Implementing the ISO 50001 System: A Critical Review

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Abstract Published in 2011, the ISO 50001 system on energy management has since become one of the fastest-growing ISO management standards. However, its efficacy, implementation and integration within enterprises have been overlooked in the literature. The aim of this chapter is to analyze the relevance of the ISO 50001 standard to reducing energy consumption, and identify its limitations, advantages, and possible weaknesses. Based on a review of the existing literature on ISO management standards and energy management, it appears that ISO 50001 has inherited advantages and limitations similar to other ISO management systems. This chapter can help researchers and managers to analyze the expected outcomes and success factors of ISO 50001. It also sheds more light on its impact on existing energy-related policies.

Keywords Energy management · ISO 50001 · Energy conservation · Energy management system · Environmental management system

1 Introduction

According to the International Energy Agency, the overall augmentation of energy demand in the next 25 years might reach as high as 37% (IEA 2014). This rise has motivated many countries to implement incentives, or to mandate market-based certification programs for energy management (Du Plessis 2015). These initiatives are assumed to improve organizational greening and to reduce CO_2 emissions (Siciliano et al. 2015).

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One of the main certifiable tools in this area is the international standard for energy management systems (EnMS), ISO 50001. Published in 2011, this standard has since become one of the fastest-growing ISO management standard, with 6778 certificates issued by March, 2014 (ISO 2014). It "enables organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption" (ISO 2011: v). Although a few empirical studies have demonstrated the overall satisfaction of certified organizations with the standard's principles and its economic benefits (Ates and Durakbasa 2012; Gopalakrishnan et al. 2014; Therkelsen et al. 2013), the ISO 50001 system has been under-studied from a critical perspective.

ISO 50001 is frequently implemented alongside the existing environmental (ISO 14001) and quality (ISO 9001) management systems which are based on similar principles (Ates and Durakbasa 2012; Karcher and Jochem 2015; Wulandari et al. 2015). While various aspects of ISO 14001 and ISO 9001 have been found to positively influence operations and management of certified companies (Prajogo et al. 2012; Beattie 1999; Lo et al. 2009; King and Lenox 2009), certain scholars have raised concerns about the duration of these benefits and the very nature of the reasoning behind certification (Rondinelli and Vastag 2000; Christmann and Taylor 2011; Boiral 2007). Many studies point to various limitations and drawbacks related to the Plan-Do-Check-Act (PDCA) and formulaic approach that underlies the ISO management systems, including ISO 50001 (e.g. Castka and Corbett 2015; Yin and Schmeidler 2009; Boiral 2011; Jiang and Bansal 2003; Balzarova and Castka 2008).

These debates about ISO management systems raise questions on the added value of ISO 50001. The objective of this chapter is to analyze the relevance of ISO 50001 to reducing energy consumption, and identify its limitations and advantages. The existing literature on this standard is fairly scarce and consists of only a few articles. In order to back up our discussion with relevant facts, the principles of ISO 50001 were systematically compared with those of ISO 14001 and ISO 9001. Then, the applicability of the concerns related to environmental and quality management systems to ISO 50001 was assessed and analyzed.

The rest of the chapter is organized as follows. First, we review different approaches to energy conservation and explore the evolution of this concept. Second, we identify and explain the fundamental tenets of ISO 50001. Third, we provide a detailed comparison of three management norms. Finally, we proceed to the identification and further exploration of how empirical studies of ISO 14001/9001 can be relevant to ISO 50001. The chapter concludes by suggesting a number of possibilities for future research, together with managerial and policy implications.

2 The Principles of ISO 50001

2.1 The Development of Energy Management Practices

Over the last few years, organizations have prioritized one-time cutting and fast transformations in order to decrease their energy consumption. Since the late 70s, managers have reduced the power intake by implementing practically effortless, and low-cost solutions such as turning off unnecessary lights and adjusting air conditioning (i.e. Lambert and Stock 1979; Palm 2009; Introna et al. 2014). The same tendency can be observed with regards to other environmental issues, for example, water conservation (closing tap) or waste management (plastic recycling). Such measures do not require the construction of any system, and can be implemented in any organization, frequently without additional capital investment.

Contrary to this, rather straightforward, approach to energy conservation, some scholars have proposed the concept of "energy management", which "involves monitoring, measuring, recording, analyzing, critically examining, controlling and redirecting energy and material flows through systems so that the least amount of power is expended to achieve worthwhile aims" (O'Callaghan and Probert 1977, p. 128). Although the existing literature does not provide a single definition of energy management (Testa and Vigolo 2015), most of them imply analysis, reporting, and action, all of which together lead to continuous improvement (i.e. Abdelaziz et al. 2011; Capehart et al. 2012), which means that a certain systematic approach is required.

While environmental pressures are increasing, no study has reported a change in the preferences of enterprises to energy conservation. In fact, at the emergence of energy management concept, certain organizations had already attempted to integrate a profound EnMS into their activities. For example, McClelland and Cook (1980) looked at the case of a university in the USA where the administration began the energy-reduction program with quick-fixing measures, gradually advancing it by implementing more sophisticated solutions: energy supervisors, regular check-ups, sensitization of students. Although many organizations still use one-time fixing measures (Introna et al. 2014), more and more organizations adopt systematic approaches, particularly the ISO 50001 system, which has been adopted by almost 12,000 enterprises (ISO 2015a, b, c).

2.2 The ISO 50001 Management System

Analogously to ISO 14001 and ISO 9001, the ISO 50001 energy management standard does not differentiate between organizations with diverse geographical, cultural or social conditions. The criteria for energy assessment form the logic

behind the norm and include multiple aspects, the most important of which are: the origin of the current energy consumption; analysis of collected data; setting the energy baseline and performance indicators; establishing objectives for reducing the power intake; documentation control; and continuous improvement.

Figure 1 illustrates the main principles of the ISO 50001 system. These principles are integrated within the PDCA cycle which is also in the heart of ISO 9001 and ISO 14001. In fact, implied steps are almost identical to those suggested by other management standards. The main difference lies in the introduction of so-called "energy baseline" and "energy objectives" in the "Plan" stage of the implementation process. In case of the energy management norm, power reduction actions are chosen based on these two calculations, and therefore a certain definite improvement has to be continuously achieved.

As for the "Do", "Check" and "Act" parts of the system, they are based on principles similar to those of other ISO management systems: top management commitment, appointment of an energy management representative, establishing energy policy, setting an energy baseline, fixing energy objectives and targets, ensuring employee awareness and providing workers with necessary trainings, and, finally, procuring continuous improvement. In fact, official texts of ISO 50001:2011, ISO 9001:2015 and ISO 14001:2015 do not differ significantly (see "Appendix"). The relevance of the above mentioned key practices has been widely covered in the literature on ISO management systems and is summarized in Table 1. Where possible, papers exploring energy-related issues are inserted as reference. Otherwise, relevant studies on quality and environmental management standards related to the practices mentioned are indicated.

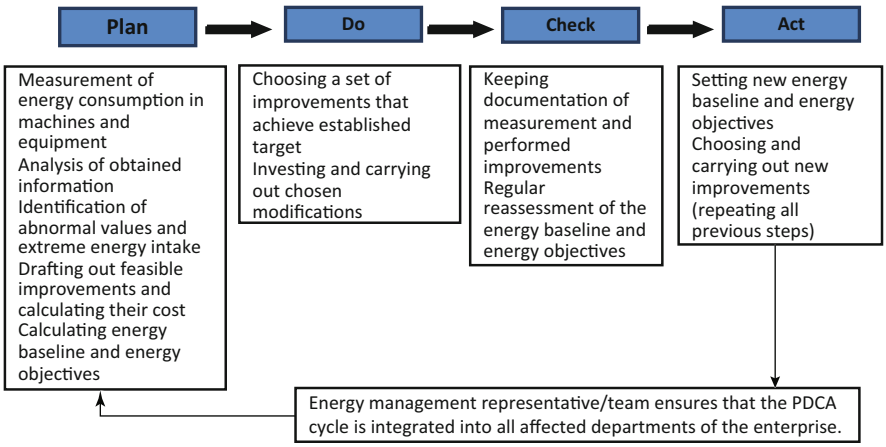

Fig. 1 PDCA cycle of ISO 50001. *Source* Developed by authors based on the official text of ISO 50001:2011

Table 1 ISO 50001 principles and evidence from the literature

ISO 50001:2011 principles	Evidence from the literature	Authors
1. Top management commitment (p. 5)	There are three levels of top management commitment to corporate social responsibility: minimum legal compliance; enlightened self-interest; pro-active change	Stahl and Grigsby (1997)
	Top management commitment has a significant positive effect on productivity	Rodgers and Hunter (1991), Switzer et al. (1999)
	Although the link is weak, organizations conform better to the environmental standards when top management is more committed to them	Chung et al. (2005)
	Management commitment indirectly influences environmental behavior at work	Fernández-Muñiz et al. (2012)
2. Energy management representative(s) (p. 6)	Appointment of energy management representatives is an efficient way to reduce energy consumption	McClelland and Cook (1980)
	Management representative contributes significantly to the long-term total quality goals of the company	Lo and Sculli (1998)
3. Energy policy (p. 6)	The depth of policy reflects the degree of environmental management system success	Chung et al. (2005)
	Environmental policy is the core of environmental management system	Darnall and Kim (2012)
4. Energy baseline (p. 7)	It is essential to estimate the baseline of current energy use in order to set targets for energy reduction	McClelland and Cook (1980)
	The success of the restoration ecology can only be assessed by having in mind the exact starting point	Hobbs and Harris (2001)
	Greenhouse gas emissions baselines helps to assess the reduction potential	Ådahl et al. (2004)
5. Energy objectives and targets (p. 8)	The notion of monitoring and targeting has first been suggested to conserve energy in the British sheet board, paper and textile industry	Gotel (1989)
	The effectiveness of goal-setting for achieving energy efficiency is beyond controversy	Harris (1989)
	Various software for energy management integrate the principle of creating objectives	Hooke et al. (2003)
6. Employee awareness and training (p. 8)	Transforming energy-using behaviors is one of the ways to save energy	McClelland and Cook (1980)

(continued)

Table 1 (continued)

ISO 50001:2011 principles	Evidence from the literature	Authors
	Human errors influence power plant environments, and their correction can lead to significant decrease in energy consumption	Worledge (1992)
	The long-term competitive advantage can only be achieved by investing in training of employees	Yiu and Saner (2005)
	Training increases the awareness of environmental issues, and helps organizations to achieve its "greening" goals	Sammalisto and Brorson (2008)
7. Documentation control (p. 9)	Efficient documentation control makes the established procedures more accessible and available for employees	Epstein and Roy (1997)
	Systematic verification of policies improves the overall quality of documentation and makes environmental management "system dependent" rather than "person dependent"	Morrow and Rondinelli (2002)
	The success of the environmental management system depends on many factors, one of which is documentation control	Sambasivan and Fei (2008)
8. Continuous improvement (p. 12)	Continuous improvement is vital to the survival of enterprises	Kaye and Dyason (1995)
	Efficient quality management cannot be achieved with "quick fixes" and requires a particular focus on continuous improvement	Kanji and Asher (1996)
	Only by integrating the continuous improvement framework can organizations adapt quickly to changes	Kaye and Anderson (1999)
	Companies following continuous approach for quality management achieve greater results	Terziovski and Power (2007)

2.3 Implementation and Outcomes of the Standard

The outcomes of ISO 50001 have been investigated in few recent case studies. According to Gordić et al. (2010), the implementation of the standard resulted in approximately 25% reduction in energy consumption within a Serbian car manufacturer. Similarly, Majernik et al. (2015) verified the effectiveness of ISO 50001 within a car supplier, and confirmed a significant positive change. Imel et al. (2015) has also reported a significant decrease (39%) in energy use within a county in

Florida that integrated multiple principles of the norm into its daily operations. However, this transition might be seen challenging for some companies. Generally speaking, the benefits of any environmental management system—whether it is general, like ISO 14001, or more specific, like ISO 50001—are not automatic and straightforward but rather depend on the implementation process (Yin and Schmeidler 2009; Boiral 2011; Jiang and Bansal 2003). This process has been the object of few studies focused on ISO 50001.

For instance, Antunes et al. (2014) propose an Energy Management Maturity Model to guide enterprises in the implementation of ISO 50001. The paper illustrates the integration of the norm through a five-level process, with specific activities applicable to every level. Authors have also investigated common challenges related to these activities, so that managers could attempt avoiding them. The recent paper of Jovanović and Filipović (2016) suggests a different maturity model, and authors claim to have tested suggested levels within certified and non-certified organizations. Other scholars (Lee et al. 2014) developed a so-called six-sigma approach which, similar to Antunes et al. (2014), is also based on five principal steps: define, measure, analyze, improve and control. The article provides several recommendations and a list of most energy-consuming appliances in the manufacturing industry. It is argued that this six-sigma approach can be successfully used "as part of the ISO 50001 implementation" (Lee et al. 2014: 23). Besides that, there have been some attempts to technologically modernize this process, and to introduce special software that would facilitate the implementation of the norm. Gopalakrishnan et al. (2014) suggested a computer program that allows small and medium-sized enterprises to find non-conformities by answering a list of questions related to ISO 50001. Tarasovskii and Petukhov (2014) made a review of existing automated solutions for metal-processing industry, and put forward some ideas of how the time spent by energy managers on paper-work and on the construction of tables and figures can be significantly decreased.

Introna et al. (2014) proposed an energy management maturity model based on five dimensions: knowledge, methodological approach, information system, organizational structure, and strategy. These dimensions are evaluated on the scale of five levels: initial, occasional, planning, managerial, and optimal. For example, there is little benefit in installing a complex computerized measuring program without raising employees' basic understanding of energy management goals. Introna et al. (2014) argue that it is impossible to "introduce advanced management activities before adopting some elementary ones" (p. 115). Whilst the suggested model can help companies to upgrade their energy practices in compliance with ISO 50001, the advantages and limitations of such an advancement remain unclear. Indeed, why should companies consider implementing energy management standard, if its added value to existing environmental management system established by ISO 14001 or other similar norms seems rather dubious?

3 Implementing ISO Management Systems: Lessons from Practice

3.1 Selection of Articles

The critical analysis of the ISO 50001 system was based on two sources: the empirical literature on the ISO management systems and a few specific studies on ISO 50001.

Although the literature on ISO 50001 is relatively scarce, the advantages and limitations of ISO management systems have been the object of many studies (e.g. King and Lenox 2009; Poksinska et al. 2003; Boiral and Roy 2007; Balzarova and Castka 2008). In order to choose the most relevant empirical studies on ISO management systems that could shed more light on the ISO 50001 system, the monograph of Castka and Corbett (2015) was used. This work of more than 200 pages provides the most extensive review of the literature on such management systems as ISO 9001, ISO 14001 as well as on other voluntary standards. Authors initially selected 2836 articles which contained a wide range of keywords [e.g. "ISO 9000 (including ISO 9001 and other variations), ISO 14000, ISO 26000, management standard, process standard" (Castka and Corbett 2015: 177)], and subsequently chose several hundred papers for the analysis by applying specific inclusion and exclusion criteria. As the creators of the monograph were not constrained by the number of pages, this overview provides precise and complete information on every selected study.

However, the work of Castka and Corbett (2015) included only those articles that were published before 2014, which means that only a couple of manuscripts on ISO 50001 were reviewed by the authors. For this reason, we launched multiple searches in ABI/Inform, Business Source, IBSS and Web of Science databases, and found a dozen pertinent studies on ISO 50001. In the selection of these articles, we firstly chose papers that mentioned ISO 50001 or Energy Management at least once, and then reviewed their abstracts. Only studies that specifically explored the decision for adopting the standard, the EnMS design, implementation process, follow-up procedures, issues related to auditing or certification outcomes were ultimately retained.

Having reviewed these papers, a table containing arguments about ISO 9001 and ISO 14001 that are directly applicable to ISO 50001 was created (Table 2). The analysis provided by this table is based on the fact that, as it has been underlined in the scholarly literature (e.g. Heras-Saizarbitoria and Boiral; Boiral et al. 2017), the core idea, implementation and audit processes for above-mentioned ISO standards are almost identical.

Therefore, due to a high degree of resemblance between the official texts of ISO 50001 and other management standards (for additional information on this comparison, please refer to "Appendix"), the conclusions of Castka and Corbett (2015) are relevant to shed more light on the possible outcomes of ISO 50001. The Table regrouped the advantages and limitations of ISO 50001 into the four steps of

Table 2 Applicability of the literature on ISO 9001/ISO 14001 to ISO 50001

	Main findings of the literature	Applicability to ISO 50001 and managerial implications
Certification decision	Internal motivations lead to better internalization of management standards. As a consequence, environmental performance of enterprises is ameliorated. (Prajogo et al. 2012; González-Benito and González-Benito 2005; Boiral and Roy 2007; Terziovski and Power 2007; Naveh and Marcus 2005)	The resemblance of standards makes it possible to suggest that internalization of ISO 50001 might be greater when motivation for the certification originates inside the organization. It might also result in better energy conservation. Therefore, environmental managers of companies are encouraged to prepare the organization to the installation of energy management system by explaining its importance and the multitude of advantages
	Higher motivation for management standards leads to better financial results (Martínez-Costa et al. 2008; Montalván and Chang 2006; Jacobs et al. 2010; Lo et al. 2012; Nicolau and Sellers 2002)	Implementing ISO 50001 leads to increased income. Companies that participated in the survey of Therkelsen and McKane (2013) saved on average 503,000$ in less than 2 years. In our opinion, enterprises with significant energy consumption might find this figure motivating, which will result in a more in-depth integration of the standard
	Adoption of management standards leads to organizational learning. As a consequence, implementation of the second or third norm, based on the same documentation (e.g. ISO 9001 and ISO 14001) occurs more rapidly (Karapetrovic and Casadesús 2009). Also, the adoption of one management standard in many cases predicts the willingness of companies to integrate other ones (King and Lenox 2009)	EnMS is usually built on already existing management structures (Karcher and Jochem 2015; Wulandari et al. 2015). Hence, the adoption of ISO 14001 might encourage and facilitate the implementation of ISO 50001. In fact, we argue that companies that have already been certified with ISO 14001 might find the energy management standard redundant. Considering the similarity between these norms, it seems reasonable for enterprises to integrate energy-related issues inside previously created ISO 14001 system
	In organizations driven by external pressures, the certification process tends to be shaped by the degree-purchasing syndrome (Boiral 2012)	External pressures for the adoption of ISO 50001 tend to encourage a symbolic adoption of the standard and the search for certification as an end in itself. It is recommended that companies adjust their certification-acquiring process according to its proper motivations.

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Table 2 (continued)

	Main findings of the literature	Applicability to ISO 50001 and managerial implications
		The degree of implementation, the involvement and training of employees, the purchase of energy saving equipment, precision in measuring energy intake—the degree of integrating all these aspects should be carefully considered in relation to companies' willingness, and to external pressures
System design	Management standards should be customized to the needs of a particular company in order to be integrated efficiently (Peter 1995; Naveh and Marcus 2005). Motivations for acquiring management certifications should determine the procedures and documentation, not vice versa (Bénézech et al. 2001)	According to some scholars (e.g. Westphal et al. 1997; Attewell 1992), the process of standard's optimization is best managed by trained employees of the organization, and not by external consultants. Externalization of these processes might make the implementation more burdensome, and less effective. It might be pertinent for EnMS managers to consider forming a system-customization team, in order to better integrate it within the company
	In many instances companies decide themselves what to make of standards (Boiral 2011)	Managers might attempt to integrate the principles of ISO 50001 into the existing management system, with the purpose to reduce administrative procedures and paperwork. However, such adjustments should be carried out with caution, and should not have a negative effect on the efficiency of the system
Implementation	ISO management systems can be considered as a tool to transfer individual and collective knowledge (Bénézech et al. 2001; Boiral 2011)	ISO 50001 can facilitate knowledge transfer on energy management: documents are created to organize and manage the existing and evolving information more efficiently. However, managers are encouraged to minimize the amount of unnecessary paperwork by merging similar or identical procedures in case of several management systems (e.g. quality and environmental ones)
	The proper adoption of management standards depend on employees	As it is the case with all management systems, the involvement of

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Table 2 (continued)

	Main findings of the literature	Applicability to ISO 50001 and managerial implications
	(Darnall and Kim 2012; Balzarova et al. 2006) and managers (Van der Wiele et al. 2009; Boiral 2003, 2011; Poksinska 2007). Their greater involvement lead to more profound implementation of norms' principles (Fuentes et al. 2003; Poksinska 2007; Boiral 2003)	employees is the key to a successful implementation of ISO 50001. Managers should contemplate various types of employees' involvement: launching specific initiatives, encouraging workers' endeavors, introducing new policies addressing in-role energy reducing activities (for example for operators working with high energy-consuming equipment), favoring voluntary behaviors (turning off lights, adjusting air-conditioning, reducing phantom energy, etc.)
	ISO management systems are certified on average within 12 months (Singh et al. 2006)	A study by Karcher and Jochem (2015) indicates that 59% of companies aim to be certified with ISO 50001 within 6 months. This is achieved with a maximum delay of half a month. However, companies should bear in mind that rapid adoption of the standard might diminish its positive outcomes
Audit process	Companies certified with ISO 14001 by reputed registrars comply better to environmental policy statements (Fryxell et al. 2004). Some enterprises choose better-known auditors as they tend to give more attention to details, which might lead to additional improvements in the future (Castka et al. 2015). Effectiveness of auditors varies (Gyani 2008; Lafuente et al. 2010), and even the interpretation of such terms as continuous improvement is subject to debate (Burdick 2001; Ammenberg et al. 2001). While some registrars primarily conduct audits "for compliance", others perform audits "for continuous improvement" (Poksinska et al. 2006; Power and Terziovski 2007)	The auditing process of ISO 14001 and ISO 50001 is similar. Companies willing to adopt energy management standard should consider the reputation of the audit-performing registrar. Reputed agencies might pay more attention to specific details that could eventually be fixed and bring additional benefit to the whole management system. Managers should also understand in advance whether they seek for certification with the sole purpose of "having it" or with the desire to improve their processes
	In some instances, auditors might be influenced by the remuneration system, and their judgments might not be accurate (Dogui et al. 2014).	While it is difficult to minimize the effect of the remuneration system on the external verification, companies undergoing ISO 50001 certification

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Table 2 (continued)

	Main findings of the literature	Applicability to ISO 50001 and managerial implications
	This conflict of interest leads to procedural, rather than substantial, audits (Heras-Saizarbitoria et al. 2013)	might provide comfortable conditions for auditors in order to ensure unbiased certification. These include, and are not limited to: rapid and easy access to documents and employees; reduction of audit-related pressures by avoiding conversations on such topics as time, payment, and involved resources; presentation of the situation "as is", without artificial enhancement
	Sometimes, lines between consulting and auditing get blurry (Terziovski and Power 2007)	Managers responsible for the EnMS should have a clear understanding of the difference between consultants and auditors. While the first ones assist companies in integrating the norm, the latter ones are responsible for verifying it. If necessary, incompliances might be eliminated in the aftermath of the audit, with or without the help of consultants
Follow-up	Firms certified with ISO 14000 are more likely to assess their suppliers' environmental performance and to set certain criteria (Arimura et al. 2011)	According to ISO 50001, companies should evaluate energy consumption of purchased equipment and machines, and provide suppliers with criteria for their selection. The standard recommends these steps only for purchases that can potentially significantly influence energy consumption. In our opinion, managers should not forget about multiple equipment that require low energy intake, but once their impact is accumulated, the consumption might be high: bulbs, air conditioners, computers, printers, etc.
	The fact of having a certification does not guarantee continuous improvement of processes and systems (Granerud and Rocha 2011; Boiral 2003; Heras-Saizarbitoria et al. 2013)	Managers of companies willing to obtain ISO 50001, should not rely solely on the audit decision in evaluating the success of the energy management. It is important to ensure that the system functions at all times, and not only during audits (Boiral 2011)

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Table 2 (continued)

	Main findings of the literature	Applicability to ISO 50001 and managerial implications
	The process of improvement is not over when the firm becomes certified. The presence of Environment Management System team is necessary to ensure continuous improvement (Balzarova and Castka 2008)	ISO 50001 emphasizes the importance of an energy management representative/team. Riche (2013) argues that energy consumption is an inter-department challenge. Karcher and Jochem (2015) provide empirical evidence that energy management teams include employees from various departments (mostly, production and management departments). Depending on size and structure of the enterprise, managers should form such teams accordingly, including as many employees from relevant departments as possible
Outcomes	Few companies experience no effect of management standards on productivity, cost savings, company profitability, and waste reduction (Santos et al. 2011; Lo et al. 2009; Levine and Toffel 2010; Poksinska 2007; King and Lenox 2009; Russo 2009; Darnall and Kim 2012)	Recent studies (Karcher and Jochem 2015; Therkelsen and McKane 2013; Wulandari et al. 2015) have shown that ISO 50001 has a positive financial effect. According to Therkelsen and McKane (2013), the average payback period of ISO 50001 installation is 1.7 years. Without any doubt, this can only be achieved if energy intake is decreased, and hence the negative impact on the environment is minimized. Companies should bear in mind that implementation of energy management system might not only be beneficial from the economic point of view, but might also help to optimize processes, and to construct a responsible environmental image
	Companies certified with management standards reduce their emissions more than enterprises that follow the principles of such norms, but are not certified (Alberti et al. 2000; Potoski and Prakash 2005)	Ates and Durakbasa (2012) argue that the more principles of ISO 50001 are taken into account, the better results are achieved. However, the pressure of certification audit might motivate managers to integrate the system more profoundly, and might lead to additional reduction of energy consumption

successful implementation of ISO Management Standards evidenced by Boiral (2011): certification decision, system design, implementation, follow-up. Two additional categories were added to this classification: audit process and outcomes. While audit process is linked with follow-up activities, the literature on the subject clearly distinguishes internal organizational issues related to continuous amelioration of the system (e.g., Arimura et al. 2011; Boiral 2003; Granerud and Rocha 2011), and problems linked with auditors' capabilities and expertise (e.g., Dogui et al. 2014; Heras-Saizarbitoria et al. 2013; Terziovski and Power 2007). The "outcomes" category was introduced with the purpose to compare results of adopting environment management systems, and to potentially show the limited added value of ISO 50001. Where empirical evidence exists, our suggestions about the possibility of identical advantages and limits of the energy management standard were supported by recent investigations on the norm. Several illustrative examples of the similarity in the arguments about every step of the successful implementation process are further presented and explained.

3.2 Certification Decision

The majority of researches on certification decisions are tightly linked to the nature of motivation that drives companies to proceed with the integration of management systems. When the decision to get certified stems from inside the company (as compared to external pressures) financial indicators tend to improve (Martínez-Costa et al. 2008; Montalván and Chang 2006; Jacobs et al. 2010). The same remark applies to environmental performance (Prajogo et al. 2012; González-Benito and González-Benito 2005; Boiral and Roy 2007). Drawing on these observations, it seems reasonable to assume that internal motivation for EnMS leads to better results than when such a decision is driven by external pressures, including from suppliers or the market. Boiral (2012) argues that when certification is motivated by external pressures, the standard acquisition and the preparation for the audit tend to be shaped by the degree-purchasing syndrome. That means that companies would adopt these norms ceremonially, and there is no guarantee that they will actually follow integrated principles after the certification is granted.

However, it is rare to find an organization that would adopt ISO 50001 before the implementation of more established ISO management standards, particularly ISO 9001 and ISO 14001 (Karcher and Jochem 2015; Wulandari et al. 2015). In fact, most companies use quality and environmental management systems as a base for the introduction of EnMS due to the necessity to integrate similar documentations and procedures. Moreover, Karapetrovic and Casadesús (2009) argue that the implementation of one ISO standard leads to a certain organizational learning, which facilitates the adoption of consecutive similar norms. As the average integration time for EnMS standard is 6 months (Karcher and Jochem 2015), which is significantly less than for other management standards (Singh et al. 2006), organizations seem to be already aware of various principles of ISO 50001.

This observation provides evidence for the similarity between standards, and also raises the question of whether companies should adopt ISO 50001, which we discuss further in the article.

3.3 System Design

The process of integrating specific system inside a company has been the object of several studies (Peter 1995; Naveh and Marcus 2005; Bénézech et al. 2001). These studies underline the importance of management systems' customization in order to address particular needs of firms. It is argued that the superficial implementation of ISO management systems tends to reduce their effectiveness (Peter 1995; Naveh and Marcus 2005). One can assume that the same remark applies to the adoption of ISO 50001. Previous investigations (Westphal et al. 1997; Attewell 1992) have shown that systems are better customized by internal employees rather than external consultants. Hence, the creation of a team that would be responsible for the installation of EnMS within the existing environment might help to adjust elements of the system to the specific needs of the company.

3.4 Implementation

The involvement of employees appears as the key to successful integration of management standards (Darnall and Kim 2012; Balzarova et al. 2006). Without workers' participation, most systems become ceremonial and ineffective (Yin and Schmeidler 2009; Boiral 2007; Heras-Saizarbitoria and Boiral 2013). Similar to ISO 50001, new versions of quality and environmental management system standards do not suggest clear recommendations for increasing personnel's participation in pro-environmental activities. However, besides regular employees, top managers and middle-managers are also supposed to actively take part in this process (Van der Wiele et al. 2009; Boiral 2003, 2011; Poksinska 2007). Analogously to ISO 9001 and ISO 14001, the ISO 50001 system highlights the importance of top management involvement before, during, and after the process of certification. Hence, managers responsible for the adoption of energy management system should bear in mind the importance of various activities directed at increasing employees' involvement: incentive programs, new policies for operating energy-intensive equipment, promoting voluntary endeavors, etc. Table 2 provides more information on different behaviors that could be beneficial for ISO 50001.

Another important observation in relation to the implementation of management standards is the time it takes from the certification decision, to the reception of the official proof of a successful audit. Singh et al. (2006) argue that certificates for ISO 9001 and ISO 14001 are usually received within 12 months. Interestingly, Karcher and Jochem (2015) found this figure to be almost twice as little for ISO 50001.

Around 60% of companies that took part in their survey got certified within a maximum of 7 months. This decreased time confirms the existence of the organizational learning, which can also raise the question of the added value of the EnMS standard.

3.5 Audit Process

It should be noted that the auditing processes for ISO 14001/9001 and ISO 50001 are essentially the same. Auditors of different standards usually represent the same company, and sometimes are trained to verify compliance to multiple norms. However, scholars have questioned for years the interpretation of certain terms by auditors. For example, Burdick (2001) and Ammenberg et al. (2001) raised concerns about how the notion of "continuous improvement" is understood by external inspectors. That is why some articles question the very nature of audits: "for continuous improvement" or "for compliance" (Poksinska et al. 2006; Power and Terziovski 2007).

Another issue lays in the way auditing firms are chosen and remunerated by organizations. Audit companies usually bill their clients on hourly basis (Dickins et al. 2008; Leventis et al. 2005), and, hence, companies expect auditors to perform their duties in the shortest time frames. This might lead to skewed judgments (Dogui et al. 2014), and to procedural audits without substantial logic (Heras-Saizarbitoria et al. 2013). Not only are such issues certainly present in case of ISO 50001, they might also be even worse because of the peculiarity of ISO 50001. Indeed, the integration of EnMS implies multiple measures that auditors might not be aware of, or might not be capable to estimate accurately in a short period of time and under pressure from the organization undergoing certification. In fact, a few published articles discuss the difficulty of proper energy intake evaluation in industrial processes (Giacone and Mancò 2012), the lack of energy data for some organization types (Dzene et al. 2015), and even the necessity to take into account such highly volatile variables as weather conditions and production levels (Lammers et al. 2011).

3.6 Follow-Up

ISO management standards are based on the idea of continuous improvement, which does not happen "automatically" after certification (Granerud and Rocha 2011; Boiral 2003; Heras-Saizarbitoria et al. 2013). Yet, some companies might consider that once certified, the system should work without additional efforts. The continuous adjustments and modifications are required at all times, and not just at the moments of audits in order for such systems to work (Boiral 2011). To ensure such improvements, Balzarova and Castka (2008) emphasize the importance of an

environmental management team. ISO 50001 also states that energy management team is required for further enhancement of the installed system. Moreover, some scholars have pointed to the necessity of insuring its inter-departmental nature (Riche 2013; Karcher and Jochem 2015). When employees from different departments are united for solving energy-related issues, they produce more efficient results (Riche 2013). Yet, Karcher and Jochem (2015) provide support that most companies compose energy management teams of workers from production and management departments only. We argue that managers of EnMS project should create such teams depending on such factors as size and structure of the enterprise. Perhaps, representatives of those departments that have the most influence on energy consumption should be invited, in order to provide ground for an efficient dialogue and to avoid cumbersome meeting for employees from irrelevant departments.

3.7 Outcomes

Most studies on ISO management systems' outcomes mention the positive effects of their implementation, including in terms of productivity, cost savings, company profitability, and waste reduction (Santos et al. 2011; Lo et al. 2009; Levine and Toffel 2010; Poksinska 2007; King and Lenox 2009; Russo 2009; Darnall and Kim 2012). The same remark seems to apply to ISO 50001. Recent studies (Karcher and Jochem 2015; Therkelsen and McKane 2013; Wulandari et al. 2015) provide evidence of reduced operating costs and energy intake. It might also be suggested that EnMS has a positive effect on productivity and company's global environmental image, although this point has not been supported by empirical studies. Another series of studies compares outcomes of certified companies with those of firms that attempt to follow principles of the standards, but prefer not to get certification (Alberti et al. 2000; Potoski and Prakash 2005). These articles argue that companies that underwent external audits generally reduce their emissions and environmental footprint more significantly than their non-certified counterparts. The same effect can be expected with ISO 50001, although further research is needed to confirm or deny this hypothesis.

3.8 The Relevance of Adopting ISO 50001

The similarity between the most widespread environmental management standard, ISO 14001, and ISO 50001 (see "Appendix" for the comparison), as well as multiple common advantages and disadvantages described in the sub-sections above tend to question the relevance of implementing this EnMS. Indeed, why cannot enterprises simply adjust their environmental system to take into account energy consumption, without having the pressure of being audited, and without

introducing a whole set of new documentation? Furthermore, as underlined by Zobel (2008), energy, as an environmental aspect, is already included in the scope of the EMSs.

This question seems all the more important that ISO 50001 does not even emphasize the use of renewable energy (Laskurain et al. 2015), which would to some degree justify the necessity of energy standard. Recent research on the renewable energy sources with ISO 50001 certified companies (Laskurain et al. 2015) demonstrated that most benefits can be observed only in those organizations that go beyond the norm's requirements. Considering the fact that the use of alternative energy has been widely supported by the academia (Kaygusuz 2007; Kaygusuz et al. 2007; Sovacool 2009), this observation is an important omission of the norm.

Furthermore, Johnson et al. (2013) conducted a comparison analysis between the Ship Energy Efficiency Management Plan—the standard usually used in the shipment industry—and ISO 50001. After the analysis of two standards, authors found that the EnMS standard appears to be more exhaustive: it includes all the requirements suggested in the maritime document, and recommends additional amelioration. Yet, according to our study, enterprises might achieve the same results by integrating energy aspect in their ISO 14001 system. Managers would simply need to regularly measure the use of energy in the company, in order to ensure constant decrease. As explained previously, ISO 50001 prescribes enterprises to introduce so-called energy review and energy baseline in order to have verifiable statistics on the energy consumption. While the calculation of these data might lead to more quantifiable results and control, it should result in increased amount of documentation. Although interviewees of the recent study conducted by Laskurain et al. (forthcoming) seem to state that "the paperwork load is greater in the case of ISO 14001 than ISO 50001" (p. 13), the number of documents related to various management standards will certainly increase.

It is also worth saying that no standard can cover every aspect of all industries. Some enterprises will always try to either develop their own, more strict, requirements for energy management, or to establish the system of exchanging best practices and know-hows with the companies of their sector (Ates and Durakbasa 2012). However, after the conducted analysis we were puzzled by the lack of added value of the standard, and perhaps further researches could shed more light on this important issue.

4 Conclusions and Implications

The aim of this chapter was to analyze the proposals and added value of ISO 50001 and the existing literature on the subject of energy management. The principles of the EnMS standard were compared with such wide-spread international norms as ISO 14001 and ISO 9001, and it was found that they have numerous points in

common: the composition of the energy policy, objectives, training and awareness, control of records and internal audit.

The monograph of Castka and Corbett (2015) that provides an extensive review of articles on various management standards was used for the critical analysis. The applicability of this review to ISO 50001 was assessed, and managerial implications were suggested. Several recent empirical papers found during the review of the literature on the EnMS standard were used in this process. More specifically, they made it possible to compare some findings on ISO 50001 with those on ISO 9001/14001 and revealed the absence of significant differences. Many of the findings on quality and environmental management standards might be directly applicable to the energy management norm. Despite our attempts to find advantages and limitations related exclusively to ISO 50001, only a couple of studies found standard-specific limitations. One study compared this norm with regulations in the energy domain, and the other discussed the omission of renewable energies in the standard. These research studies raise more doubts about the usefulness of ISO 50001, as it seems to bring little value to existing environmental management standards, particularly the ISO 14001 system.

4.1 Theoretical Contributions

This chapter provides an up-to-date review of research on the ISO 50001 energy management standard. The majority of these studies considered ISO 50001 to be an example of good practice (Jovanović and Filipović 2016; Antunes et al. 2014; Lee et al. 2014) but did not critically assess the value of the norm in comparison to existing international norms. Our analysis highlights the limited value of introducing ISO 50001 into companies already certified with ISO 14001. It has been hypothesized that common pitfalls of introducing widespread quality or environmental management standards will also be found in the case of ISO 50001. This chapter finds evidence that confirms this suggestion by comparing the results from the literature on ISO 9001, ISO 14001 and ISO 50001. Also, some studies point to the absence or oversimplification of energy-specific features in the standard: renewable aspects (Laskurain et al. 2015), availability of energy data (Dzene et al. 2015), and the need for technical expertise (Karcher and Jochem 2015). All these doubts reinforce our conclusion on the dubious benefits of adopting this standard.

4.2 Practical Implications

Managers interested in energy management should reassess the actual need of their companies with regards to ISO 50001, and attempt to integrate energy aspects in more recognized ISO management systems, particularly ISO 14001. If a company does not have a management system, we would advise it to consider introducing

ISO 14001, as it will potentially take into consideration a larger variety of environmental issues, rather than a specific energy-related standard. However, based on the literature, it is possible to provide a set of recommendations for companies that undergo EnMS certification, and these are set out in Table 2.

This chapter has also practical implications for public authorities. Given the uncertain added value of ISO 50001, the introduction of incentive-based schemes to encourage companies to green their energy-related operations, as has been done in Germany (ISO 2014), seems questionable. While these financial support programs certainly increase the number of certified companies, we doubt they have a significant positive impact on energy performance, although some studies (e.g. Stenqviest and Nilsson 2012) suggest they do. More attention should be paid to directing companies towards substantial rather than ceremonial implementation of existing environmental norms.

Also, considering two standard-specific limits of ISO 50001 (measuring energy consumption and omitted emphasis on the use of renewable energy), our research urges policy-makers to make additional efforts to develop a trustworthy methodology for measuring energy use independent of such volatile conditions as weather or production levels, and to ensure that such important aspects as renewable energy occupy central place in the policy. Ensuring these two points would bring some added value to future versions of ISO 50001, and might have a much bigger impact on the improvement of energy performance of certified enterprises.

4.3 Limitations and Future Research

At the time of writing the present chapter, relatively few papers exploring ISO 50001 were found. The comparatively recent date of the norm's publication and the lack of literature on the question made it challenging to critically assess various aspects of the standard's implementation and operation. It would be interesting to repeat the analysis at a later date, including new articles, that will, without doubt, appear in the next few years. It might reveal other dubious points of the norm for companies that contemplate getting certified with ISO 50001.

This chapter suggests the irrelevance of ISO 50001 for companies that are already certified with ISO 14001, but this proposition is made solely on a theoretical basis. It would be extremely important for future research to test the added value of the EnMS standard for other environmental systems. Many angles can be taken into account in such research: an employee perspective, the actual ecological footprint of enterprises, managers' involvement in two environmentally-related standards, and the priorities of the company when similar management systems are being installed. Combining qualitative and quantitative methodologies might help to shed more light on the usefulness of ISO 50001.

Another crucial aspect that needs to be addressed is the preparedness of auditors to verify companies' compliance with the energy management standard. As explained in the chapter, the standard requires some technical knowledge, skills,

tools and equipment to carry out a proper certification audit. The lack of these might lead to the increase in certified companies that do not actually comply with the standard's principles. More extensive research is needed to answer this important question with certainty.

Appendix

Explanations on the table:
This table includes the comparison of ISO 50001:2011 with two international standards: ISO 9001:2015 and ISO 14001:2015. That is why the column "ISO 50001:2011" is the center of this table: it can be viewed from that column to the left (with the purpose to view the comparison of the energy management standard with the quality one), as well as to the right (to compare the energy management standard with environmental one).

The sign signifies important points with certain differences in these standards.

Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
ISO 9001:2015 is more explicit about the specific requirements for the management system than ISO 50001:2011 in this section	4.3 Determining the scope of the quality management system 4.4 Quality management system and its processes	4.1 General requirements	4.3 Determining the scope of the environmental management system 4.4 Environmental management system	ISO 14001:2015 includes all general requirements of ISO 50001:2011 and has some additional ones: "organizational units, functions and physical boundaries" (p. 6); "authority and ability to exercise control" (p. 6). This scope should "be available to interested parties" (p. 7)
ISO 50001:2011 emphasizes the necessity of "appointing a management representative and approving the formation of an energy	5.1 Leadership and commitment	4.2 Management responsibility 4.2.1 Top management	5.1 Leadership and commitment	ISO 50001:2011 emphasizes the necessity of "appointing a management representative and approving the formation of an energy

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Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
management team" (p. 5). This statement is absent in ISO 9001:2015				management team" (p. 5). This statement is absent in ISO 14001:2015
	Not applicable	4.2.2 Management representative	A.5.3 Organizational roles, responsibilities and authorities	ISO 50001:2011 has more duties assigned to management representative. ISO 14001:2015 only mentions the possibility of the top management to appoint a representative, or a group of representatives to be responsible for environmental policy
No significant difference (quality policy is a more specific version of environmental policy)	5.2 Policy	4.3 Energy policy	5.2 Environmental policy	No significant difference (energy policy is a more specific version of environmental policy)
ISO 9001:2015 contains a set of specific questions designed to assist organizations in planning. ISO 50001:2011 illustrates the process of planning in a chart (p. 16)	6.2 Quality objectives and planning to achieve them	4.4 Energy planning 4.4.1 General	6.2.2 Planning actions to achieve environmental control	ISO 14001:2015 contains a set of specific questions designed to assist organizations in planning. ISO 50001:2011 illustrates the process of planning in a chart (p. 16)
	Not applicable	4.4.2 Legal requirements and other requirements	6.1.3 Compliance obligations	No significant difference

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Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
A peculiarity of ISO 50001:2011		4.4.3 Energy review		A peculiarity of ISO 50001:2011
A peculiarity of ISO 50001:2011		4.4.4 Energy baseline		A peculiarity of ISO 50001:2011
No significant difference	6.2 Quality objectives and planning to achieve them	4.4.5 Energy performance indicators	6.2.2 Planning actions to achieve environmental control	According to ISO 50001:2011, energy performance indicators have to be measurable in order to compare the results with the energy baseline. ISO 14001:2015 only requires measurable targets "if practicable" (p. 10)
No significant difference	6.2 Quality objectives and planning to achieve them	4.4.6 Energy objectives, energy targets and energy management action plans	6.2.1 Environmental objectives	No significant difference
	Not applicable	4.5 Implementation and operation 4.5.1 General	Not applicable	
No significant difference	7.2 Competence 7.3 Awareness	4.5.2 Competence, training and awareness	7.2 Competence 7.3 Awareness	No significant difference
ISO 9001:2015 includes more specifications on the communication of information regarding the management system or its results	7.4 Communication	4.5.3 Communication	7.4 Communication 7.4.1 General 7.4.2 Internal communication 7.5.3 External communication	ISO 14001:2015 includes more specifications on the communication of information regarding the management system or its results. It also emphasizes the importance of external

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Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
				communication (if necessary)
ISO 50001:2011 has more documentation requirements, as data on energy baseline, objectives and review has to be recorded	7.5 Documented information 7.5.1 General	4.5.4.1 Documentation requirements	7.5 Documented information 7.5.1 General	ISO 50001:2011 has more documentation requirements, which can be explained by the necessity to record all information about energy baseline, objectives and review
ISO 9001:2015 introduces the "control of changes" requirement for documents (p. 9). Besides that, no significant difference	7.5.2 Creating and updating 7.5.3 Control of documented information	4.5.4.2 Control of documents	7.5.2 Creating and updating 7.5.3 Control of documented information	ISO 14001:2015 introduces the "control of changes" requirement for documents (p. 13). Besides that, no significant difference
ISO 9001:2015 sets the requirement to keep documentation when planned operations are carried out in order to ensure the conformity of services to requirements (p. 10)	8.1 Operational planning and control	4.5.5 Operational control	8.1 Operational planning and control	ISO 50001:2011 sets these requirements only for those activities with "significant energy use" (p. 10). ISO 14001:2015 provides examples of controls, and emphasizes that they "can be used individually or in combination" (p. 13)
	Not applicable	4.5.6 Design	Annexes	ISO 50001:2011 requires to consider energy use in the

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Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
				planning and construction of new buildings or facilities. ISO 14001:2015 does not include explicitly such requirement, although some annexes do make special notes about buildings [A.1 (p. 18), A.4.3 (p. 21), A.6.1.2 (p. 24)]
ISO 9001:2015 provides more specifications on the information to communicate to suppliers regarding its requirements	8.4 Control of externally provided products and services 8.4.1 General 8.4.2 Type and extent of control 8.4.3 Information for external providers	4.5.7 Procurement of energy services, products, equipment and energy	8.1 Operational planning and control	No significant difference
ISO 9001:2015 leaves it at the discretion of enterprises to decide when, what and how to monitor advancement	9.1 Monitoring, measurement, analysis and evaluation 9.1.1 General	4.6.1 Monitoring, measurement and analysis	9.1 Monitoring, measurement, analysis and evaluation 9.1.1 General	ISO 14001:2015 prescribes organizations to set criteria when re-evaluation is needed, ISO 50001:2011 simply states "respond to significant deviations in energy performance" (p. 11)
	Not applicable	4.6.2 Evaluation of compliance with legal requirements and other requirements	9.1.2 Evaluation of compliance	No significant difference

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Comparison	ISO 9001:2015	ISO 50001:2011	ISO 14001:2015	Comparison
No significant difference	9.2 Internal audit	4.6.3 Internal audit of the EnMS	9.2 Internal audit 9.2.1 General 9.2.2 Internal audit programme	No significant difference
No significant difference	10.2 Nonconformity and corrective action	4.6.4 Nonconformities, correction, corrective action and preventive action	10.2 Nonconformity and corrective action	No significant difference
ISO 9001:2015 emphasizes the importance of protecting documents and their confidentiality and legitimacy	7.5.2 Creating and updating 7.5.3 Control of documented information	4.6.5 Control of records	7.5.2 Creating and updating 7.5.3 Control of documented information	ISO 14001:2015 emphasizes the importance of protecting documents, their confidentiality and legitimacy
No significant difference	9.3 Management review	Management review 4.7.1 General	9.3 Management review	No significant difference
No significant difference	9.3 Management review	4.7.2 Input to management review	9.3 Management review	No significant difference
No significant difference	9.3 Management review	4.7.3 Output from management review	9.3 Management review	No significant difference

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