

The Implementation of Building and Energy Management System in Optimizing Energy-saving Practices Taichung Tzu Chi Hospital, Taiwan

GGHH Agenda Goals

- Buildings
- Energy
- Water

Hospital Goal

- Innovation in building design, system and equipment to reduce energy (electricity and oil) consumption by 1% yearly
- Reduce carbon dioxide emissions and quantify hospital's carbon footprint

Progress Achieved

- Building Materials were locally sourced. Roofs are tilted for rain catchment and easy installation of solar panels. Used brick are permeable to allow absorption of ground water
- Increase in electricity consumption was only 3% despite the 7% growth in medical services provided from 2013 – 2014
- The installation of solar power generation equipment in 2007 creates over 1,245,000 kWh of electricity. Generated electricity reduces hospital's CO₂ emission by 128 metric tons and facilitates electricity savings of USD \$114,715 (NT 3,487,000)
- The installation of Building Energy Management System helped reduce operating time of Air Handling Units by 42%. Consequently, decrease in electricity usage and CO₂ emission was recorded. Around 5,847,300 kWh and 3,134 metric tons of CO₂ emissions were saved yearly compared to previous consumption
- The Heat Pump System effectively heats water from 26 to 58 Celsius. Using the Heat Pump System reduces the CO₂ emissions by 42 metric tons and allows the hospital to save approximately USD \$31,253.1 (NT 950,000) annually. Before utilization of the Traditional Boiler incurs expenditure amounting to USD \$42,767.4 (NT 1,300,000) for its operation using natural gas while generating 112.8 tons of CO₂ emission. However, with the use of Heat Pumps, electricity consumed is around 131,000 kWh which is approximately USD \$11,514.30 (NT 350,000)
- Our solar panel installation and green building design received much recognition from various awarding institution. Some of these awards are "Jingyi" award in 2008 and "Green Building Certification (Silver)" from the Construction and Planning Agency of the Ministry of the Interior 2013
- From January 2012 to December 2014, 172,227 m³ of recycled water was collected from rainwater catchment and water recycling facility. The collected water replaced usage of

tap water for irrigating gardens and cleaning public toilets which reduced hospital's CO₂ emissions by 33 metric tons



Green label building

Building Energy Management System

Reclaimed water system

Rainwater system

The Issue

In 2011, Taichung Tzu Chi Hospital has started to expand by increasing hospital beds from 381 to 1081. The expansion subsequently increased our energy needs which heightened our electricity consumption. The consumed electricity accounts for most of our energy expenditure (86.4%). Due to this, we faced significant challenges in managing and balancing energy consumption and expenditure with energy conservation.

- Taiwan ranked 18th in the list of countries experiencing water scarcity. On average, Taichung Tzu Chi Hospital consumes 742 liters per capita daily. This is relatively higher compared to other commercial sectors. However, installation of water – saving technologies and equipment reduced water usage by at least 38%

Sustainability Strategy Implemented

Installation of Building Structures and System:

- Our centralized monitoring system uses Building Energy Monitoring System (BEMS) that collects usage data of illumination, air-conditioning, medical gas, water, diesel expenditure and conditions of electrical circuits
- Using hospital's built-in Wastewater Reclaimed Systems, non-hazardous waste water from daily activities is filtered. Water is cleaned through sand filters, by addition of disinfectants and is then deposited in 6 storage tanks with a combined volume of 290 metric tons
- The rainwater harvesting system could store up to 276 metric tons of rainwater Public restrooms were equipped with water-saving toilets

Implementation Process

1. Green Building Design :
 - Since the beginning, we opted for local construction materials to protect the ecosystem and prevent land erosion. Therefore, we used water permeable bricks around the hospital and tilted roof. This action provided easy collection of rain water and setting up of solar panels to collect and generate electricity
2. Digitalized Monitoring System:
 - We used BEMS collects usage data and compares with historical data of air-conditioning, illumination and water. If the system detects any abnormality in terms of the set trends, an alarm will be triggered and initialize usage reduction measure, if needed.
 - Analysis of data collected from BEMS is made in conjunction with observed weather conditions, level of hospital activities and operated medical equipment in order to employ the best operating energy model
3. The 3R's (Replace, Re-use, Recycle)
 - Helical recessed lamp is gradually replaced by LED lighting
 - The boiler is being operated using natural gas and not with diesel as energy source
 - Air Handling Unit schedule uses 42% less time compared to regular system to cool down
 - Rainwater was collected to irrigate gardens and recycled water was used in public toilets in the hospital.
 - Water-saving devices in public facilities were installed including sensor faucets, tap aerators, low-flush toilets and two-stage flushing devices
 - Speed of water flow is adjusted in dormitories from 19.2L/min to 10L/min
4. Implementation of environmental conscious activities and obligatory classes that provide staff members with continual educational credits:
 - Regular seminars and orientations are conducted to educate employees on energy-saving ideas and its incorporation to daily routines
 - Every 22nd of April (World Earth Day) a seminar is arranged to communicate with the employees the importance of saving energy. During this particular seminar, saving energy is highlighted because of summer season. This season incurs highest electricity consumption among others
 - Several policies and reminders have been communicated employees and patients such as, switching off electric appliances that are not in use, taking stairs instead of elevators (for 2-3 levels), setting air conditioners' temperature not exceeding 26 degrees Celsius, switching off lights at lunch breaks and shutting down personal computers after work

Tracking Progress

- Automatic Surveillance Systems monitors daily energy utilization from which energy expenditure may be collected. Acquiring this data facilitates setting energy expenditure limit for specific hospital location or department
- Green policies ensure that yearly goals are created to set limits for energy expenditure. The Maintenance Department reports actual amount of energy expenditures at monthly meetings held

- Cost for energy expenditure stays under 7% of hospitals net income. Yearly electricity consumption should be less than 2.80% (annual electricity utility cost divided by total kWh/year)

Challenges and Lessons Learned

Energy demand in each departments of hospital is not the same. When we started to extend new building, we lack management indicators model to evaluate energy efficiency of different departments. Utilizing BEMS, collection and data analysis pertaining to energy expenditure was made more effective and efficient. This paved way in standardizing energy expenditure for different hospital location and departments. Moreover, departments who made significant reduction in terms of energy use and cost serve as benchmark for other hospital members.

Reducing Greenhouse Gas emissions requires behavioral change but personal habits were proven difficult to change. The energy conservation plan may only be implemented through cooperation from different stakeholder. In order to address this concern, continuous communication, education and training was given to develop good habits.

Next Steps

Optimization of BEMS in response to changing climate is essential in helping hospitals to collect data on energy expenditure. This data could help hospitals determine the right decisions in updating their power-feeding system. In addition, computerized monitoring and routine maintenance are key elements to successfully prevent over-usage. Finally, public education is the most important factor in helping hospitals to reduce energy usage; therefore, protecting our natural resource.

Demographic information

Taichung Tzu Chi Hospital is located in Tanzi District of Taichung City, spanning over 184,921 square-meters and holds a 1081 beds capacity, with a staff number of more than 1,500. We provide holistic care and preventive medicine through community medicine, home visits and health counseling. Since the beginning, we opted for local construction materials to protect the ecosystem and prevent land erosion.

Links

<http://taichung.tzuchi.com.tw/>

Quotes:

It is always challenging to turn a very difficult situation into something easy. More so, it is difficult to turn them into something that is workable or feasible. At the beginning of the implementation, we received opposition from hospital staff and visitors. By utilizing modern technology, we gained experiences on how to smartly use the data to communicate and to provoke change. Although tools can be very helpful, we human still are the backbone of energy solution. – Mr. Xu-Fu Yu, Taichung Tzu Chi Hospital

Keywords / Topics:

Energy efficacy, Green Building, carbon dioxide emissions, Building Energy Management Systems, BEMS

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