

The Strategy of Saving Energy in Convenience Stores in Taiwan

Hao-Yu WENG

National Chung Hsing University

1. The condition of convenience stores in Taiwan

Convenience stores in Taiwan offer consumers quite many services that bring numerous advantages to people in Taiwan. The convenience stores offer consumers variety of food, cold and hot drink, fresh made coffee, newspapers and magazines, the aproducts of daily use, ATM machine, and even offer the channels for paying bills. Some of convenience stores in Taiwan which are established along the traffic line even offer parking apace, toilet and facility for relaxation offered, the service items could be said it has everything that one expects to find!

The nature of the business of convenience stores in Taiwan is it's open 24 hours and offer services which consumers need in any time. Because of its convenience, the store plays an important role in people's life, and as an enterprise, there was another nature of the business, franchising, this nature of the business assist people to set up convenience stores, offer working opportunities to people, and expand the domain of the chain convenience stores in Taiwan, therefore, it result in the increasing number of convenience stores. According to the recent data for the top five chain convenience stores companies have involved into 9204 stores. It is reported that in every area having 2500 people, there is at least one established convenience stores.

2. The potential of saving energy in convenience stores

Since there is an enormous number of convenience stores in Taiwan, saving a small amount of energy in one store could save a remarkable amount of energy from all the convenience stores in Taiwan. The nature of the business of 24 hours open and those friendly services result in impressive electricity consumed. Data even shows the consumed electricity of convenience stores is 4 times higher than the department stores and 1.6 times higher than supermarkets. Therefore, appropriate electricity management of convenience stores shows high potential in saving energy in Taiwan. So, having devise plans to face the high consuming electricity is an important topic in Taiwan.

The percentage of general electric consumption for equipments is as follows.

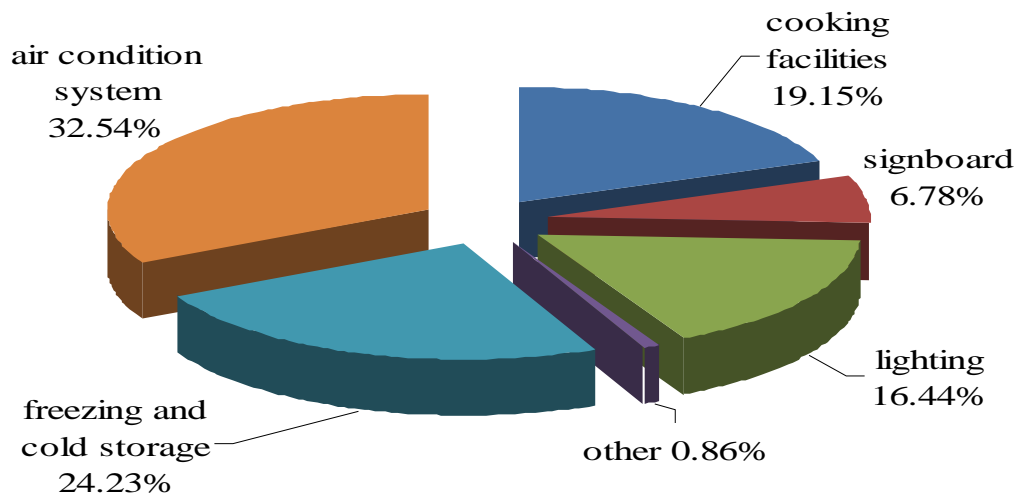


Figure1: Total electric consumption in facilities of convenience stores.

3. Strategies of saving energy in convenience stores

There are three main areas which can be focused on to reduce current power-consuming situations: 1) freezing and cold storage, 2) lighting and 3) air condition system. Besides, there are other ways for saving energy and all of those strategies can be integrated by an energy monitor system which can control the situation of consumed energy in anytime.

The most important thing is that if it could save a little electricity in one store, and then it could save a huge amount of electricity from all the convenience stores in Taiwan. Other useful strategies for reducing consumed electricity are to promote the energy-saving ideas, activities starting from clerks down to consumers. Although this activity could save some electricity, it could be accumulated to a huge amount of electricity to be saved.

A. freezing and cold storage

In convenience stores the electricity consumed in freezing and cold storage is 25%. So not only a good planning of design of freezers and cold storage be given emphasis, but also on how efficient these machines in saving energy.

The first step could be focused on structure design of cold storage cabinet which display food and could be divided to open-style cold storage cabinets and conventional display consoles. Generally speaking, the consumption of electricity on open-style cold storage cabinets are higher than conventional display consoles equipped. The reason is that open-style cold storage cabinets need much bigger cold air to maintain food

temperature. There is no ability to keep cold on opening, cold air combined with the in-door air result in the load of freezing equipments and frosting problems, So the initial design for cabinet structure is to avoid escaping of cold air, and the high efficiency converted technology can be introduced to the open-style cold storage cabinets and conventional display consoles equipped with anti-fog design for saving energy. In addition, there are not so many consumers at night, for open-style cold storage cabinets, attaching transparent curtain could avoid escape of cool air, thus, better insulation is effective.

The double-layers glass door is an important role on heat insulation used on conventional display consoles, and double-layers glass door are designed with anti-fog system. Under the good condition of maintained temperature in convenience stores, the cabinets which are designed including double-glass door is more easier to let the outside of doors maintain temperature higher than 13°C or could control electric heat divided to control the desired electric heat to save electricity by reduce load of cold storage equipment.

B. Lighting Equipments

The lighting equipments are applied widely in convenience stores, including the stores in-door lighting, display consoles lighting, signboard lighting, and the corridor lighting around stores, let the lighting equipments become a high consuming electricity item.

LED technology is an alternative for traditional illuminations. The most important thing is that the electric consumption of LED is just 60% of traditional fluorescent light tubes, and LED produce less heat. This could reduce the load of air condition system and the LED could apply in in-door lighting for a comfortable light condition, and also it could be used in display refrigerators to replace the traditional light tube. In Taiwan, LEDs are new rapidly replacing the use of light tube. And through a one year experiment, the result shows that it could reduce electricity to 69% of original electricity.

Because the nature of the business style of convenience stores is 24 hours open, the electricity consumption of signboard is high, which is about 7%. This should not be neglected. To reduce the power consuming-situation, there are three main strategies proposed:

1. Adopting automatic light-sensors in signboard. The automatic light-sensors could control whether the light open or not and how much light will be used depending on the weather. The device appropriately compliment sunlight with electric illumination are

also functioned for saving energy.

2. Setting up the light reflection board in the back of the signboard to increase the ratio of light reflection, and operating in coordination with the automatic light-sensors. The more the light reflected, the less the electricity is consumed.

3. Alternating high-power ballast to electronic ballast. The old signboard use the high power ballast and 40 W fluorescent tube. These 4 fluorescent tubes were placed every 35 centimeter; and use from on 5 pm to 7 pm which is about 4830 hours a year. Comparing with the new signboard using the electronic ballast, and because of the use of the light reflection board, the way of arrange the tubes become continuous, two tubes on up and down side, reducing the amount of tubes, and with the automatic light –sensor could reduce the electricity consumption about 2 hours a day.

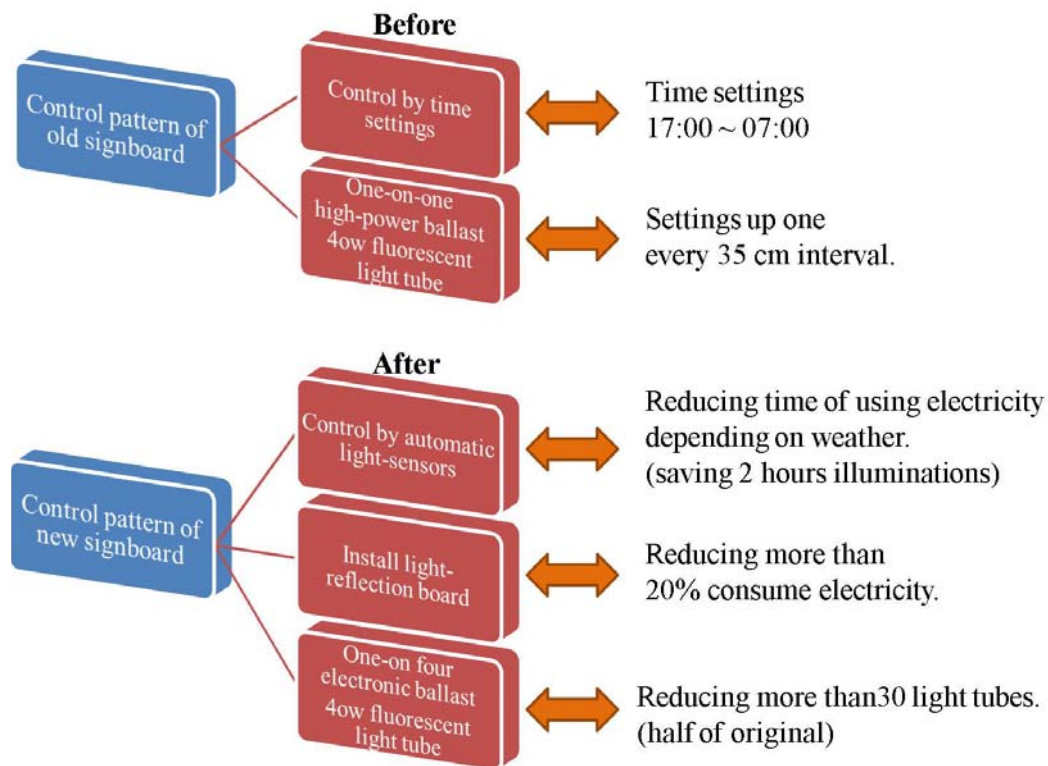


Figure2: Automation of signboard illumination: before and after.

C. Air condition systems

Convenience stores offer consumers a comfortable environment to buy something they need. Some of convenience stores in Taiwan offer a place for consumers to have meal or take a break. Maintaining a comfortable environment is undoubtedly an issue for convenience stores. The consumption of electricity from air condition system is 30%

and improving ways on how to reduce energy consumption should be necessarily addressed consumed electricity situation.

There are three areas which could be given attention to on how to save energy from using air-condition system: 1) high efficiency equipment apply, 2) system design for saving energy, and 3) design for reducing load of air condition.

The VRV air condition system could adjust the load of individual air condition. It could save about 30% of electricity more than the ordinary air condition system. The compressor of ordinary air condition system is stable, in other words, the amount of Freon released from compressor is fixed. When the in-door environment has reached the needed temperature, the compressor stop running, and if the temperature rises again, the compressor runs again. Comparing, the VRV air condition is adopted converted compressor, controlling the rotational rate due to the change of efficiency, when in-door temperature change, control system would put out different efficiency depending on proportion of load, when the air condition start running, compressor would running in high- rotational rate, which could lower in-door temperature rapidly; as arrived the desire temperature, the compressor would running in low-rotational rate, this way could that in-door temperature is maintain constant, and not only saving electricity, but have people feel comfortable.

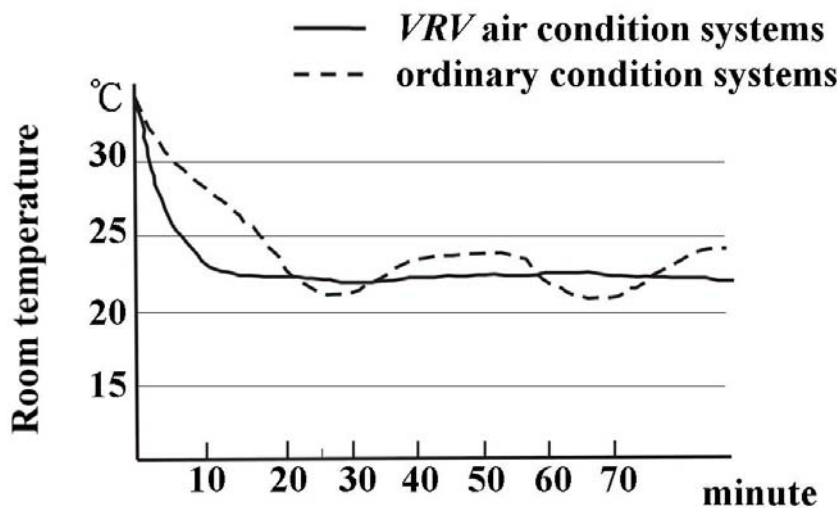


Figure3: Precision comparison of temperature control

There are always a lot of people coming in and out of the store, so the cold air is easily escapes. Now, stores often use the automatic door which could sense if there are people wanting to go inside. But if there are too many people coming inside and out, the

automatic door might not work. To avoid the loss of cold air, the air curtain avoids the cool air from escaping. It uses the cold air wall to insulate inside and outside air, and with the high-efficient converted air condition systems which regulate the temperature of the selling area corresponding to the outside whether will be very effective in energy saving.

Another way is to install the low-temperature energy-saving ventilators. There are much heat released by cold storage systems and cooking facilities, people and the out-door air come into stores..., thus, it adds more load for the air condition system to cool the area. Comparing, install the low-temperature energy-saving ventilators could lead low-temperature into stores in winter to decrease in-door temperature, so that it wouldn't have to waste too much energy on air condition system; in Summer, the ventilators could be cycle the in-door air to clean the air, which could reduce the time of running of air condition systems.

The indoor temperature could be adjusted at 25-26°C. It's reported that if rising 1°C the setting of in-door temperature, 6% electricity consumption saved. So it is important for store clerk to regularly monitor and adjust the indoor temperature at 26°C to save electricity from air condition use.

D. Other

Besides the three main aspects, there are still many situations could be improved.

Improving qualities of using electricity and power factors:

1. The original capacitor is adjusted from 300 μ F to 500 μ F. The reason for increasing the amount of entering capacitor is because it could avoid circuit power loss because of falling behind, and improve the quality on offering electricity.
2. Install voltage adjuster in front of main switch and illumination load, this way could promote ineffective to effective electricity.

There should be transparent lids on the cooking facilities of tea egg or other food, and these lids help to avoiding the steam and heat escape, and reduce the load of air condition system. The tea egg should be cooked at the backroom, and then moved to display area after cooked thoroughly. This step also could reduce load of air condition system.

Furthermore, popularizing energy monitoring systems which are performed by the network-based energy management and temperature control system construct an integrated energy saving monitor system. Through this system, the operating status and temperature setting of the energy consuming facilities can be continuously monitored and recorded. Derived data can contribute on how to improve the energy efficiency of

convenience stores and expect to save about 15% electricity.

Some convenience stores even use computer to simulate the situation before building the stores. It measures the length of roof to reduce the sun light radiate into the stores, in this way it can avoid the temperature of store become too high and the electricity to be used in the air condition system can be reduced.

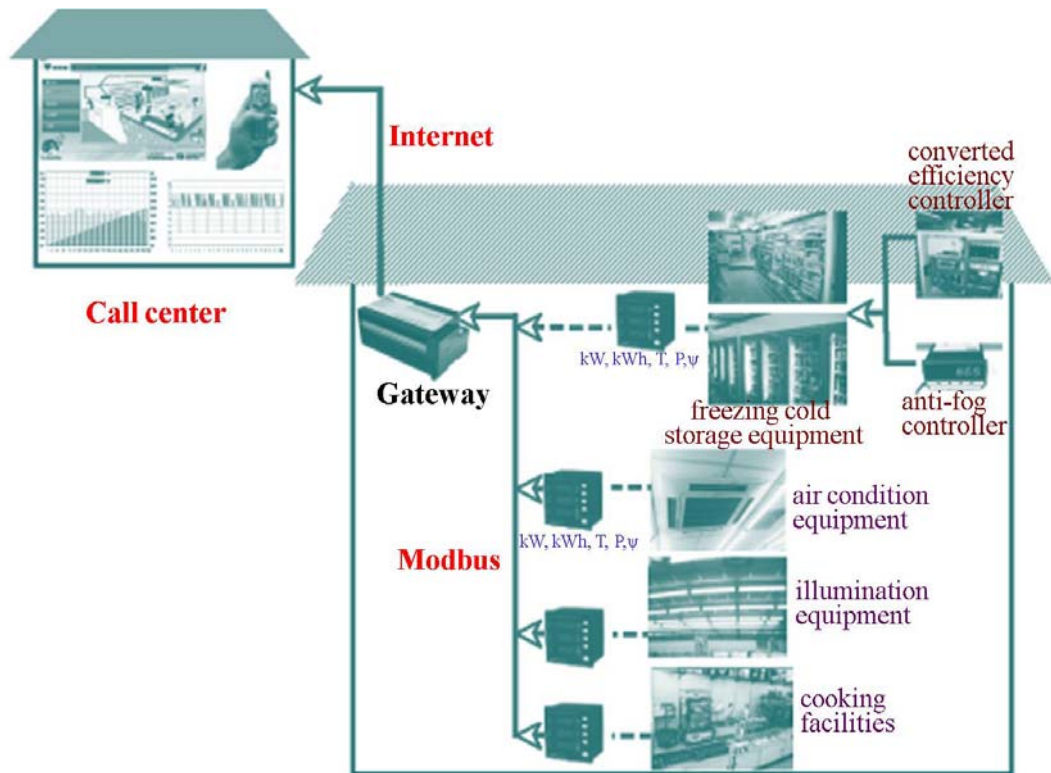


Figure4: diagram of freezing and cold storage equipment popularizing energy monitoring systems

4. Conclusion

To promote the saving energy policy successful in Taiwan, there are four effective steps to consider: 1) introduce new type saving energy equipment, 2) Establish correct operation and management, 3) emphasizing the good machine maintenance, 4) promoting the idea of effectively use energy to clerks.

Therefore, convenience store companies in Taiwan are suggested that should consider key ten points before building up stores: 1) quality of offering stable voltage, 2) lighting should be reasonable (lower than 1000Lux), 3) adopt high efficiency electronic ballast with tri-band light tube, 4) the light of signboard and passage are adopted with automatic light sensor controller, 5) adopt high efficiency models on air condition

systems and freezing and cold storage, 6)observed reasonable value of temperature, 7) strengthen regular check-up and maintenance, 8) encourage store management to offer trainings on saving energy for managers and stores clerks, 9) keep a record on some important store activities like setting temperature at 25-26°C, cleaning the filters of air condition system and freezers and cold storage equipment, clean of light tube...etc, 10) give regular supervision and assistance right in the store. By adopting those strategies, it is projected that it could save about 28% energy consumption in 2020.

The conditions of high convenience store density in Taiwan result in the high potential of saving energy. Some of those strategies which could respond to saving energy have been performed for a period time, some of those are just being tested, and there might be new techniques which will be developed in the future. Generally there are some fruitful results are displayed.

To face the globe energy crisis, saving energy could start from these convenience stores. A huge amount of energy would be saved if all those strategies mentioned will be followed. Nowadays, we all know that we are using energy from limited resources and find alternative resources will all take time. Thus, knowing how to save energy is very important understanding to mitigate over consumption of energy from depleting resources.

Strategy of Saving energy	Amount of electricity reduced (kW)	Amount of kilowatt-hour saved (kWh/a year)	Amount of CO2 reduced (metric ton)
Signboard illumination control automation	1.29	672	0.356
Improve illumination of marketplace	1.10	800	0.424
Install low-temperature energy-saving ventilators	0	2448	1.3

Table: Data for saving energy by adopting some strategies in one store.

Reference:

便利商店節能技術手冊：經濟部能源委員會編印

能源科技發展白皮書：經濟部能源局

中央廣播電台 NEWS：台灣便利商店高密度 2009/7/9 報導

經濟部能源報導月刊：<http://energymonthly.tier.org.tw/200902/34.pdf>