THE ROLE OF INFORMATION TECHNOLOGY (BMS) IN MAINTAINING A SUSTAINABLE ENERGY: THE CASE OF IRAN

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Abstract - While the amount of non-renewable energy resources are decreasing and energy consumption and its price are increasing, governments are looking for ways to provide energy efficiency and conservation that not only decrease the use of energy but also create stronger economies for governments and greener environment for people. Therefore, based on investigation in this field, the role of IT is undeniable because one of the giant achievements in energy saving is done by one of IT technologies which is called BMS (Building Management System). According to some statistics, the number of homes required to be built in Iran is about 1,500,000, so employing BMS in new buildings is considered an important issue towards zeroing energy wastage in buildings and bringing efficiency to energy consumption. By using BMS electronic controllers that are linked to a computer network, important building systems, like pumps, chillers, lights and so on, are controlled and monitored real-time and remotely. BMS has the potential to provide energy savings up to 20%, if it is effectively implemented, as well as to decrease the maintenance costs and hence improve energy consumption. Therefore, this article, in addition to introducing BMS systems and their roles in energy saving, explains the ways these systems can have the best use with maximum efficiency in Iran environment.

Keywords: Controlling and Monitoring System, BMS , Energy Conservation, Energy Crisis

1. INTRODUCTION

Nowadays, by new achievements in IT science and its related technologies, people's life is affected and changed in many aspects. One of the recently effective technologies that have attracted number of people and industries is BMS[1]. BMS is one of the most effective and applicable technologies for controlling building devices and services like heating, ventilation, and air conditioning systems because they make up the largest portion of commercial building energy use (52%) [1]. Even, BMSs can control lighting, security, fire safety, and other systems in order to make a building operation more efficient and effective than before because, as referred to by [1], the second largest use of energy in commercial buildings is lighting, which accounts for 20% of a building's energy consumption on average.

The importance of BMS came from the worrying about decreasing non-renewable energy resources like gas, oil and so on as well as significantly increasing energy prices; therefore, building managers must focus on minimizing energy consumption in order to keep their business competitive. This paper deals with this intention and narrows down to energy conservation in buildings and the effects of BMS on energy saving.

2. BMS TECHNOLOGY

BMS technology is considered important so far as in some countries like Singapore, many new office buildings of which built recently should have a central control system to ensure that the building is energy efficient.

Also, because buildings are significant energy consumers (currently between 30 and 40 percent), using BMS is more effective in building for energy saving; according to statistics, in the United States, buildings were responsible for 38.9% of total energy consumption and 72% of electricity consumption in 2006 [1].

2.1. What is BMS?

Since almost all buildings have some kind of mechanical and electrical devices and services in order to bring convenience for their residents, there is a need for some means to ensure that these devices work properly, and their overall function can be controlled and monitored effectively. By having continuous controlling and monitoring, not only can we use their optimum functions, but also we can do savings in the cost of their energy usage. For example, by having these kinds of devices, we can ensure that the room temperature is suitable for the residents and prevent over-warming/cooling which is considered a kind of energy wasting. [fig 1]

The system that can do such functions is called BMS which is used in most new commercial and institutional buildings, and now it is widely used in residential buildings too. BMS is a high technological system installed in buildings and automatically controls and monitors the mechanical and electrical equipment in buildings such as air handling and cooling plant systems, lighting, power systems, fire systems, and security systems [2]. BMS refers to a system that uses sensors, controls and activators all of which use an electronic

[1] Building Management System

digital processor to implement control algorithms and have the capability of communicating with other controls. The BMS term covers all control elements, including hardware, controllers, any linking network and central controllers [3].

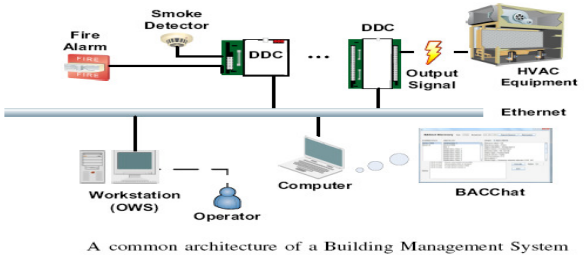

Fig. 1. BMS Common Architecture [5]

In general, it can be said that, "The purpose of a BMS is to automate and take control of these operations in the most efficient way possible for the occupiers/business, within the constraints of the installed plant" [2]. In addition, BMS has the following advantages that helped to use it in most buildings: significant reduction in energy bills, improved comfort for staff, more effective operation of building services plant, and better ability to monitor and collect building performance data for analysis [4]. With automation and advanced electronics, setting the speed, equipment, and installations are designed for the control, monitoring and optimization of the various functions and services provided in a building [6].

From the point of IT technology, BMS is a stand-alone computer system that can calculate the preset requirement of the building and control the connected plant to meet those needs. Its inputs, like temperature sensors, and outputs, like on/off signals, are connected to outstations around the building; and in modern BMS a modem is connected to the system in order to provide remote access [2].

3.Why Energy Conservation is important?

After the energy crisis of 1973 [7] an urgent need to decrease energy consumption as rapidly as possible came to picture. By making use of the capabilities the central computer of the BMS could provide, many energy saving functions were developed and integrated into the BMS [7]. After that, from 1973 to 2006, the consumed energy in Asia was almost doubled, while at the same time the Europe energy consumption was cut by half.[fig2]

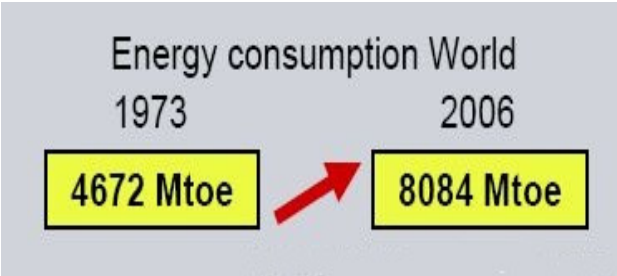

Fig. 2. World Energy Consumption [8]

The millennium we live in was started with public awareness about energy conservation and increasing people's paying attention to this issue. In this regard, the alarm of significantly increasing the non-renewable energy resources played a decisive role in social awareness regarding conserving energy; therefore, many countries started using natural energies like those of wind, sun, etc., and some other countries tried to upkeep their energy sources by using IT technologies one of which being BMS.

Nowadays, because buildings are major energy consumers, many of them are equipped with BMS because energy efficiency in buildings offers the greatest potential to decreasing worldwide consumption.

According to an EIA 2010 survey, energy demand in the world is growing by 3.2 percent per year and energy consumption worldwide is expected to rise faster than population. In the U.S., the EIA estimates end-use energy consumption will grow by 0.7 percent per year from 2008, reaching nearly 40 quadrillion BTUs by 2020.Annually, commercial buildings spend more than $100 billion on energy, making it the single largest operational cost, though the most manageable. For an average office building in the U.S., energy represents 30 percent of total operating expenses. Use of energy conservation measures reduces this expense and offers a wide range of other economic and social benefits to building owners, tenants, and the surrounding community. As a result of several factors, including rising energy costs and the growing attention given to corporate social responsibility, green building has gained substantial popularity [1]; every country wants to have some contribution to energy saving.

In 2004, commercial and residential buildings have accounted for 38% of the total energy usage in the United States. In some regions like Hong Kong, where the industrial sector is relatively small, the impact of commercial and residential buildings in energy consumption is even higher (in Hong Kong 2008, the figure is 65%). As such, there has been an increasing interest in the computing field in applying the sensor networks and other computing technologies in the development of smart green buildings [5].

Today, people, for the purpose of cost reduction for their consumed energy as well as decreasing the energy resources and alarming of scientists on energy resources scarcity, started using BMS in their buildings. For example, from 12,000 surveyed subscribers in Building Technologies' 2010 Energy Efficiency more than 90% of the respondents are implementing or have completed energy-related upgrades[1].

Driving forces for Energy Efficiency:

- Kyoto Protocol, reduction of CO2 emission (-5% in comparison to 1990)
- EU activities to reduce CO2 emission until 2020 (-20%)
- Demand for energy savings, due to long-term increasing prices of oil, gas and electricity
- European standard EN 15232 Energy Performance of Buildings, Impact of Building Automation and Controls

- DIN V 18599 Energy Efficiency of Buildings - Calculation of the Energy Demand for HVAC and Lighting
- Energy Efficiency Certificate for residential and non-residential public buildings (Classification A – D)
- Global Green Building Initiatives Public awareness of saving energy and protecting the environment [11].

4. RESULT OF ENERGY CONSERVATION WITH BMS

As it was mentioned earlier, BMSs are implemented in numerous buildings all over the world. In this section the results of these implementations have been reviewed in order to see clearly the advantages and necessity of using these systems in our country and using their economical and environmental advantages.

One of the buildings that implemented BMS in order to have cost reduction in their consumed energy (gas and electricity) is University of Ulster (Belfast Campus) that gained annual cost savings of £4,540 or 8% with payback period of 3.5 years[12].[fig3]

	Predicted	Post Project Evaluation
Heating Energy Savings	435 MWh	343 MWh
CO_2 Savings	124 tonnes/yr	96 tonnes/yr
Capital Cost	£16,000	£16,000
Savings	£5,750	£4,540
Payback Period	2.8 yrs	3.5 yrs

Fig. 3. BMS saving in University of Ulster [11]

Also, in an air conditioning survey which was done in the UK by implementing BMS control adjustment, calibration and policy adoption, the building could achieve 138,648.00kW/hr on energy reduction which equals to 6237.00 £ on annual saving while the cost of implementation of the BMS was just 1000.00 £ [13].

In addition, in Sweden, school campus Erikslund implemented BMS for area of 12,600 m2 and could obtained 32% energy reduction for heating which was equal to 707,000kWh and 14% electricity reduction which was 100,000 kWh. Even a hospital in Belgium, by implementing BMS for the hospital's main building, obtained 35.7% energy reduction for heating which was equal to 341,098kWh and 15.8% electricity reduction which was 295,376 kWh [9].

In another example ABB company, by introducing one of its BMS systems called i-bus, entered Singapore market and helped several landmark buildings in Singapore cut energy consumption and win industry awards for energy efficiency and low environmental impact. For occupiers they have brought massive energy savings calculated by one at 17% and by another at around US$ 370,000 a year. One of the selected buildings for implementing ABB BMS system was the 59,000 m2 National Library building [11].

Table1. ABB BMS system called i-bus® KNX saving [11]

Implemented Function	Savings	Parameters (Positive)
Individual Room Temperature (Controlled by Timer)	Up to 10%	Low thermal mass of surrounding walls
Individual Room Temperature (Controlled by Presence Detector)	Up to 25%	Room not permanently occupied
Automatic blind control*	Up to 30%	- High daylight factor - Venetian blinds on outer surface of building ➔ Reduced heat incidence into the building
Constant light control (closed loop control and presence detection)	Up to 50%	- High daylight factor - Blind control*
Lighting control (open loop control depending on outside light and presence detection)	Up to 45%	High daylight factor
Presence detection (simple switching of the lighting)	Up to 20%	Rooms and corridors not permanently occupied/in use

*positioning of blinds according to temperature and solar altitude

5. Needs for BMS in Iran's Buildings

Iran is one of the top three owners of natural energy resources like gas and crude oil in the world [14]. However, by referring to the world is facing energy crisis that push us to find a way in order to use renewable energy resources and put effort to do energy conservation by using the latest IT technologies [10]. Now, this situation is also true in Iran. As the time passes, Iran needs to use more and more energy resources and according to Figure 4, its own consumption is growing moderately, and besides all these, according to Iran statistics, currently the number of homes required to be built in Iran is about 1,500,000 [15], and after building this number of houses, the required energy for their residence will significantly increase (like electricity). For producing electricity in Iran according to[16], the sources of energy for producing are oil, gas, and coal, and it was reported that it accounted for 97.58% of the total sources in 2008. Figure 4 illustrates the statistics for Iran oil and electricity consumption and production, and Figure 5 demonstrates Iran energy consumption which clearly shows the dramatic growth of energy consumptions.[fig4,5]

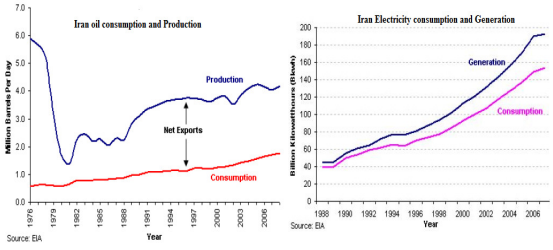

Fig. 4. Iran oil and Electricity consumption and Production [14]

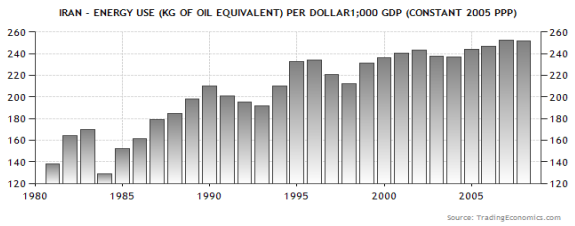

Fig. 5. Iran Energy Consumption [17]

Figure 5 shows the amount of energy consumption in Iran now and figure 6 is the amount of energy production will show. It can be seen clearly that the amount of produced energy is slightly higher than its consumption, and it can be forecast that after building those houses and regarding the population growth, Iran will face scarcity of energy.[fig6]

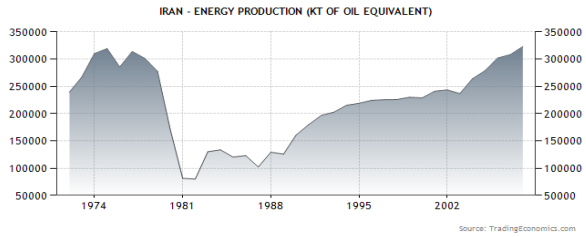

Fig. 6. Iran Energy production [18]

6. CONCLUSION

As it was mentioned about universal energy crisis and the measures taken by the developed countries in this regard as well as world new legislation that promotes the of use energy-efficient technologies, the world's attention is drawn to using BMS technology in buildings, the major consumers of produced energy. Therefore, in our country the government must have concentrate on developing this technology, first in the governmental buildings, then in commercial buildings, and at the end in residential buildings. In this way, not only can government save money significantly due to decreasing the wastage of energy, but also it can save its natural energy resources for future and force industries to increase the use of renewable energies like solar energy or wind energy and, at the same time, to decrease energy consumption through intelligent energy management technology in their buildings. By using BMS technology in buildings, efficient savings are made possible. Moreover, significant energy savings can be achieved while at the same time the residents of buildings can benefit from a pleasant room climate and optimum comfort and reduced energy costs.

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