

# Actions and Experiences in Green Hospitals

Global warming and environmental protection advocacy are issues that we must undertake in national development and industry competition. In the green era, health care facilities have a huge responsibility for planning for the future and improving the quality of medical services.

Green hospital is a hospital operated with the concepts of environment protection; green hospitals not only provide health care services but also an environmentally friendly place that causes less harm to our planet.

The following section will introduce how Taiwanese and international hospitals operate to achieve energy saving and carbon reduction. Their experiences fall into the seven categories mentioned by “Healthy Hospitals - Healthy Planet - Healthy People” published by Health Care Without Harm: energy efficiency, green building design, alternative energy generation, transportation, food, waste and water. We also include education, a key strategy, in the last section.

## Energy Efficiency

By implementing energy-efficient measures for lighting, air conditioning and water heating systems etc., health care facilities could decrease energy consumption. Improving energy efficiency is the most cost-effective way to save energy and has quickest effect on global warming.

### Taiwan: Buddhist Dalin Tzu Chi General Hospital

Buddhist Dalin Tzu Chi General Hospital has devoted to promoting preventive medicine, community health promotion activities, and becoming a health promoting hospital since starting operation in August 2000. In the end of 2005, the hospital began to implement the health promoting hospital project that includes a hospital-wide health promoting system started in 2006, and application for membership in the Health Promoting Hospital International Network in 2007. It hopes not only to engage in staff, patients, community, and spiritual health, but also to include the environment as one of the

five health promotion agendas.

For the water heating systems, the traditional coal-fueled boiler system has the risks of explosion, huge carbon dioxide emission and energy consumption. After modifying the systems, the heat pump would produce hot water from absorbing the heat from the surrounding while reducing the production of carbon dioxide. Although the cost of the heat pump system is higher, it saves almost one fourth of the energy. Meanwhile, the cool air produced by the system can be incorporated into the air-conditioning system; they would stop or start automatically and thus increasing energy efficiency by adjusting to the temperature and cold water.

In addition to the heating system, it saves 6,018,147kW.h of electricity every year by installing inverters, monitoring the operative time of the extractor machine, using electric- saving lighting equipment, supplying the heat water by heat pump system, and improving the automatic sensor lighting in the public toilets and electrical lighting. Altogether it reduces 3,971,977kg of carbon dioxide annually.

## **Taiwan: Changhua Christian Hospital**

Changhua Christian Hospital is a medical center located in Central Taiwan. The superintendent and all staff are advocates of environmental protection and devoted to saving energy. They have won many honors and awards in energy saving and waste reduction from the government.

In their medical building, before adopting the landscape lighting photovoltaic system on its top floor, great quantity of electricity was consumed, especially during peak hours. After the installation of the 32.9kW photovoltaic system that operates along with Taipower Service, it provided clean renewable energy and reduced electricity use during peak times. It can save NT\$ 195,000 and reduce carbon dioxide emissions up to 41,450 kg per year.

In order to improve energy usage in the hospital, they tried to save energy and reduce carbon dioxide efficiently from its source, and the hospital had already implemented the following renovation projects:

- Changing the air-conditioner to a centralized temperature monitor in the hemodialysis room.
- Using an anti-Legionella ozone sterilization system in the cooling tower in the

Medical Building to decrease the effect of chemicals to the environment and to save water use.

- Upgrading the water-cooling system to improve efficiency. The water-cooling system zone pumps have been used for fourteen years and the motor is less efficient. With a normal full load delivery, the electric current reaches 45 ampere. By adopting inverters, the electric current was adjusted to 28 ampere according to actual needs. It can save NT\$ 161,117 and reduce 41,117 kg of carbon dioxide emissions every year.
- Renewing air-conditioning and the monitoring system in the outpatient department and burn operation room. There was no control circuit in the burn operation room prior to the renewal, and therefore the air-conditioning would operate for whole day, causing energy waste when no operation is performed. For this reason, they installed the air-conditioning switch to control the temperature. By doing so, the air-conditioning motor can save 13,965 kW.h of electricity per year.
- Changing the cooling tower radiator material to raise its heat dissipation efficiency and installing high temperature, high pressure sterilizing engineering in the supply center to save energy.

### **Taiwan: Chiayi Christian Hospital**

Water heating uses fossil fuels such as coal, heavy oil. The hospital uses steam generated during the process as the main energy source to sterilize and heat water for wards and general use. It accounts for a major part of cost in energy consumption. Therefore, if we can intercept the wasted heat emitted by the boiler chimney for reuse, it will save energy and reduce greenhouse gas emission, lowering operation costs for the hospital.

Chiayi Christian Hospital reformed the boiler chimney by setting a preheating device to intercept the heat emitted and recycle it. The new system can not only save the consumption of diesel fuel and water. It also reduces at least 115.518 kg of carbon dioxide emission per day and achieves reduction efficiency rate of 8.467%. The new system helps save NT\$ 189 of water use and NT\$ 339,417 of fuel use, with a total saving of NT\$ 339,606 per year. In addition, it achieved the emission reduction limitation standard by Kyoto Protocol, and has received a patent on the design.

## **Taiwan: Miao-Li General Hospital, Department of Health**

Miao-Li General Hospital, Department of Health, cooperated with Chunghwa Telecom in 2009 and had demonstration on saving energy by heat pump and lighting efficient project, which proved to save NT\$ 2 million per year. Compared with the eight months from January to August in year 2009 to 2010, the average monthly consumption of natural gas in the hospital decreased by 9,469 m<sup>3</sup> (54%), and saved NT\$ 122,655 on natural gas use per month. By September 2010, Miao-Li General Hospital has saved more than NT\$ 1.5 million. It is estimated NT\$2.3 millions will be saved this year.

In the hospital compound, they changed the gas boiler to a heat pump system, and changed the lighting equipment from T8 to T5 in the administration building and outpatient department. They also cooperated with the Intelligent Energy Network of Chunghwa Telecom to monitor, measure, and confirm the electricity use to enhance the system's efficiency, which will reduce energy consumption and lower the cost.

Intelligent Energy Network (iEN) is the monitoring system that collects and controls the information of related electricity use in the monitored network.

Together with the information collected, this equipment uses smart control system to improve efficiency and save energy and money.



Miao-Li General Hospital

## **Taiwan: Chang-Gung Memorial Hospital**

Chang-Gung Memorial Hospital places a huge emphasis on the optimization of energy use. Since the start of the hospital operation, they were actively involved in energy saving by design and operation management. Furthermore, the staffs are trained to promote the comprehensive energy saving methods. Their excellent performance on energy saving has rewarded many times by the Ministry of Economic Affairs.

### ➤ Electricity

Electricity utilization goals were set up to manage load, record and control the usage. The electricity system was simplified to increase the transformer loading rate. Elevators stop during down times, at night

and on holidays, and escalators are controlled with sensors. Large drinking fountains save energy by time-controlled auto switch according to frequency and area of use. Furthermore, the smaller machines are also controlled to ensure electrical use safety and achieve energy efficiency.

➤ Lighting

High efficiency, disaster-proof T5 lighting equipments are used. They are used in elevators, stairways and emergency lighting boxes. Automatic control equipments are used at windows or areas with natural lighting. Low-illuminated design is used in public areas or the areas with less people at night, and the infrared control system is used in the parking lot.

The administration and outdoor areas adopted the fluorescent light and table lamps. High-pressure sodium lamp and high efficiency, high power metal halide lamps are also used outdoors. LED or photovoltaic style lamps are used in the hospital compound.

➤ Steam

From June to August, the steam usage reduction is achieved by reducing temperature of heated water by one to five degrees. Heat pump was built to use ice backwater to raise the temperature of hot

water and decrease the temperature of cold water. The system also recycles the heat energy of steam, and stops the boiler at night, and uses electro-thermal system instead of heavy oil to maintain the temperature. Additionally, condensation water was reused, and part of the heated water can be heated during off-peak hours. The boiler chimney was also improved to increase the efficiency. The hospital would adjust the system's according to the frequency of boiler use, the necessity of steam and/or the setting of heat pump.

➤ Information system

Energy saving computer and peripheral devices such as LCD monitors were procured and used. In the hospital, the full-time departments would reduce the number of computers and printers turned on at night. IT related consumables such as toner cartridges would be recycled.

➤ Medical instruments

Priority in purchasing new medical instruments is based on energy saving or low energy consumption. However, old instruments still in use and not as efficient are used differently by reducing the standby time and energy consumption. The hospital would review energy use and replace high energy consuming equipment to reduce energy wastage. Modern, energy

-saving equipment is purchased, such as 1000RT air-conditioner with inverter, electrodeless discharge lamps and LED OA.



Chang-Gung Memorial Hospital- High efficiency, disaster- proof electrical lighting equipments

### **Taiwan: Taipei Medical University- Shuang Ho Hospital**

As the largest green building hospital in Taiwan, Shuang Ho Hospital devotes itself to energy saving and conservation, by setting up operational energy-saving systems, and constantly monitoring their efficiency.

#### ➤ Water

Water saving faucets were added in public areas while the flush system of the toilets were adjusted to save water.

#### ➤ Electricity

Lighting areas were adjusted in public areas according to use and switches

were added in offices. Equipments with high electrical consumption were replaced, sensor lighting lamps were adopted in medical buildings, operating times of elevators in the medical building were adjusted (only two elevators, one for visitor and the other for bed transport, are in service from 11 pm to 7 am), and the operating time of water pumps were adjusted.

#### ➤ Air-conditioning

The temperature of iced water was increased by 1°C to lower the electric current of ice water machine. It can save 6% of electricity consumption.

#### ➤ Fuel use

In order to reduce the carbon dioxide emissions and air pollution, the hospital chose clean gas as fuel.



Shuang Ho Hospital

## **Taiwan: Mackay Memorial Hospital Tamsui Branch**

A heat pump system is installed in the dormitory of the administration center. Two flood 80RT heat pumps supply both hot water and cold water. During the day, the pump provides pre-heated and pre-cooled water for the boiler system. The hot water would be mainly used for the dormitory and pumped into the heated water tank on the roof, and the cooled water is pumped into the pre-cooling tank.

The boiler heats 24.1tons of water per hour in the day, and only 17.7 tons at night. Assuming 5.1 hours of operation per day, the hospital can save approximately NT\$ 700,000 per year and reduce heavy oil use by 30%. Moreover, carbon dioxide emission is reduced by 130,000 kg (49% less emissions than before).



Mackay Memorial Hospital Tamsui Branch- Heat pump system

## **Singapore: Alexandra Health Cluster**

Within the hospital, aspects of processes, systems and technologies work together to achieve energy efficiency.

The following are some examples of increasing energy efficiency:

- Installation of motion sensor lighting equipment.
- Using compactly-stacked blade servers in the data centre frees up more space in the hospital for other purposes. These blade servers also use less power by 33% compared to the traditional rack mount servers.
- Piped water from the Yishun pond adjacent to the hospital is used to cool the data centre.