

ENABLERS AND BARRIERS OF IMPLEMENTING ISO 50001- ENERGY MANAGEMENT SYSTEMS (ENMS) IN SRI LANKAN CONTEXT

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ABSTRACT

Energy is critical to organizational operations and can be a major cost to organizations. Besides the economic costs, energy crisis can impose various environmental and societal costs by reducing resources and supporting environmental problems. Especially in buildings, energy is considered as one of the main cost centres for their operations. Considering the importance of managing energy, a number of national, regional and international Energy Management Systems (EnMSs) have been developed to integrate energy efficiency into organisations' management practices while fine-tuning operating processes and improving efficiency of industrial systems. Among them, ISO 50001-EnMS, which was introduced by International Organization of Standardization (ISO) is the most popular system which has been implemented all over the world. However, literature and preliminary studies revealed that there are very few ISO-50001-EnMS applications within Sri Lanka. Hence, there is a little doubt relating to the implementation of ISO 50001-EnMS in Sri Lankan Context. Therefore, the aim of this paper is to critically review the enablers and barriers of implementing ISO 50001-EnMS in Sri Lankan context. A comprehensive literature review, desk study and a preliminary expert survey were employed in achieving the aim of the paper. The research findings identified that financial constraints; lack of experts relating to EnMSs; unawareness on the importance of applicability; complexity of documentation processes; institutional complexities and different cultural aspects as the most critical barriers while identifying the improved organizational image; well-documented energy utilization procedures; regulatory compliances and internal/external recognition and rewards as the key enablers for the implementation of ISO 50001-EnMS in Sri Lanka.

Keywords: Energy Management; ISO 50001-EnMS; Sri Lanka.

1. INTRODUCTION

Increased global warming is posing a major threat to global environment. The buildings and industries are the large emitters of carbon dioxide emissions, the major greenhouse gas, and accounting for about 78% of the world's annual coal consumption, 41% of the world's electricity use, 35% of the world's natural gas consumption, and 9% of global oil consumption. According to McKane (2007), developing countries with emerging and expanding industrial infrastructure have a particular opportunity to increase their competitiveness by applying energy efficient best practices. Meanwhile increased globalization and the opening up of domestic markets will make the implementation of cost-efficient energy efficiency measures within industry even more necessary (Rohdin *et al.*, 2006).

As explained by Hrustic *et al.*, (2011), focusing on a reducing energy end-use at the company is one of major ways to overcome this energy crisis. Energy Management System (EnMS) is such tool which supports companies in this important work. Among the available EnMSs in world, ISO 50001- energy management system (EnMS) is the most popular standard to date. Though ISO 50001 is being implemented all over the world, it has not yet been developed exclusively in Sri Lanka. Even though ISO 50001 is gaining recognition as an internationally adoptable energy management system, at present there are only a handful of ISO 50001 accredited buildings in the country (Senaweera, 2011). This implies that there may be some resistance, barrier or other reason which prevents the implementation of ISO 50001-EnMS in Sri Lanka. If such issues prevail, they may have arisen due to several unidentified causes. Hence, the adoptability of ISO 50001 in Sri Lanka is a questionable area

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that has not yet been explored. Therefore, a need was identified to explore the adoptability of ISO 50001- EnMS in the Sri Lankan context to recognize the feasible and appropriate means of achieving energy efficiency in buildings

This study therefore, aimed at finding enablers and barriers for the implementation of ISO 50001 - Energy Management through a comprehensive literature survey and unstructured expert surveys. The paper structure begins with a review on Sri Lankan energy crisis and building energy consumption followed by a literature review on identifying enablers and barriers of establishing national energy management system (EnMS) and need for implementing of ISO 50001- EnMS within the Sri Lankan context. Finally it presents the discussion of research findings together with future research agenda.

2. GLOBAL ENERGY CRISIS

Rapidly growing world energy usage has already elevated the concerns regarding supply difficulties, reduction of energy resources and major environmental impacts (Lombard *et al.*, 2008, pp. 394-398). Therefore, there is probably no severe topic more in the public concern now than energy. In the ISO Focus (2009) magazine, Edwin Piñero has highlighted the current energy crisis situation as an overriding concern in the minds of citizens, politicians, and businesses. Hence, energy touches all aspects of society and the effects of shortages can reverberate throughout economies and the daily lives of entire population.

The principal business of an industrial facility is making a profit through production of goods and services, not ensuring energy efficiency. However, the cost of energy is one of the main cost drivers for businesses and therefore, reduction in energy consumption leads to reduction in operating costs, and thereby helps to improve the profitability of organisations (Jayamaha, 2006). As explained by McKane (2007), in developing countries, the portion of the energy supply (excluding transport) required for buildings is frequently in excess of 50% and can create problems between economic development goals and a constrained energy supply. Especially in Asian countries, the absolute figure is rising fast due to construction booms and technology developments (Lombard *et al.*, 2008).

To overcome this problem and be effective, energy efficiency programmes need to be engaged in the industry at the management level as well as at the operational level. However, energy savings potential is intensely fixed in industrial operational and management practices (McKane, 2007). Therefore energy efficiency, “using less energy to provide the same service” (Lawrence Berkeley national laboratory, 2013, para.1) should be achieved as a corporate goal of the entire organisation. The process of achieving energy efficiency can be identified as the energy management that supports the three pillars of sustainability: economy, environment and society (Piñero, 2011).

3. ENERGY MANAGEMENT SYSTEMS (ENMSs)

According to the Wongtharua *et al.*, (2005), energy management can be defined as managing all kinds of energy used in an organisation by creating an optimum programme of purchasing, generating and consuming various types of energy based on overall short-term and long-term management programmes, with due consideration of costs, availability, economic factors, and so on. Furthermore, Piñero (2011) has identified well-organized tools, guidance, and resources; as the key requirements of energy management. These tools, guidance, and resources should include basic information on how to integrate energy management into the overall organisational management structure.

Energy management system standard provides guidance for industrial and commercial facilities to integrate energy efficiency into their management practices, including fine-tuning production processes and improving the energy efficiency of industrial systems (Sri Lanka Standard Institute, 2013). By identifying the importance of managing energy and the necessity of such system, the Environmental Energy Technologies Division, USA has defined well planned EnMS as an international framework for industrial, commercial, or institutional facilities, or entire companies, to manage their energy, including procurement and use. Further, many countries including Denmark (DS

2403 E:2001), Sweden (SS 627750:2003), Ireland (IS 393:2005), Korea (KSA 400:2007), Spain (UNE 216301:2007), China (GB/T 23331:2009), U.S.A. (ANSI/MSE 2000: 2000) and the European Union (EN 160001:2009) have developed national EnMSs to integrate energy efficiency into their management practices while fine-tuning operating processes and improving efficiency of industrial systems used in buildings (Senaweera, 2011).

Though there are several countries and regions that have developed and are developing various energy management standards on the international front, they have subtle variations in language, content, and approach which make them unsuitable to be applied internationally. Therefore the International Organisation of Standardization (ISO) identified energy management; as one of its the top five priorities based on its enormous potential to save energy, increase profitability, and reduce greenhouse gas (GHG) emissions worldwide (McKane, 2009) and took the initiative to fill the above requirement by developing ISO 50001-EnMS which can be globally applied.

4. ISO 50001 STANDARDS ON ENERGY MANAGEMENT SYSTEMS: AN OVERVIEW

ISO is the International Organization for Standardization. It has a membership of some 160 national standards bodies from countries large and small, industrialized, developing and in transition, in all regions of the world. ISO's portfolio of over 18 600 standards provide business, government and society with practical tools for all three dimensions of sustainable development: economic, environmental and social (International Organisation for Standardization, 2011).

ISO 50001 is an international energy management standard that provides a framework around people, information systems and technology to deliver sustained year on year energy and carbon savings. ISO 50001-EnMS requirements with direction to use, was published in June 2011. It provides a framework for industrial plants, commercial facilities or whole organizations to manage energy. In accordance with ISO, the standard could affect up to 60% of the world's energy use, with wide applicability across national economic sectors (Sri Lanka Standard Institute, 2013). This standard has developed with the partnership of ISO members for the United States (American National Standards Institute - ANSI) and Brazil (Associação Brasileira de Normas Técnicas - ABNT) under the participation of 12 observers and liaison organizations include the United Nations Industrial Development Organization (UNIDO) and the World Energy Council (WEC) (Senaweera, 2011).

ISO 50001 has been able to draw on numerous national or regional energy management standards, specifications, and regulations (International Organisation for Standardization, 2011). Noteworthy is the fact that it has provided stimulus and a framework for the development of national standards, policies, laws and regulations. This will be especially true in developing countries and emerging economies that still lack national energy management standards (McKane, 2009). Also ISO 50001 will provide organisations and companies with technical and management strategies to increase energy efficiency, reduce costs, and improve environmental performance (Sri Lanka Standard Institute, 2013). Moreover, organisations can integrate ISO 50001 with other management systems such as quality, environment, occupational health, and safety.

The Director General of Sri Lanka Standards Institute (SLSI), who are the regulatory body and member body of ISO, has the right to adopt this standard as a national standard. SLSI has planned out a series of steps to promote this standard throughout the country with the support of the Sri Lanka Sustainable Energy Authority (SLSEA). They have a wealth of experience in certifying management systems as they have certified over 500 organisations in Sri Lanka and overseas on different management systems such as ISO 9001, ISO 14001, ISO 22000, and ISO 18000 (Senaweera, 2011). SLSI has confirmed that the purpose of ISO 50001 is to enable organisations to establish necessary system and processes for enhancing the energy performance, energy efficiency and energy consumption. Furthermore this system standard helps to overcome environmental impact and cost related problems through systematic management process (Senaweera, 2011). Moreover, the standard provides various benefits such as providing significant financial savings by systematic improvement in energy efficiency, protecting against future energy price rises, supporting continual improvement,

reducing carbon and other emissions, compliance with legal and regulatory requirements, providing framework for global best practice in energy management, providing global recognition demonstrating credible green credentials, providing continuity and momentum when changes in key staff occur and easily integrating into other Management Standards such as ISO 9001, ISO 14001 and ISO 18001.

Organisations can develop and implement an energy policy, objectives, targets and action plans based on legal requirements and information of significant energy use. ISO 50001 also explains how to demonstrate competence, operational control and best practice procurement of energy services, products and equipment. This international standard is based on the Plan – Do – Check – Act (PDCA) continual improvement framework and incorporates energy management into everyday organizational practices, as shown in Figure 1.

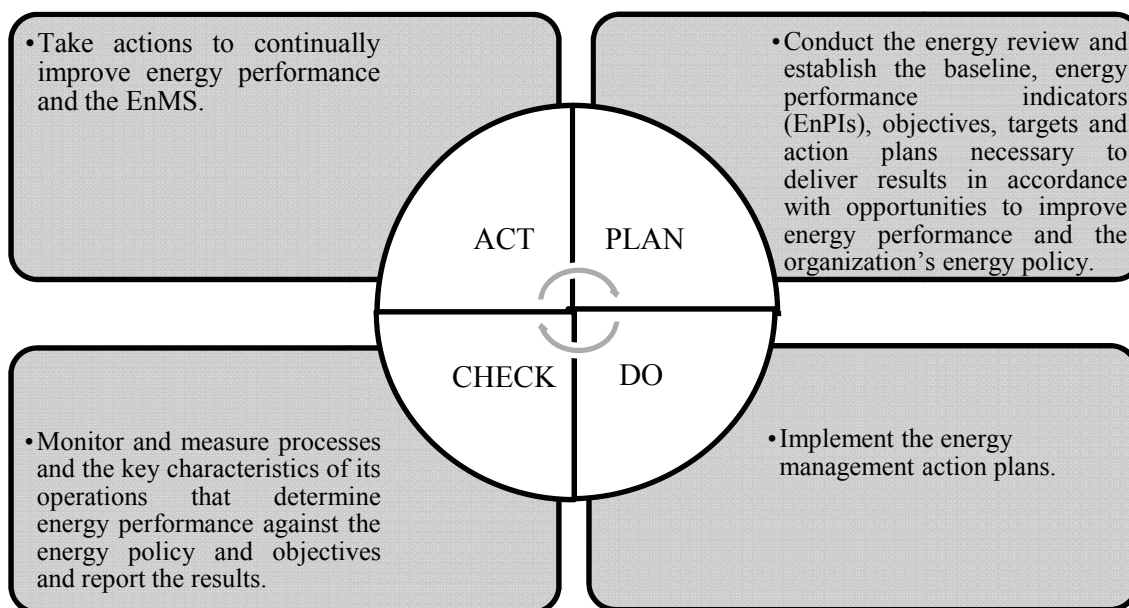


Figure 1: PDCA Cycle of ISO 50001 Implementation Procedure
(Source: Adapted from SLS ISO 50001:2011, 2013)

It is hoped that the introduction of ISO 50001 will result in widespread uptake of the standard among all types of energy users. The Plan-Do-Check-Act model has been proven successful for managing quality and environmental issues (ISO 9001 and ISO 14001). Therefore, this may provide great support to the owners, facilities managers and users of buildings, of Sri Lanka whilst contributing to improve the national economy. Each new management system standard is an improvement over the prior ones based on lessons learned from the experiences of the forerunners. Therefore, the driver of a successful energy management system will not only lead to effective management of the process, but also increased energy efficiency and more prudent energy use (Piñero, 2011).

5. RESEARCH METHODOLOGY

The study was structured to be conducted in three stages. The arrangement was effective due to the nature of problem being studying. The first two steps, literature review and desk study identified a list of enablers and barriers available for the implementation of ISO 50001. As the final step, an expert survey was carried out with professionals of SLSI, who is the responsible party for regulating ISO standards within Sri Lanka. The professionals selected for the preliminary survey have expertise knowledge and experience in auditing and implementation processes of ISO 50001 of SLSI. The data collection was mainly carried out through unstructured interviews. The purpose of conducting an expert survey was to get the comments of the experts who were interviewed and refine the list of enablers and barriers identified after the desk study to comply with the Sri Lankan context.

6. ENABLERS AND BARRIERS OF IMPLEMENTING ISO 50001 IN SRI LANKA

A comprehensive literature survey and desk study was first carried out to identify the enablers and barriers for the implementation of ISO 50001. The findings of the review are given in Table 1. The enablers and barriers were derived based on scientific literature (Rohdin *et al.*, 2006; Piñero, 2011; Hrustic *et al.*, 2011; Chayapoosorn and Ngaoprasertwong, 2012; ISO, 2013; McKane, 2009).

Table 1: Identified Enablers and Barriers for Implementing ISO 50001: Literature Findings

Enablers	Barriers
Internal and external recognition and rewards (United State Environmental Protection Agency)	Institutional problems (MacKane <i>et al.</i> , 2009 and Thollander and Dotzauer, 2010)
Reduce cost (SLS ISO 50001:2011, 2013)	Low credibility and trust on information
Engage top management (ISO Focus ⁺ , 2011)	Weak principal agent relationships
Reduce environmental impact (GHG emission). (Lambert, 2011)	Lack of support and guidance
Innovative, flexible and scalable (SLS ISO 50001:2011, 2013)	Unbearable certification cost
	Hidden costs
	Difficulties on budget allocation
	Large amount of documentation required
	Availability of highly technical sections
	Time consuming procedures for achieving the accreditation
	Lack of power on energy management
	Negative attitudes of employees
	Complexity of certifying processes
	Organizational cultural aspects (Rohdin <i>et al.</i> , 2006)
	Unawareness on the importance of applicability (Siriwardana, 2009).

As the next step, an expert survey was conducted with the professionals from the SLSI, who have the expertise knowledge on the subject of energy management as well as the implementation of ISO 50001 standards. The identified enablers and barriers through the desk study were evaluated and refined in accordance with the Sri Lankan context. Table 2 provides the list of enables and barriers which were identified through the expert survey.

Table 2: Identified Enablers and Barriers for Implementing ISO 50001: Expert Survey Findings

Enablers	Barriers
Formalized and documented energy policy and objectives	Insufficient benefits and outcomes
Regulatory compliances	Lack of support and guidance
Improve business performances	Inconsistency on top management support
Integrate the management system	
Secure energy supply	

The Table 3 provides the refined list of enablers and barriers of implementing ISO 50001 in Sri Lanka, which fulfills the final objective of this paper.

Table 3: Enablers and Barriers for Implementing ISO 50001 in Sri Lanka

Enablers		Barriers
Internal and external recognition and rewards	Institutional problems	Low credibility and trust on information
Formalized and documented energy policy and objectives		Weak principal agent relationships
Regulatory compliances		Lack of support and guidance
Improve business performances	Financial constraints	Unbearable certification cost
Reduce cost		Hidden costs
Engage top management		Difficulties on budget allocation
Reduce GHG emission	Complexity of certifying processes	Large amount of documentation required
Integrate the management system		Availability of highly technical sections
Secure energy supply		Time consuming procedures for achieving the accreditation
Innovative, flexible and scalable	Organizational cultural aspects	Lack of power on energy management
	Unawareness on the importance of applicability	Negative attitudes of employees
	Insufficient benefits and outcomes	
	Lack of support and guidance	
	Inconsistency on top management support	

Following section provides descriptive information relating to the commonly available enablers and barriers for implementation of ISO 50001 EnMSs, in Sri Lanka.

6.1. ENABLERS OF IMPLEMENTING ISO 50001 IN SRI LANKA

Followings are the main enablers that could be identified through the literature review together with the views of professionals of SLSI.

6.1.1. INTERNAL AND EXTERNAL RECOGNITION AND REWARDS

Recognizing the contributions of teams and individuals helps to reinforce the value of energy efficiency and encourage even greater improvements. Acknowledging successes will help sustain motivation. Verbal appreciation, simple forms of thanks like formal written commendations and certificates, plaques presented at award ceremonies, salary increases, and stock options can all act as enablers.

External recognition from a third party (government agencies, non profits, the media, and trade associations) validates the importance of the energy program, provides satisfaction to those who earned the award, and enhances the organization's public image. A solid reputation contributes to the organization's competitive advantage by making it more attractive to customers, current and potential

employees, lenders, and business partners.

6.1.2. FORMALIZED AND DOCUMENTED ENERGY POLICY AND OBJECTIVES

Though technology has been continuously developed, documentation procedure has gained significant importance over any other business operation. Therefore, maintaining well documented procedures has become an enabler for its users. Proper documentation procedures of ISO 50001 have made it easier to follow by organizations, itself. This has improved the user friendly aspects of the EnMS. Also documentation is important for decision making purposes and ensuring the better operations of the entire system (Sri Lanka Standard Institute, 2013).

6.1.3. REGULATORY COMPLIANCES

Implementation of ISO 50001 intended to reduce greenhouse gas emissions and other related environmental impacts and energy cost through systematic management of energy. Therefore ISO 50001 automatically fulfils regulatory requirements of organisations. Noteworthy as a country without proper regulations relating to energy management of buildings, this can take as the base for developing the energy related regulatory requirements (Sri Lanka Standard Institute, 2013).

6.1.4. IMPROVE BUSINESS PERFORMANCES

Drive greater productivity by identifying technical point solutions and affecting behavioral change to reduce energy consumption. By minimizing unnecessary energy wastages and identifying high technological solutions for existing operation can leads organizations towards fully productive future (Sri Lanka Standard Institute, 2013).

6.1.5. REDUCE COST

Reduce energy cost via a structured approach to identifying, measuring and managing organizational energy consumption (Sri Lanka Standard Institute, 2013).

6.1.6. ENGAGE TOP MANAGEMENT

Top management will consider energy management a key business issue. This leads to increase the capital allocations on energy management, consideration and support on implementing ISO 50001(Sri Lanka Standard Institute, 2013).

6.1.7. REDUCE GHG EMISSION

This is a significant enabler to meet stakeholder expectations or obligations now and in the future. Also this may relates to impacts of the organizational operations towards the environment (Sri Lanka Standard Institute, 2013).

6.1.8. INTEGRATE THE MANAGEMENT SYSTEM

Align organizational EnMSs with existing management systems for incremental benefits (Sri Lanka Standard Institute, 2013).

6.1.9. SECURE ENERGY SUPPLY

Implementation of ISO 50001 within an organization helps to understand the risk exposure and identify the areas of organization at great risk. Availability of well managed energy supply system is an enabler for organizations (Sri Lanka Standard Institute, 2013).

6.1.10. INNOVATIVE, FLEXIBLE AND SCALABLE

Develop opportunities for new products and services in the low-carbon economy of the future. Also it is applicable to any organization, large or small and from any industry (Sri Lanka Standard Institute, 2013).

6.2. BARRIERS OF IMPLEMENTING ISO 50001 IN SRI LANKA

According to SLSI, most probably, implementing an EnMS is considered as a burden for their existing operations by most of the organizations within the developing countries like Sri Lanka. Instead of seeing at the business opportunities for increasing sales and cost reductions through ISO 50001, they only concern it as a threat for their market competitiveness. Therefore, barriers for implementation must be acknowledged and addressed to minimize them for avoiding the unnecessary difficulties appear in different stages of implementation. Followings are the significant barriers identified through desk studies of the ISO, U.S. Environmental Protection Agency, Edwin Piñero *Chairman of ISO PC 242*, and U.S. Environmental Energy Technologies Division.

6.2.1. INSTITUTIONAL PROBLEMS

These institutions can be identified as the accredited certification bodies for ISO 50001. Thollander and Dotzauer (2010) have identified absence of market for best available technologies and lack of technical knowledge and required human resources, lack of experts relating to EnMSs and lack of energy policy as the critical issues for the implementation of energy management standard (MacKanel, 2009).

6.2.2. COMPLEXITY OF CERTIFYING PROCESSES

This is a major barrier that has identified through the ISO 50001 Energy Management Systems implementation case study at London South Bank University. According to that situation larger amount of documentations and over application of technical words has made the implementation procedure difficult. It consumes additional amount of human resources to handle the system.

6.2.3. ORGANIZATIONAL CULTURAL ASPECTS

Different organizational cultures, values and norms act as barriers for implementing ISO 50001 within particular organisations. Poor leadership and absence of dedicated energy coordinator is the main reason for this problem arises (Rohdin et al., 2006).

6.2.4. FINANCIAL CONSTRAINTS

Though this is very important for organisation, it must be feasible to purchase, implement and practice. Cost of implementation and cost of renewal are significantly acting as barriers for small and medium scale enterprises (SMEs) (Rohdin et al., 2006).

6.2.5. UNAWARENESS ON THE IMPORTANCE OF APPLICABILITY

ISO 50001 has introduced to Sri Lankan organisations on 2011. But it has not properly marketed within the country. Therefore most of the organisations are not properly attentive on this standard. According to SLSI, there are very few awareness programmes regarding ISO 50001 and no any training programmes on implementing, handling or auditing the standard (Siriwardana, 2009).

6.2.6. INSUFFICIENT BENEFITS AND OUTCOMES

This can be identified as the risk of investing in EnMS. For example, even though managers know what the capital cost is for an EnMS investment, uncertainty about the long-term savings in operating

costs means the investment is a risk. Therefore unawareness on benefits and outcomes of implementation of ISO 50001 is a barrier.

6.2.7. LACK OF SUPPORT AND GUIDANCE

Another barrier is not receiving enough level of information, lack of sources of information and support from the responsible parties regarding the implementation of ISO 50001. Lack of information, imperfect information and cost of information on energy management systems are the main reasons for this barrier.

6.2.8. INCONSISTENCY ON TOP MANAGEMENT SUPPORT

It should be noted that in regard to energy management, an increased focus on core business, which has been a strong trend within management and organization since the beginning of the 1990s, may prevent successful adoption of energy management practices (Thollander and Ottosson, 2010)

7. DISCUSSION AND FUTURE RESEARCH AGENDA

Although energy seems a pervading subject, that all people have to deal with on a daily basis, research regarding this topic is scarce. Building energy efficiency is one of the most significant means of reducing the threat of increased global warming. During the last decade, energy prices rose significantly for the local industry. Mainly electricity prices and oil prices have almost doubled. Even more price increases are to be expected. Therefore, identifying opportunities available for going towards the energy management system can be considered as national requirement for Sri Lankans.

Implementation of ISO 50001 intended to lead to reductions in greenhouse gas emissions and other related environmental impacts and energy cost through systematic management of energy. There is less number of organisations which have obtained and applied to obtain the ISO 50001 system. The enablers and barriers of implementing an ISO 50001 EnMS in Sri Lanka have been identified through a comprehensive literature survey, desk study and an expert survey which were employed in achieving the aim of this article.

According to the finding internal and external recognition and rewards, formalized and documented energy policy and objectives, regulatory compliances and improve business performances have been identified as key enablers while institutional problems, complexity of certifying processes, organizational cultural aspects, financial constraints and unawareness on the importance of applicability had been identified as key barriers. At the next stages of this research, these results are planned to be used in developing the framework for implementing ISO 50001- Energy Management System within Sri Lanka.

This study highly focused on identifying enablers and barriers which affect the implementation of ISO 50001 – Energy Management System in Sri Lankan context.

The next step has planned with case studies which will be carried out based on buildings which have implemented ISO 50001 – Energy Management System. The future research agenda will consist of following objectives:

- Identify the major enablers and barriers in implementing ISO 50001 in Sri Lankan context
- Introduce suitable solutions to overcome those barriers of implementation
- Develop strategies to promote the enablers of implementing ISO 50001
- Develop a framework for adopting ISO 50001 in Sri Lankan context

This framework will be worthwhile for organizations that are following and willing to implement ISO 50001 – EnMS within their organizations effectively.

8. REFERENCES

- Chayapoomsorn, S., and Ngaoprasertwong, J., 2012. The Development and Comparison of Energy Management Systems in Electronics Manufacturer. Available from: <http://dx.doi.org/10.1016/j.jclepro.2010.04.011> [Accessed 21 March 2013].
- International Organisation for Standardization, 2011. Win the energy challenge with ISO 50001 [Online]. Available from: http://www.iso.org/iso/iso_50001_energy.pdf [Accessed 21 March 2013].
- Jayamaha, L., 2006. Energy-efficient building systems: *green strategies for operation and maintenance*. USA: McGraw-Hill.
- Lambert, G., 2011, May. ISO 50001 pilot programme: US companies implement standard with government support. *ISO Focus+*, 2(5), 11-14.
- Lawrence Berkeley National Laboratory, 2013. Environmental energy technology division: What is energy efficiency [Online]. Available from: <http://eetd.lbl.gov/ee/ee-1.html> [Accessed 21 March 2013].
- Lombard, P. L., Ortiz, J. and Pout, C., 2008. A review on buildings energy consumption information [Online]. Available from: <http://www.sciencedirect.com/science/article/pii/S0378778807001016> [Accessed 21 March 2013].
- McKane, A., 2007. Industrial Energy Management: *Issues Paper*. Lawrence Berkeley National Laboratory, Vienna, Austria.
- McKane, A., 2009. Thinking Globally: *How ISO 50001 – Energy Management can make industrial energy efficiency standard practice*. Manuscript submitted for publication.
- Thollander, P. and Dotzauer, E., 2010. An energy efficiency program for Swedish industrial small- and medium-sized enterprises [Online]. *Journal Of Cleaner Production*, 18(13), 1339-1346. Available from: <http://dx.doi.org/10.1016/j.jclepro.2010.04.020> [Accessed 21 March 2013].
- Piñero, E., 2009, September. Future ISO 50001 for energy management systems. *ISO Focus*, 6(8), 18-20.
- Piñero, E., 2011. Energy excellence: In comes the ISO 50001 energy management system standard. *ISO Focus+*, 2(5), 8-10.
- Rohdin, P., Thollander, P., Solding, P., 2006. Barriers to and drivers for energy efficiency in the Swedish foundry industry, *Energy Policy*. (35), 1, 672-677 [Online]. Available from: <http://dx.doi.org/10.1016/j.enpol.2006.01.010>. [Accessed 21 March 2013].
- Hrustic, A., Sommarin, P., Thollander, P., and Söderström, M. (2011). A simplified energy management system towards increased energy efficiency in smes. In *Proceedings of the World Renewable Energy Congress 2011 (WREC 2011)*, 9-13 May, Linköping. Electronic Press.
- Senaweera, L., 2011, August. New ISO 50001 standards on energy management systems: A need of the hour [Online]. *The Island*. Available from: <http://www.island.lk> [Accessed 21 March 2013].
- Siriwardana, A. M. T., 2009. Development of a sustainable energy management standard for the industry sector in sri lanka (Doctoral dissertation, Asian Institute of Technology).
- Sri Lanka Standard Institute, 2013. SLS ISO 50001-2011: *Energy management systems: Requirements with guidance for use*. Colombo: Author.
- Thollander, P. and Ottosson, M., 2010. Energy management practices in Swedish energy-intensive industries, *Journal of Cleaner Production*, (18), 12, 1125-1133 [Online].
- Wongtharua, P., Hakeme, M., Intamat, I., Chiralerspong, C., Naveerroengrut, S., Srithong, C., ... Kumanashi, S., 2005. Total Energy Management Handbook (Final version) [Online]. Available from: <http://egs.apec.org> [Accessed 21 March 2013].