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Specification of energy assessment methodologies to satisfy ISO 50001 energy management standard

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ABSTRACT

Energy management has become crucial for the industrial sector as a structured approach to lowering the cost of production and in reducing the carbon footprint. With the development of ISO 50001 standard, energy management has enticed the attention of upper level management in terms of continuous improvement. The ISO 50001 standard requires an intensive energy assessment process to identify SEUs and EnPI, based on which target energy reductions can be realized. Such an energy assessment approach can be easily developed based on the IAC energy assessment protocol and other approaches so as not to "re-invent" the wheel but instead focus and refine the process to generate knowledge and information that would assist manufacturers to initiate and determine the focus areas for energy reduction and develop the ensuing documentation. The aim of this work is to develop an energy assessment methodology and reporting format tailored to the needs of ISO 50001. The developed energy assessment methodology integrates the energy reduction aspect of an energy assessment with the requirements of Sections 4.4.3 (Energy Review) to 4.4.6 (Objectives, Targets and Action Plans) in ISO 50001, thus enabling facilities to reduce the time and other resources required for facilitating the implementation of ISO 50001.

Introduction

World energy consumption

The Industrial revolution (1760–1840) changed the nature of manufacturing processes by using mechanical energy. Machine tools started replacing hand production methods which increased the need for energy. The manufacturing sector became a dominant fuel for economic growth worldwide. This transition led to significant energy use in the world. According to the U.S. Energy Information Administration (EIA), total world energy usage for the year 2010 was 524 quadrillion British Thermal Unit (BTU) and is projected to increase to 630 quadrillion BTU by year 2020 and 820 quadrillion BTU by 2040 [1]. The industrial sector in particular uses more energy than any other sector. According to Energy Information Administration (EIA), the industrial sector is primarily comprised of manufacturing (food, paper, chemicals, refining, iron and steel, nonferrous metals, metallic minerals and others) and nonmanufacturing (agriculture, mining and construction). In United States, the total energy use in the year 2014 was 98.3 quadrillion BTU [1]. The major energy sources consumed in the United States are petroleum (oil), natural gas, coal, nuclear and renewables.

Need for energy conservation

Energy conservation refers to reducing energy consumption through using less of an energy service whereas energy efficiency refers to using less energy for a constant service. It has been observed that there is a significant growth in energy consumption globally with respect to time.

Abbreviations: SEU, Significant Energy User; EnPI, Energy Performance Indicators; kW, kilowatt; kWh, kilowatt hour; Hp, horse power; BTU, British Thermal Unit; ISO, International Organization for Standardization; ANSI, American National Standards Institute; HVAC, Heating, Ventilation, and Air Conditioning; MSE, Management System for Energy; PDCA, Plan-Do-Check-Act; EIA, Energy Information Administration; GHG, Green House Gases; MMT, Million Metric Tons; ASME, American Society for Mechanical Engineers; EnPI, Energy Performance Indicator Tool; EN 16001:2009, Energy Management System Standard; AR, Assessment Recommendation; IAC, Industrial Assessment Center; EEAP, Enhanced Energy Assessment Process; ASHRAE, American Society of Heating, Refrigerating and Air-Conditioning Engineers; VSD, Variable Speed Drives; LBNL, Lawrence Berkeley National Laboratory; M & V, Measurement and Verification; EMS, Energy Management Systems; MMBTU, Million Btu

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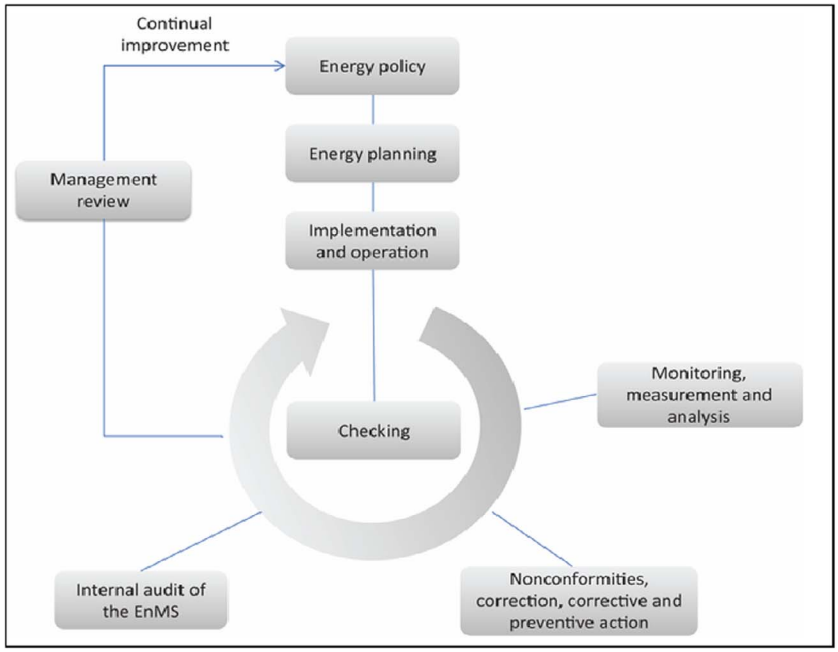

Fig. 1. Energy Management System Model for ISO 50001 [20].

Table 1
ISO 50001 requirements and information generated by different assessment methods [24,11,17].

ISO 50001 Energy Planning	Requirements	ASME Methodology	IAC Methodology	LBNL methodology
4.4.3 Energy Review	a) Identify Current Energy Source	Yes	Yes	Yes
	b) Evaluating Energy Consumption	Yes	Yes	Yes
	c) Identifying SEUs	No	No	No
	d) Variables effecting SEU	No	No	No
	e) Identifying EnPIs for facility	No	No	No
	f) Estimate future energy consumption	No	No	No
	g) Identifying Opportunities	Yes	Yes	Yes
4.4.4 Energy Baseline	a) Establishing Facility level Baseline	No	No	No
4.4.5 Identifying EnPI's	a) Identifying EnPIs for SEU's	No	No	No
4.4.6 Energy Objectives, Targets and Action Plans	a) Energy Objectives	No	No	No
	b) Energy Targets	No	No	No
	c) Action Plans for SEU's	No	No	No
	d) M & V Plans	No	No	No

The by-product of this growth in energy consumption is the increased emissions of Green House Gas (GHG) causing global warming. Many nations have started focusing on energy conservation and energy efficiency as a way to reduce greenhouse gases.

According to the manufacturing energy use and GHG emissions analysis in the United States [2], total manufacturing GHG combustion emissions were equal to 1261 Million Metric Tons (MMT) of carbon dioxide in 2006. Out of this, 619 MMT or 49% was from off-site generation of electricity and steam and remaining 643 MMT or 51% was from onsite combustion [2].

There are several reasons for reducing the energy intensity apart from environmental objectives. Due to increased globalization and outsourcing, manufacturing facilities need to be highly competitive. One way of being a market leader is to reduce the product costs thereby increasing their dollar productivity. Energy is one of the key factors in reducing operating costs. Energy conservation is also one of the pillars of sustainability and sustainable development. Over-dependence on non-renewable fossil fuels for various types of energy uses results in rapid decrease in their reserves. Studies show that if the world continues to consume fossil fuels at the 2006 rates, the reserves of oil, coal and gas will last a further 40, 200 and 70 years, respectively [3].

How to conserve energy?

Conserving energy can be done in several ways, ranging from simple no-cost behavioral changes to using sophisticated technologies. Behavioral change involves educating the people in the importance of conserving energy. It is based on creating awareness among the people and trying to develop simple habits to save energy.

Several technologies have been developed to address energy savings. The primary questions for the industry in using these technologies are whether the technologies available in the market are suitable and how much can they save in terms of energy and cost. Another barrier for implementing new technologies in the industrial sector is the investment and the rate of return. This has led to energy assessments whose primary objective is to evaluate the existing systems and arrive at recommendations for saving energy.

With increases in energy prices, industrial facilities are constantly undergoing changes in their systems in order to lower the overall cost of production. Similarly, energy management systems and application of ISO 50001 standard can significantly help to save energy. Manufacturing facilities are familiar with ISO 9001 and ISO 14000 standards and will be able to easily adopt the application of the energy assessment standards. However, the energy assessment procedures associated with energy management systems need to become more focused and streamlined in order to directly address the needs of the