

A Proposal of an Energy Saving Technology Framework for the Hospital

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The energy saving technology at the hospitals is still new, but it is important because the businesses of these institutions generate a large impact on the society in the three dimensions that guide sustainability: environmental, economical, and social. According to the World Health Organization, hospitals are responsible for about 10 % of all the Brazilian commercial energy consumption. Hospitals have a big challenge to reach sustainable performance; however, it is not only about the infrastructure, but also about the awareness of the leaders and their teams that their engagement is fundamental. It is necessary to convince people of the importance to change habits that do not prioritize the environment. Sustainability and its three guidelines must be defined on the basis of the institution as strategic planning. The energy saving technology should be used daily; it has to be part of the institution's identity. From this perspective, the objective of this research study is to develop a proposal for a framework that helps in the implementation of hospital's energy saving technology and to support the three guidelines through an agile management. The methodology used is descriptive. The proposed framework helps in the development towards the healthcare strategic planning, contributing to the growth of both institution and community. This framework is to assist in energy saving in the hospitals. It consists of three vectors: Plans for Improvement and Management Assessment, Training and User Awareness, and Diagnosis Energy. The paper recommended some actions to assist in the framework's implementation. The paper highlights that the awareness and the engagement of all people involved will be driver factors for energy savings in hospitals.

1. Introduction

The modern world's development, the human activities, the improvements onto the living conditions of the people and the world's economic development all are dependent on the supply of electricity (Darabnia et al., 2013). According to the World Health Organization (WHO), hospitals are responsible for about 10 % of all the Brazilian commercial energy consumption.

According to the energy supply approach, all forms of electricity generation bring as a consequence, the environmental impact, to a greater or lesser extent (Buonomano et al., 2014). Since those sources considered being cleaner, such as the solar photovoltaic energy, which requires batteries to accumulate the generated energy: these batteries contain heavy metals that cannot be released directly into the soil at risk of contamination; Wind, which interferes with the migration route of birds (Kropáč et al., 2013).

Hydric resources exploitation which can flood large areas and cause changes in local fauna and generate methane gas. Hydropower exploitation can also interfere with migratory routes of fish and consequently in its reproduction (Čongradac et al., 2014). Even more pollutants, taking as an example thermoelectric generation through the usage to coal, fuel oil and gas, which takes out the carbon stored in the underground and then throws in the form of carbon dioxide (CO₂) into the atmosphere causing intensification in global average temperatures for the greenhouse effect. Despite this, the projections show an increase of coal in the Brazilian energy matrix by 2030.

The choice of this sector is due to lack of financial resources through the majority of health institutions in Brazil and the precariousness in the attendance and in shortness supplies in the sector.

Brazil have 6,832 hospitals in operation, according to the Brazilian Federation of Hospitals. In its embracing 65.38 % are private hospitals and 34.62 % public hospitals, in available for the Brazilian population 430,484 beds, divided into 29.84 % of beds for covenants and 70.16 % beds for the public health system (SUS) Brazilian. From this perspective, the objective of this study is to develop a proposal for a framework that helps in the implementation of hospital's energy saving technology and to support the three guidelines through an agile management.

This research is divided into six sections, including this introduction, sustainability, strategic planning, methodology, analysis and discussion of the results and the conclusion.

2. Literature review

2.1 The energy production and the environmental impacts

Energy production has a direct influence on the environment as it is responsible for much of the emission of gases, such as carbon dioxide (CO₂), among others, that cause the constant increase in the average temperature of the Earth (Darabnia et al., 2013). These gases block part of the infrared radiation that the Earth returns to space, causing an increase in the atmospheric temperature, bringing climate changes as consequences (Buonomano et al., 2014).

The problem from electricity supply requires planning considering all the variables involved from the production source to the final consumer with analyses of all available options and from the study of the feasibility of distributed generation systems or alternative sources, especially in isolated systems, where petroleum-based fuels are used (Chinnawornrungrsee et al., 2013). These variables are connected with the study of energy efficiency increase in hydro and thermal power plants and transmission and distribution systems to reach the analysis of the viability of energy efficiency measurements in the final uses of the various segments of the society, analyzing the biggest potential energy savings (Hadian et al., 2015).

The electric power system is the main and most important facility in a hospital, being responsible for maintaining in full operation all systems and equipment's that support business procedures, clinical and attending procedures of the institution. The electrical installations of a Hospital are the most complex to design, compared to any other type of project, for everything that thinks of infrastructure and technology is applicable and used in hospitals (Raza et al., 2014).

Nowadays, even more, the hospitals need reliable electrical systems and insurance, which have high operational availability and are prepared to work in emergency situations. Thus the electrical installation must be cared for in the same way that a patient's health is treated (Tziogas et al., 2015).

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2.2 The hospitals and their energy consumption

The Brazilian hospital sector uses extensive electricity and the consumption of energy brings inevitably environmental damage of some form. One solution for the limitation of this problem is the rational use of energy.

The health facilities can be classified into clinics, healthcare centres, emergency rooms, emergency clinics, and hospitals. The hospitals have the particular feature of offering beds for patients in treatment.

The demands of energy in the hospital are characterized by the need for high reliability and quality of supply, since most of the health equipment are for the maintenance of the patient's lives. The hospitals in general, besides having high energy intensive, use their sources in an inefficient way (Buonomano et al., 2014).

In addition, a fact observed in many hospitals is that they solve their demand expansion problems (like lighting, environmental conditioning, water heating, and steam) with specific actions without a plan that seeks global actions as, for example, investment in new power plants, study of new steam circuits, and cogeneration of electricity (Darabnia et al., 2013). These solutions, which often come to be improvisation, lead to inefficient use of energy and can even endanger the facilities of the whole establishment. This fact creates a high potential for energy conservation, which can range from 20 % to 44 %. Depending on how the energy is used, a simple inspection can reveal potential gains in lighting, air conditioning, and equipment. Other simple measures include: cleaning lamps and luminaires regularly, replacing lamps and filters with the recommended intervals, making sure that thermostat and timers are set correctly (Asandului et al., 2014).

The referred measures result in benefits for all concerned members of the society, because they avoid the environmental pollution from the generation of energy that would be wasted, with: the customers of

hospitals, as energy costs are computed directly in the prices of hospital care; with utilities, which can delay investments in generation, transmission and distribution; and finally with the hospital, which needs to purchase less energy by reducing spending (Gevaart-Durki et al., 2014).

So, if the energy conservation can provide effective way to reduce spending on the healthcare, hospitals in general should advance more on reducing consumption. According to Raza et al. (2014), the two biggest barriers of energy efficiency reported by hospitals participating in the study were related to internal resources, including human resources to control the programs and the costs of the actual energy efficiency actions.

2.3 The sustainability issues

The sustainability is a term used to define the human activities that aim to supply the current human needs without compromising the future generations. In other words, the sustainability is directly related to economic development without harming the environment, using natural resources in an effective way in order to not harm the humanity in the future by ensuring sustainable development to the society. The sustainability is crucial for any organization that aims to maximize the return on invested capital.

According to Cai et al. (2013) the organizations can contribute to sustainability by transforming their production processes, when necessary. Therefore, the sustainability has become widely known among companies and it is useful for understanding the additional business interactions, especially to illustrate the importance of a broader sustainability vision.

The economic sustainability is demanded by countries with sustainable development policies, which have become important over the past two decades. The fact is that the environmental regeneration method does not follow the current pattern of use and it has led nations to sign agreements about development with less degradation and more equity.

The environmental sustainability is related to the economic representativeness of an organization, as well as, the organization uses its power of influence among consumers and society in general (Ferrero et al., 2013). Therefore, it is necessary that the companies include in the current context of developing of a simple role as a supplier of products work more broadly to contribute to environmental issues in their management. In this sense, a new style of organizations was identified facing a concern with factors affecting future generations, mainly about obtaining profit (Lega et al., 2013)

This discussion about environmental sustainability is originally from limitation and the misuse of available resources and they can be reversed by: the use of clean technologies and recycling, the sustainable use of natural resources, and the creation and consolidation of administrative mechanisms of environmental protection.

The social sustainability involves organizations with social problems and it is no longer a choice of the humanity. It begins to be characterized as mechanisms of strategic performance. The importance of social performance of the companies has strategic character and the companies started to be conscious about it, contributing to their sustainability and business performance through their image committed with the social awareness about the search for solutions to serious problems that plague the society.

It is important to note that within the principles of sustainability, it is not possible to separate the economic issues from the environmental and social issues (Qingwei, 2012). So, when an organization is ecologically sustainable, it will act in a socially responsible manner to meet the interests of the company, its suppliers, and its customers that affect or are affected by its activities.

3. Methodology

This research study has a descriptive qualitative methodological approach. The relevance of this sector is due to lack of financial resources by the majority of health facilities in Brazil, the precariousness in health service, and little supply of beds in the sector. To have an idea, in recent years there was a decrease (12 %) of health service providers institutions in the country.

From this perspective, the objective of this study is to develop a proposal for a framework that helps in the implementation of hospital's energy saving technology and to support the three guidelines through an agile management. The proposed framework helps towards the development of the strategic health plan, contributing to the growth of both institution and community.

4. The framework for decision making

In order to reduce the electricity cost and to mitigate the resulting environmental impacts, the framework consists of the following strategic vectors

- Improvement plans and assessment management

The first step in conducting an energy efficiency project involves the assessment of everyone responsible for making decisions in the hospital proposing an improvement plan. The management evaluation aims to define the front behaviour to energy issues and educate managers about the importance of energy efficiency. The waste management is should be related to electricity and it should involve the staffs to facilitate the implementation of the proposals.

The development of the improvement plan is intended to guide on the main internal actions that may promote improvements in the energy use tract based on the results of management assessment. The guidelines are established (who ?, what ?, why ?, where ?, when ?, how? and how much?) seeking the planning and distribution of tasks or activities.

The plan helps to define the actions to be conducted by setting its forms of implementation and monitoring and controlling it.

➤ Training and user awareness

The training and user awareness will help to create an energy management team, consisting of representatives of various sectors of the hospital, with the mapping task and proposed actions to reduce energy consumption. This team aims to optimize the use of energy guiding, directing, and controlling the actions over economic resources, thus minimizing the relationship between the consumption/service, reducing general and specific indices of the amount of energy required.

Before taking any initiative or action aimed at energy savings in a company, it is important to implement an internal program of energy conservation. This importance is related to the fact that individual actions tend to lose their effect over time.

The plan requires initiative and creativity, as actions that require work style changes, which are difficult obstacles to overcome. To solve these problems of implementation, the senior manager must clearly show that the program is inserted in the administrative policy of the company. Its development is the result of efforts of several sectors of the institutions and the participation of all employees.

To contribute to the progress of actions it is needed:

1. To manage and track energy billing carrying out periodic inspections of the facilities and procedures of the tasks to identify waste of energy;
2. To develop graphics and management reports in order to support the monitoring and decision making;
3. To educate and motivate health servers and to disseminate the information about the rational use of the energy and the results achieved depending on the goals that are set;
4. To have regular meetings with staffs to keep them informed of the development of the program and the results obtained and making them feel part of the program;
5. The best way to generate interest and engagement of the health servers is through communication. A program will have better results if there is motivation of all the health servers and training to ensure the correct implementation of the program.

➤ Energy diagnosis

It is accomplished energy diagnosis that is applied to all final uses to determine the energy conservation potential in the final uses present in healthcare facilities. This step makes up the energy efficiency project being carried out after the management assessment and improvement plan. It is important to check whether the whole system has or not inefficient equipment's that consume a lot of electricity, such as:

1. Lighting systems,
2. Water heating,
3. Water pumping,
4. Exhaust systems,
5. Elevators,
6. Environmental conditioning system,
7. And health equipment.

The proposal of an energy saving technology framework has as its main element the engagement of all its employees. The main objective is to reduce the impacts on the environment and, so, it is important to notice that is the financial gains obtained due to reduction in energy expenditure values provide savings in new social projects for the community.

4.1 Recommendation for the implementation of the framework

Before making any initiatives or actions in order to obtain energy saving in the hospitals, it is appropriate to implement an internal program of energy saving. The importance of this program is related to the fact that not-integrated actions tend to lose their effects over time, so, it is better to develop a program for the improvement of the teamwork: Energy Conservation Improvement Program – ECIP.

This program requires initiatives and creativities as well as actions that need lifestyle changes, which are difficult obstacles to overcome. To circumvent these implementation issues, the senior managers should clearly show to their crews that the program is inserted into the administrative policy of the hospital. The elaboration should result from efforts of various sectors and from the participation of all employees.

The ECIP improvement teamwork can contribute to the progress of the following actions:

- To manage and to track energy sales: their consumption, demand, load, and power;
- To conduct periodic inspections of the facilities and of the employees' task procedures in order to identify energy waste situations;
- To develop management graphics and reports in order to support decision making;
- To raise awareness and motivation of the employees, patients, and family members of the patients in order to disseminate information about the rational use of electricity and the results achieved;
- To have frequent meetings with staffs in order to keep them informed of the development of the program and making them feel as part of the program.

A program will have better results through training the staffs to ensure its correct implementation and the motivation of all of those people involved. The best way to stimulate the interest and the engagement of the staffs is through communication.

5. Conclusions

The bad use of energy in hospitals can increase operating costs by providing cutting funds in important areas within the institution. The key is to identify the improvements and the awareness of all people involved. . The hospitals have a huge challenge to achieve sustainable performance, however, it is not only about the infrastructure, but also about the awareness of the leaders and the team engagement is fundamental.

The proposed framework consists of: the improvement plans and assessment management, the training and user awareness, and the energy diagnosis. For reducing energy consumption in hospitals, it is important to note that the plan will have better results if there is motivation of all health servers and training to ensure the correct implementation of the program.

The adoption of these measures, in addition to bringing direct benefits to the hospital, such as cost reduction, is also beneficial for the society as it contributes to the reduction of emission of harmful gases to the environment, providing significant environmental benefits by reducing energy consumption. In this sense, the proposed framework assists that the health institutions become sustainable in the three pillars: economic, environmental, and social.

This research study proposes a framework to assist with the energy saving in the hospitals. It was not the goal of this paper to test and validate the proposed framework. Future work can overcome the limitation of not testing and not validating the proposed framework. The authors intend in their future research studies implement the framework in several hospitals in different sets such as public and private, small and big, and from developed and from emerging countries in order to analyze the possible variations of the framework.

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