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Industrial Energy Management Systems in Italy: state of the art and perspective

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Abstract

Despite the economic crisis, the impact of industry sector share on the total primary energy demand in Italy is still significant. The certification of companies according to the standard ISO 50001:2011 ("Energy management systems - Requirements and guidelines for use"), can represent a key element in the achievement of objectives set in the 20-20-20 Climate-Energy Package.
This paper illustrates the state of implementation of ISO 50001 certifications in Italy, reporting on the results of a questionnaire carried out as a part of a master's thesis project at Sapienza, University of Rome in collaboration with FIRE (Italian Federation for the Rational Use of Energy) that included the major certification bodies, certified companies and consultants. The purpose is to outline the current situation, identify the perspectives and highlight the pros and cons related to the implementation of an Energy Management System (EnMS).
The big picture shows that Italy, one of the leading countries in energy efficiency policies, suffers from a significant delay in the implementation of the EnMS in industry with respect to Germany.
The results of the survey also show that the definition of energy performance indicators, as well as the individuations of an energy baseline and a monitoring plan constitute the requirements most critical to comply with for companies than for consultants. It also appears that more than 35% of companies already ISO 50001 certified have received benefits in terms of cumulative energy saving above 5%, and that the main reason why they have implemented an EnMS is related to the potential impact on increasing the competitiveness of the core business.

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Keywords: energy efficiency; ISO 50001; EnMS; monitoring,; EnPI.

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1. Introduction

According to estimates of the US Energy Information Administration, world energy consumption will increase by 56% in the period between 2010 and 2040 with the industrial sector being more than half of the total energy demand in 2040 [1].

The growth of energy consumption linked to greater environmental awareness has led the EU Member States to agree on the climate and energy targets included in the Climate-Energy Package 20-20-20, providing a 20% reduction of greenhouse gas emissions , 20% share of renewable energy and a 20% increase in energy efficiency by 2020, compared to the indicators in 1990 [2].

In response to these demands, Italy has developed the new National Energy Strategy [3], that is based on a broad and articulated national program of energy efficiency that allows to reach the 2020 level of consumption about 24% lower than in the European baseline scenario. In recent years, thanks to the interventions activated by the 2007 Action Plan on Energy Efficiency, the Italian government already enabled a saving of about 4 Mtoe/year of final energy in 2010 (and about 6 of primary), exceeding the targets set for that date (equal to about 3.5 Mtoe).

On July 18, 2014 was published the Legislative Decree n 102/14, implementing the European Directive 27/2012 on energy efficiency. The 102/2014 Decree establishes a framework of measures for the improvement of energy efficiency intended to contribute to the national objective of energy saving; especially large and energy intensive companies will have to perform an energy audit at the production sites located throughout the country by 5 December 2015 and every four years [4].

Recently, the '"American Council for an Energy-Efficient Economy" has classified Italy second in the world for the national efforts made in favor of energy efficiency policies, due primarily to the interventions in the transport sector, while the other sectors have shown considerable margins of improvement, especially the industry [5].

In the current recession scenario, the Italian energy demand of the industry has decreased during the last six years [6]. However, the impact of the industrial energy consumptions on the total primary energy requirement is equal to 21% and still remains significant [7].

One of the most promising strategy of saving energy demand and related costs in industry is to implement an energy management system (EnMS), defined as a systematic procedure aimed at establishing policies and energy targets and to identify the processes and procedures necessary to achieve them [8].

In June 2011, the ISO 50001:2011 [9] was issued to set out the requirements for the construction of an EnMS, replacing the European standard EN 16001:2009 [10]. ISO50001supports an organization to achieve continual improvement in energy performance [11] with the typical design and structure of the Deming Cycle, in a similar vein to the previous standards on quality management systems (ISO 9001) and environmental management systems (ISO 14001) [12]. The certification of conformity of an EnMS with respect to this international standard is non-binding. The broad implementation of the ISO 50001 would address effective organizational framework for energy performance able to manage all aspects of energy, including procurement and use[13].

Schulze et al. [8] conducted a systematic review of scientific publications in the field of energy management in industry showing that the countries where most of the studies focused are China, Germany, Sweden and the United States, while there is a scarcity of information about energy management practices in Italy.

This paper aims to fill this gap, providing a state of art of ISO 50001 certifications in Italy and reporting the results of a survey about the certified organizations in the national territory, with the goal of identifying the advantages and difficulties encountered in implementing an EnMS. This work has been carried out as part of a master's thesis project at Sapienza - University of Rome [14], in collaboration with FIRE (Italian Federation for the Rational Use of Energy).

1.1. ISO 50001 certifications in Italy

Fig. 1 illustrates the cumulative histograms made from the data reported in the ISO Survey 2013, which shows the top ten countries in the world for number of ISO 50001 certifications issued between 2011 and 2013.

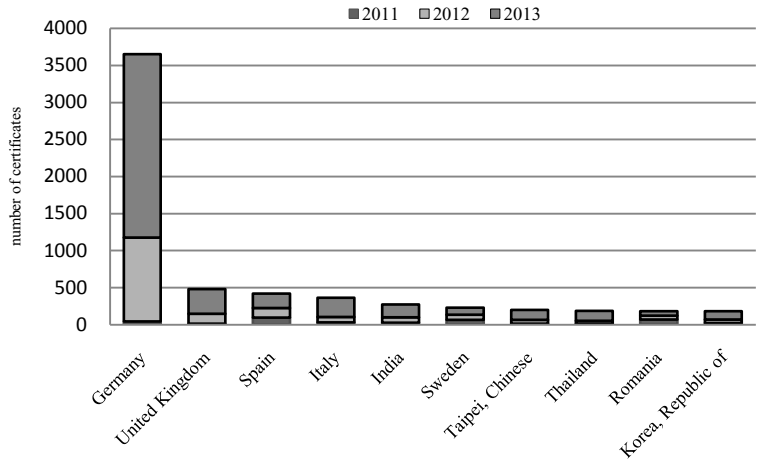

Fig. 1. The top ten countries in the world for number of ISO 50001 certificates between 2011 and 2013.

As can be seen in Fig. 1, Italy (with 362 sites certified) is the fourth place in the world for total number of ISO 50001 certificates, and there is an evident gap between Germany (3652 certified sites) and the rest of the world (less than 500 certificates as sites). This gap is mainly related to the tax reliefs introduced by the German government for companies that are ISO 50001 certified [15].

Analyzing the Italian situation, Fig. 2 shows the growth trend of the certificates between 2011 and 2013 overlaid to the theoretical curve of evolution of a new product introduced in the market. Notably, Italy is in the beginning stage of a development period, with significant potential for growth in the short/medium term.

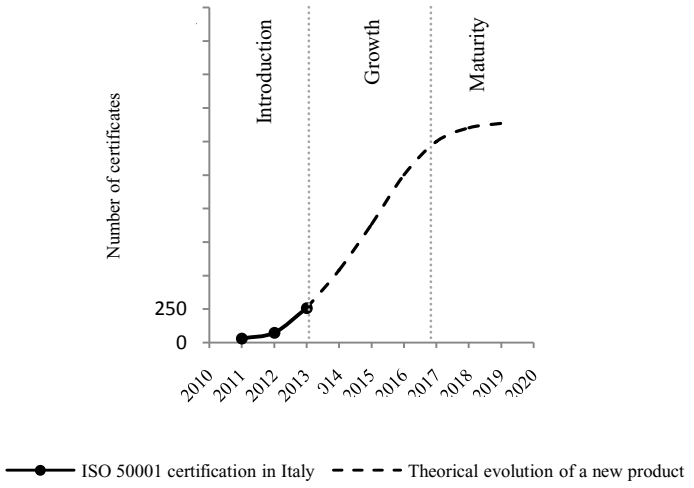

Fig. 2. Comparison of a theoretical curve of evolution of a new product in the market and the evolution of the ISO 50001 certification in Italy.

2. Methodology

The work presented in this paper summarizes the results of a survey that aimed to collect and review the know-hows and experiences of all the players active part of the process of implementation of an EnMS, respectively: certified companies, certification bodies and consultants. For each category ,a questionnaire has been prepared, consisting of multiple-choice questions specifically designed. Some of the questions were directed to multiple types of interviewees in order to cross compare the viewpoints [16].

The compilation of the questionnaire was based both on telephone conversations and e-mail messages.

In the first category, 65 certified companies were contacted and 40 of them agreed to answer the questionnaire. In the number of the participants, 60% operated in the industry sector and the remaining in the residential, commercial and transportation sectors. The staff was mainly represented by the energy managers, or by experts in energy management.

Concerning the certifications bodies, 14 of them were contacted and all accepted to take part to the exercise. Notably, the contacted certification bodies have been responsible for the 80% of the Italian certifications.

Finally, among the consultants, 50 were contacted who have worked on the implementation of more than 60 EnMS on Italy, with a 36% of participants.

Tab. 1 summarizes the actors topics matrix.

Table 1. Main topics of the questionnaires and actors involved

Actors Involved	Background motivations for an EnMS	Requirements more difficult to satisfy	Most disregarded elements identified	Energy savings obtained
CertificationBodies			✓	
Companies	✓	✓		✓
Consultants	✓	✓		✓

As shown in Table 1, the first question addressed to companies and consultants regarded the background motivations for the implementation of an EnMS with three main motivations, such as: i. obtaining energy and cost savings, ii. increase the competitiveness of the core business or the belief EnMS will be a key requirement in the short/medium term.

To the organizations and consultants was asked, then, about the critical issues encountered in the implementation phase of an EnMS. The following elements were considered as main requirements of an EnMS, in particular: the definition of the energy policy, the identification of the energy management team, the definition of the baseline, the EnPIs and the monitoring plan (not required to consultants). The responses could range from a difficulty level 1 (very easy) to 5 (very difficult). The results of the survey were then compared with the elements actually found disregarded by the certification bodies in the verification phase of compliance with the requirements of ISO 50001, giving to the interviewees the opportunity to respond openly.

Finally, the analysis concluded with finding a correlation between the EnMS implementation and the energy savings benefits. This part of the study included the companies surveyed and those that gained support from the consultants included in the survey. Four categories of energy savings level were considered: less than 1%, between 1% and 3%, between 3% and 5% and greater than 5%.

3. Results

The analysis of the results is here done on topic by topic approach.

3.1. Background motivations

Fig. 3 shows the results of the survey concerning the reasons why an organization decides to implement an EnMS.

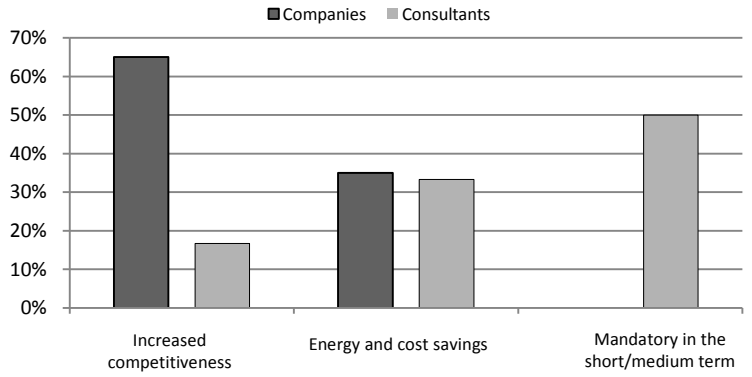

Fig. 3. Background motivations for an EnMS

It seems that the organizations involved in the survey believe that an EnMS can provide an efficiency of the system and therefore allow to increase the competitiveness of the core business; most of the consultants, instead, think that organizations want get ISO 50001 certified because they think it will be a mandatory requirement in the short / medium terms.

This difference of viewpoints, reveals the actual awareness of those companies already ISO 50001 certified of the real potential of an EnMS. This potential is not limited to energy and cost savings, but it reflects in a strategic factor. The ISO 50001, unlike other consolidated management systems, such as ISO 9001, ISO 14001 and ISO 18001,is not exclusively based on regulatory compliance, but allows a real improvement of the performance of the company.

3.2. Criticalities and non-conformities

One of the most interesting aspects of the survey was related to the identification of the elements considered most difficult to satisfy in the adoption of an EnMS, both for the companies that for consultants. Fig. 4 shows the results based on the cumulative sum of the two higher levels of difficulty, which is the level 4 and level 5, in relation to each of the aspects investigated.

As can be seen from the results, the definition of the energy performance indicators (EnPIs) is the most critical element both for the companies that for consultants. As reported in May et al. 2013 [17], the EnPIs are instruments necessary to quantify the energy performances and there is no singular indicator that can be applied in every situation, because it can change according to the decision to make.

Different types of EnPI can be defined, ranging from simple energy consumption to a quantitative relationship (a simple ratio or a more complex engineering models) between the energy consumption and one or more energy drivers, which are those independent variables that can influence the energy efficiency

(e.g. production volumes) [18]. According to Goldstein et al. [19], a common problem is related to a wrong design or poor application of EnPIs, which has often led to an incorrect interpretation of the actual energy performance of the company. Another critical issue for consultants (see Figure 4), is related to the choice of a proper time interval for the collection of data used for the energy baseline, defined in the ISO 50001 as a quantitative reference that provides a basis for the comparison of energy performance.

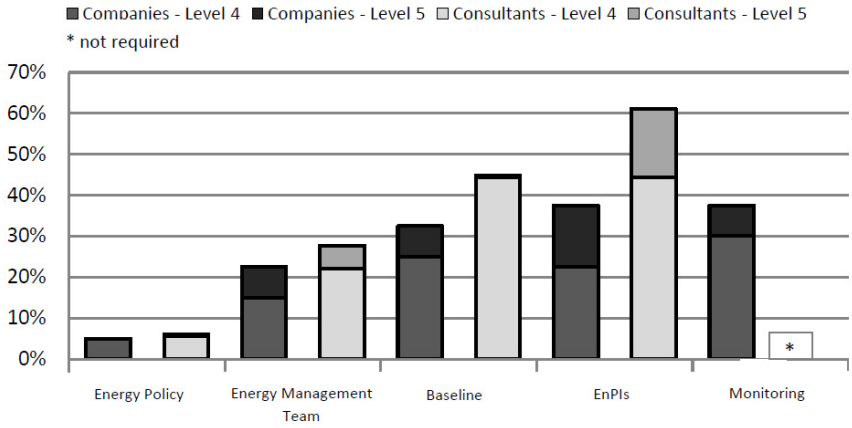

Fig. 4. Requirements of an EnMS more difficult to satisfy, from a level 1 (very easy) to 5 (very difficult).

Thollander and Ottoson [20] reported that the monitoring of energy consumption of the production processes is one of the most important requirements of EnMS. As evident in Fig. 4, this is the second aspect critical for companies, because in the complexity of industrial plants is not easy to design an effective monitoring system that provides data useful to the definition of reliable EnPIs.

Fig. 5 summarizes the results of the survey about the items that are disregarded by the certification bodies. We can see how the elements actually considered critical by companies and consultants (EnPIs, monitoring and baseline) are also the most frequently found not in compliance with the ISO 50001 requirements.

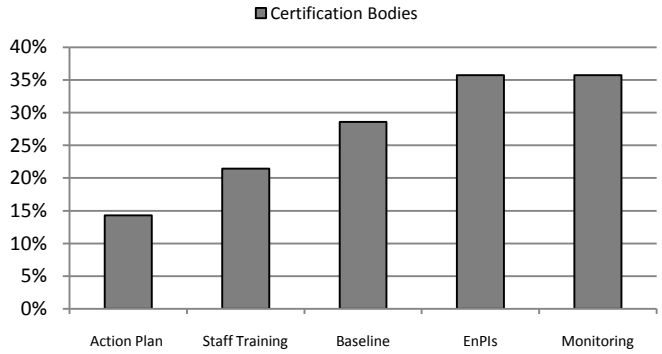

Fig. 5. Most disregarded elements of an EnMS identified by the certification bodies.

3.3. Energy savings

Another interesting aspects of the survey was to provide a quantitative estimate of the energy savings (in terms of cumulative saving) obtained by the companies through the implementation of an EnMS.

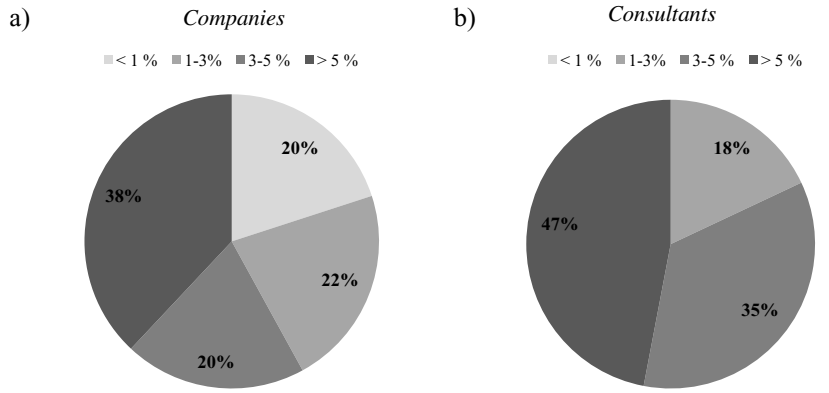

Fig. 6. Cumulative energy savings obtained with an EnMS - Points of view of companies (a) and consultants (b).

From the results shown in Fig. 6 it can be seen how, despite the relatively short periods of implementation of an EnMS, the highest percentage of respondents has achieved energy savings of over 5% (respectively 38% of businesses and 47% consultants).

4. Conclusions

According to the Italian government, the energy-intensive companies in 2013 were 2.922. When comparing this company population to the ISO 50001 certifications (seeFig. 2), it is easy to conclude that the development margins are enormous.

As for the main barriers to the diffusion of proper energy management strategy, the primary cause identified is the lack of awareness by companies not yet certified of the real potential of an EnMS, whose benefits in terms of energy savings have been highlighted by the survey results.

Other items found during the survey are the difficulty of synergy between the stakeholders and the lack of specific incentive mechanisms (from this point of view the "white certificates" are a valuable tool to support energy efficiency measures, but they are not sufficient).

Furthermore, it is important to create a clear picture of guidelines to facilitate understanding and avoid possible elements of ambiguity (e.g. energy audits currently are regulated by three different standards: ISO 50002: 2014, UNI CEI EN 16247 and UNI CEI TR 11428 with value respectively international, European and national).

By focusing on specific technical issues related to an EnMS, the survey has demonstrated the difficulty to identify an adequate monitoring systems necessary to have a full awareness of the actual dynamics of the industrial systems and the definition of correct EnPIs, given the criticality in the identification of correlations between energy consumption and indipendent variables of different nature (e.g. process, maintenance and environmental parameters).This last aspect is an interesting area for the research activity [21].

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Biography

Fabrizio Bonacina is a PhD candidate in Industrial and Management Engineering, at Department of Mechanical and Aerospace Engineering, Sapienza University of Rome, since November 2014. His research activity mainly focuses on energy efficiency in industrial processes and the definition of Key Performance Indicators (KPIs).