which can be used by organizations to systematically implement energy management system. Eventually the paper provides a model that illustrates the realization of a PDCA cycle which is necessary for energy management in the organization.

Key words: Energy, Management, Organization, Responsibilities, Structure, Scheme, Committee, Standards, System, Support, Integration, Decision, Making, Leadership, Efficiency, Technical, Investment, Evaluation, Reporting Budget, Consumption

Introduction

The energy costs in Germany are high in international comparison. For instance, already at an inner-European comparison, the electricity prices for German industry are around 14% higher than the other European countries [1]. The reason is



especially a high tax component known as Renewable Energy Act (German: Erneuerbare-EnergienGesetz, EEG). Through the planned expansion of regenerative energies, a further increase of energy costs is predicted [2]. This is straining the manufacturing companies enormously. Because of a share in energy imports of about 72%, the German national economy is additionally exposed to staggering prices at global market and a supply risk [2]. The competitive advantage and the strength of German industry are the products with high quality standards. As labor is very expensive in Germany, this competitive advantage is achieved through a high degree of automation in the German industry. Therefore an undisturbed supply of energy is absolutely necessary for the German industry in order to stay competitive in the world market [3]. Hence energy is seen as a critical factor for the economic competitiveness [4] with 33%, the industry has the highest share in the total energy consumption [1]. In terms of electric energy consumption this share lies at 44% [5]. Beside politics, which is responsible for the attractiveness of the market location Germany, consequently the industrial itself must become active to stay attractive in the market. Energy management provides the industry a possibility to overcome these challenges and become energy efficient.

Current situation A wide range of different methods and measures are known in energy management but hardly systematized. However, the energy management in industrial companies is not purely a technical task, rather an interface function [6]. Usually the cross-sectional tasks in the areas of business administration, law and technology among others have to be processed alongside the steps of operational energy flow as shown in figure 1. Thereby, an increasing complexity is detectable. For example; even the concise energy law in Germany encompasses around 3000 paragraphs [7]. An appropriate organizational orientation of the company is necessary to achieve the objectives of energy management. Here the state of the art norms and standards provide assistance and guidelines to tackle this complex challenge.

Definition

Altogether there exists a wide range of definitions in academic literature concerning the energy management system for companies [8]. That is why a structured and summarized definition is proposed as follows:

Energy management is the targeted deployment of methods and measures for energy –related tasks, thereby implementing a continual energy efficiency improvement approach in companies while keeping the costs and uninterrupted energy supply in consideration.



An Energy management system comprises of

1. definition,
2. implementation
3. and controlling

of measures regarding energy-relevant issues. Here, the approach is

1. transparent,
2. systematic
3. and continuous.

goal is to guarantee the energy supply under the following economic and ecologic aspects:

1. adequate,
2. efficient
3. and sustainable.

2. Norms and standards

Energy management can be operated on the basis of standards and guidelines at different depths. It varies from individual, ad hoc implemented energy efficiency measures to certified energy management system. An energy management system is a systematic and continuous approach for sustainable energy improvements. However before implementing an energy management system in a company, a German Norm DIN EN 16247-1:2012 that provides guidelines to audit the company can be used to prepare for the internationally known energy management standard ISO 50001.

2.1. Energy audit Energy audit is based on the norm DIN EN 16247-1:2012. It is considered as a fundamental step for companies that want to increase their energy efficiency and reduce energy consumption. It is a systematic approach for inspection and analysis of energy consumption of a plant, a building, a system or an organization with the goal of identifying energy flows and the potential for energy efficiency improvements. The energy audit process, i.e. the process of actual audits must meet essential criteria suggested in the norm. It includes the individual steps .

Energy management norm

DIN EN ISO 50001:2011 defines energy management system as the sum of totally integrated or interacting elements leading to the introduction of an energy policy and strategic energy goals, as well as processes and procedures to achieve these strategic objectives. It thus creates the conditions for the full application of methods and measures of energy management. Design and structure correspond to the previously introduced management systems ISO 9001 for quality management



systems and ISO 14001 for environmental management systems. Thus, integration into existing management systems is possible. Here, the Deming cycle serves with the elements Plan, Do, Check and Act (PDCA) as a basis, which forces a continuous improvement program. Once the energy management system is fully implemented in a company, it is possible to get the company ISO 50001 certificate. This certificate brings next to the optimized energy efficiency additional benefits. Such as a simple proof of being environmental friendly so an improved brand image. Furthermore companies can get tax reliefs in Germany if they are ISO 50001 certified. The norm gives a list of criteria which a company must fulfill in order to get the certificate but the norm does not provide any guidelines or strategy to implement all these criteria in the company.

Conclusion

Energy management is both for the companies and for society as a whole, of great and ever increasing importance. Its core objectives are supply security, economic efficiency and environmental protection. For individual companies, there exist different reasons to apply energy management practices, to implement related measures and to establish an energy management system. Nevertheless there are a lot of barriers such as employee awareness, behavior and motivation, know-how and financial resources that hinder companies from implementing an energy management system and execute measures to increase energy efficiency. A variety of energy management methods are known in the literature. With the specific use of these methods existing barriers can generally be overcome. However, for a sustainable and continuous improvement a structured and systematic approach is required. Although standards and guidelines provide an appropriate guidance for energy management, still these do not offer any structure or method to implement them in companies. It is shown in this paper that the multi-stage-model provides an approach for the gradual introduction of an energy management system where different starting and ending points can be considered. Through the organization structure, proposed in this paper, a Plan-Do-Check-Act cycle for a sustainable and continuous improvement can be realized. The goal is to make optimal use of existing resources and existing expertise in the companies. Additionally through this the companies can qualify for the ISO 50001 certification. The essential foundation required to implement energy management system is to analyse the current situation and to identify optimization potential regarding the energy efficiency. Here DIN EN 16247 standard provides a good support. In Germany the application of standards in the companies not only provides a frame-work but also a possibility to avail other benefits, such as tax cuts



and eligibility for government support programs. Data on the energy situation for the implementation of energy management is of utmost importance. Properly collected and processed they create transparency and are the basis for business decisions. With adequately defined EnPIs, analyses and comparisons can be carried out and controlling methods and measures can be derived. The list of EnPIs provided in table 1 offers a good starting point

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