Implementation of Simple Measures for Savings Water and Energy Consumption in Kuwait Government Buildings

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Abstract:

This paper gives in details the efforts made by the Public Services Department (PSD) to reduce water and energy consumptions in the Ministry of Social Affairs and Labour's (MOSAL) buildings in Kuwait. PSD manages around 125 buildings distributed over 6 governorates. PSD's efforts included the installation of programmable thermostats for A/C units, urging MOSAL's staff to switch off lighting after working hours, replacement of old A/C and lighting systems by newer systems and installation of shutters and solar films for windows, insulation materials for walls and roofs and low-flow water tools for faucets. These efforts reduced the overall water and energy consumptions by 15 and 25%, respectively, in all MOSAL's buildings. Additionally, MOSAL is planning to collaborate with Kuwait Institute for Scientific Research (KISR) to further reduce water and energy consumptions in MOSAL's buildings by optimizing operation strategies and utilizing new water and energy technologies.

Keywords:
Air-conditioning, lighting system, low-flow water tool, programmable thermostats, solar films.

1. INTRODUCTION

The electrical peak demand and energy consumption are increasing rapidly in the State of Kuwait due to population growth and urban development. The peak electrical demand increased from 6,750 MW in 2011 to approximately 11,850 MW in 2012 (MEW, 2012). The electrical peak demand is expected to reach 28,000 MW in 2025 (AlSayegh et al., 2005). The Ministry of Electricity & Water (MEW) in Kuwait has done a number of measures to reduce the huge annual increase in both peak electrical demand and annual energy consumption. MEW assigned the Kuwait Institute for Scientific Research (KISR) to develop the 1983 Energy Code of Practice, which saved the state more than $15 billion (Meerza and Maheshwari, 2002). Additionally, MEW funded a number of important research activities for KISR to reduce peak electrical demand and annual energy consumption such as energy auditing and peak power reduction strategies in air-conditioning (A/C) buildings, which saved additional peak electrical demand and annual energy consumption. MEW made an important step in 2007 by establishing an executive committee for savings electricity and water in Government Buildings and this committee still exists and conducts periodic meetings. The Ministry of Social Affairs and Labor (MOSAL) is a member in this executive

committee. This committee has helped the government agencies to implement number of measures to save water and energy in their buildings.

Most of social affairs activities are executed by MOSAL. The main objective of the government is to distribute social welfares for its Citizens. This can be done through establishing social units to help families socially and financially, nursing homes for youths, supervision of sport clubs and civil organizations. Additionally, MOSAL is responsible to organize and regulate the employments of forging labors at the private sector. Public Services Department (PSD) at MOSAL is responsible to maintain and sustain electrical, mechanical, A/C, pluming and firefighting systems for all MOSAL's buildings. MOSAL manages around 125 buildings in six Kuwaiti governorates. Additionally, water and energy conservation efforts have been given to PSD since 2007.

This paper describes the efforts done by the PSD to reduce water and energy consumption in MOSAL buildings for the past 5 years. Additionally, the paper will give MOSAL's vision for the next 5 years for further reducing water and energy consumption in their buildings.

2. METHODOLOGY

PSD has taken a number of measures to reduce the electrical consumption in about 125 buildings. These measures can be summarized as follows:

1. Installation of programmable thermostats for A/C units and implementing new lighting schedules.

2. Replacement of old A/C units and lighting systems with more energy-efficient systems.

3. Putting in shutters and solar films for windows.

4. Setting up insulation materials for roofs and walls and low-flow water tools.

3. RESULTS AND DISCUSSIONS

PSD implemented a number of measures to reduce water and energy consumption in 125 buildings distributed over 6 governorates. The following sections describe in details these measures:

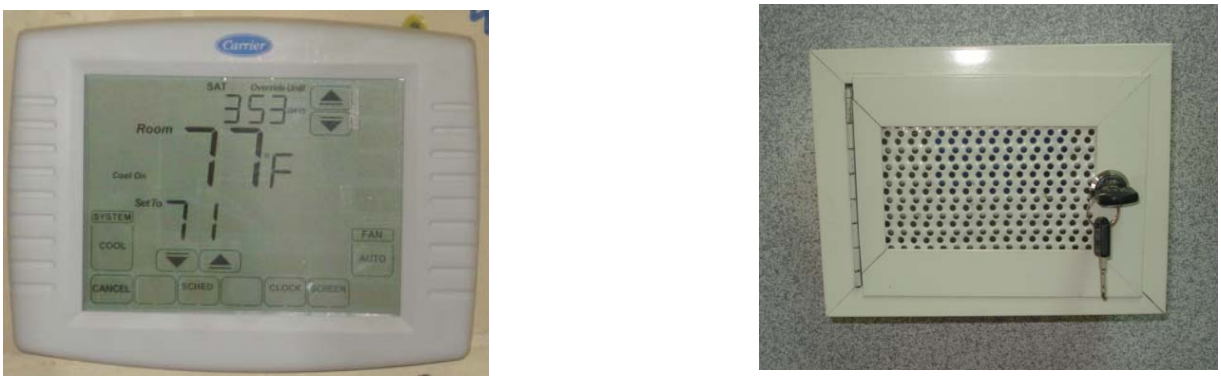
3.1. Programmable Thermostats and Implementing New Lighting Schedules

PSD installed programmable thermostats for most of A/C units in MOSAL's buildings. Table 1 shows the temperature set point ranges during occupancy and non-occupancy periods. The temperature set points remain the same in the weekends for non-occupancy periods. However, the pre-cooling periods start at midnight for the start of the week to overcome the heat buildup during the weekends and to ensure comfort conditions for the occupancies. Figure 1 illustrates one of the programmable thermostats utilized for the A/C units, which is securely fitted in a metal box to eliminate any changes in temperature settings by MOSAL's staff. This measure has been in action since 2008, received a lot of complains from MOSAL's staff in the beginning and the measure was about to be suspended from MOSAL's upper management. However, PSD staff made a number of experiments with temperature settings to achieve the optimum set point temperatures during occupancy and non-occupancy

periods. The ranges of temperature set points, which is shown in Table 1, were acceptable in all MOSAL's buildings. PSD were able to reduce the energy consumption by 20% by installing these programmable thermostats. For the lighting systems, PSD urged MOSAL's staff to switch off the lighting systems after working hours and in non-occupied offices, which started back in 2008. The degree of compliance was about 25-30% in 2008 and increased to more than 60% in 2012 due to increased awareness toward saving energy within MOSAL's staff. This action has reduced good amount of energy consumption for the lighting systems.

Table 1. Temperature Ranges during Occupancy and Non-Occupancy Periods.

Periods	**Temperature Range (^oF)**	**Time Range (h)**
Occupancy	70 -72	05:00 – 14:30
Non-occupancy	78 - 80	14:30 – 05:00



(a) (b)

Fig. 1. (a) Model of Programmable Thermostat, and (b) Locked Metal Box for Thermostats.

3.2. Replacement of Air-conditioning and Lighting Systems

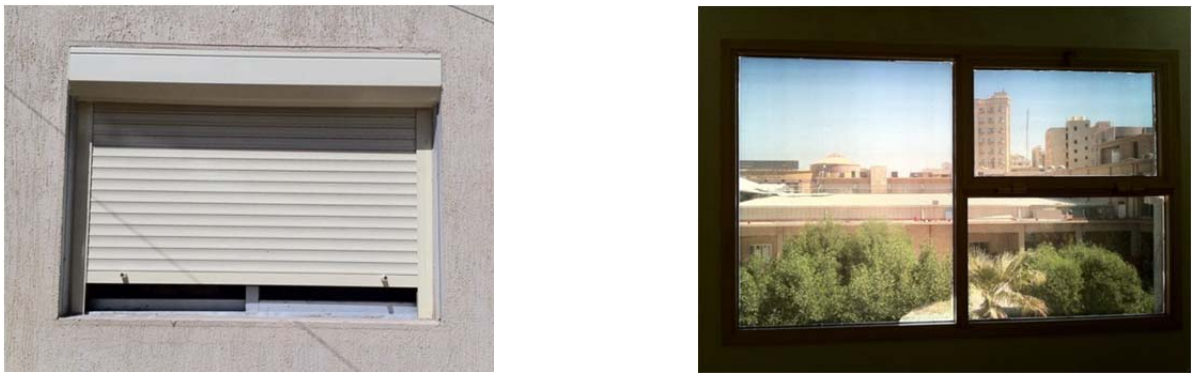
PAC and mini-split unites were replaced with newer more energy-efficient units as seen in Fig. 2(a). The savings in energy consumption were ranged between 15 and 20% for these A/C units. Additionally, incandescent lambs with 100 W each and low-efficient fluorescent lambs with old T12 tubes of 20 W and 65 W were utilizes in most of the offices and halls in MOSAL's buildings. A new measure was taken to replace most of these lambs by newer more energy efficient lighting such as compact fluorescent lambs with power range 13 W to 27 W each, as illustrated in Fig. 2(b). The savings in lighting systems reached up to 73%.

(a) (b)

Fig. 2. (a) Model of new mini-split unit and (b) New type of more energy lighting system

3.3. Shutters and Solar Films for Windows

Windows play significant role in heat gain and air infiltration inside MOSAL's buildings. To reduce these adverse parameters, PSD installed shutters and solar films for most of the windows, as illustrated in Fig. 3, where single and double-glazed windows were used in old and new constructed buildings, respectively. These measures have helped to reduce the heat buildup inside the MOSAL's buildings, which in turn reduce the cooling loads and energy consumption.



(a) (b)

Fig. 3. (a) Shutters and (b) solar films for windows in MOSAL's Buildings.

3.4. Additional Measures

Additional measures were also taken by PSD to reduce water and energy consumption in new and existing buildings. These additional measures can be summarized as follows:

1. Installation of insulation materials such as extruded polystyrene for roofs and walls in new and existing buildings as per Kuwait Energy Code of Practice [MEW, 2010], as seen in Fig. 4.

2. Putting in low-flow water tools for faucets as shown in Fig. 5.

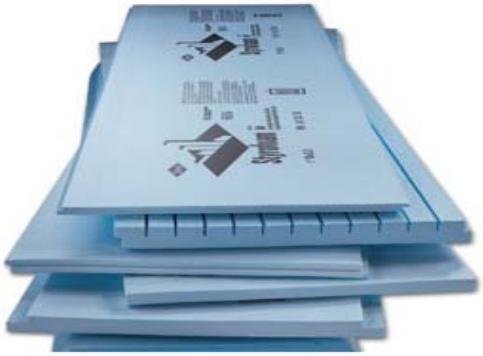


Fig. 4. Type of insulation materials used for walls and roofs.

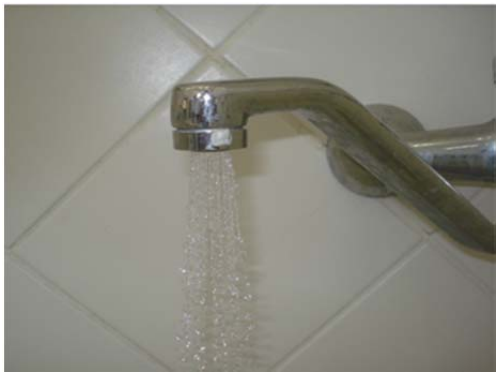


Fig. 5. Type of low-flow water tool to reduce water consumption in faucets.

4. FUTURE PLAN

MOSAL is planning to collaborate with Kuwait Institute for Scientific Research (KISR) to develop strategic energy and water conservation plan for the next 5 years. KISR has huge experiences in reducing water and energy consumption in new and existing buildings for the past 5 decades. Therefore, the main objectives of this plan will be as follows:

1. To further reduce water and energy consumption in all MOSAL's buildings.

2. To train PSD's staff to carry out water and energy conservation measures individually in the future.

The plan will consist of a number of important steps to ensure successful execution. These steps can be summarized as follows:

1. Online monitoring of water and energy to establish base case water and energy consumption in all MOSAL's buildings.

2. Conduct in-depth energy audits for all MOSAL's buildings.

3. Establish new operation strategies based on feedback from online monitoring and energy audits.

4. Implement new technologies to further reduce water and energy consumption in MOSAL's buildings.

5. Establish water and energy savings after implementing new operation strategies and technologies compared against base case scenarios.

6. Develop training program based on the outcomes of this plan for engineers and technicians in other government and institutional agencies in Kuwait.

5. CONCLUSIONS AND RECOMMENDATIONS

PDS has implemented a number of measures to reduce water and energy consumptions after the establishing of Executive Committee to save water and energy in government buildings by MEW in Kuwait back in 2007. These measures included the installation of programmable thermostats for A/C units, urging MOSAL's staff to switch off lighting after working hours, replacement of old A/C and lighting systems by newer systems, installation of shutters and solar films for windows and insulation materials for walls and roofs and low-flow water tools for faucets. These measures reduced the overall water and energy consumptions by 15 and 25%, respectively. Additionally, MOSAL is planning to collaborate with KISR to further reduce water and energy consumptions in MOSAL's buildings by optimizing operation strategies and utilizing new water and energy technologies.

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