

ASEAN Best Practice Competition for Energy Management in Building



ASEAN Energy Awards 2014
Category : Small & Medium Building



KANTANG Hospital
Trang, Thailand





Category: Buildings Large Small and Medium
 Industries

Title of Activity / Project / Theme:

Energy Management

Applicant General Information

Name of Company	: Kantang hospital
Business Address	: 39 Khuan-thong-see Road , Kantang Trang Thailand 92110
Number of Employees	: 251 persons
Type of Building	: Hospital Building. Total area of a building 5,572 square meters
Age of Building	: 23 Years
Nature of Business	: Public hospital / Medical Center
Contact Person	
Name	: Dr. Yodsagorn Nedsaengtip
Position	: Director of Kantang hospital
Telephone	: 66-075-251256
Mobile phone	: 66(8)-1-271-1552
Fax	: 66-075-252014
E-mail	: doctong@hotmail.com

Project Abstract:

Kantang hospital is community hospital (non-controlled building) which can serves 60 beds. Number of building users was about 154,953 people/year (staff 251 person, IPD 52 person/day and OPD 522/day). There are 2 categories in working time; the first category is 24 hours nursing, 3 shifts with 8 hours each (ER, delivery operation, IPD) and the second category is working hour 8.30 A.M.-4.30 P.M.. The hospital has the area between each buildings with the complex medical service including managing building, OPD/IPD building, emergency room, operation room, pipeline system, autopsy room, and library room. The hospital consumes 3 main types of energy which are electricity, diesel and LPG. The average total energy is 6,043,573.90 MJ/year. Energy conservation has been operating since 2010 by leading of Dr. Yodsagorn Nedsaengtip, MD. as a director of this hospital. As the result, the trend of energy dramatically decrease due to participating of all officers to drive the plan to save the energy. In addition, 3P (Place, People and Process) strategy are important to operate energy conservation. In conclusion, all of these could help save **15,008.02 kWh per year calculated as 64,834.65 baht per year. Moreover, energy efficiency index (EEI) of the hospital was 101.27 MJ per bed-day in 2013. It decreased 5.61 percentage of EEI in 2012.**



CERTIFICATION AND ENDORSEMENT

The Kantang hospital hereby agreed to allow the ASEAN Board of Judges and other experts that may be designated by ACE to visit the building and verify the authenticity of the data. However, two weeks advance notice is required to allow for necessary arrangements.

We also hereby agreed that ACE can publish the whole submission in ACE publications and website, without any prior consent of the owner of the buildings. If the submission will be published in other publications, the consent of the concerned building would be required.

We, the undersigned certified that the information given is true and accurate and prepared with the consent of the party/ies involved.

(Dr. Yodsagorn Nedsaengtip)

Director of Kantang hospital
Kantang hospital, Thailand

Tel : 66-075-251256, 66(8)-1-271-1552

Fax : 66-075-252014

E-mail : doctong@hotmail.com

(Mr. Bandhit Ngamwattanasilp)

Managing Director
Innovation Technology Co., Ltd.

Tel : 662-914-4080-1

Fax : 662-914-4082

E-mail : bandhit.n@inno.co.th

(Dr. Twarath Sutabutr)

Deputy Director General

Department of Alternative Energy Development and Efficiency, Thailand

Tel : 662-223-0021-9 ext. 1230

Fax : 662-226-4213

e-mail : twarath@dede.go.th

Introduction

Kantang hospital was established in 1940 as a secondary public health center. In 1963, it was extended to the primary public health center. It is located at around Tang Provincial Electricity Authority. In 1970, it was upgraded to Medical Center and Health and elevated to 10-beds hospital in 1981. In prior 1987 to 1989, it extended to 21 Rai by donation and rent at KhuanThongSi Road, Trang district, Trang province, was expanded to 30-beds hospital. It was been community hospital (60-beds) from 1996 to present.

Building age	:	23	year
Levels	:	2	level
Ground levels	:	-	level
Car parking	:	-	level
Total building area	:	5,572	m ²
Used area	:	51,797	m ²
Air-conditioning area	:	2,075	m ²
Non-air conditioning area	:	3,497	m ²
Car parking	:	5,075	m ²
In-patient	:	60	bed

The hospital has the characteristics of its building group which has not been located close together with the complex medical service including managing building, OPD/IPD building, emergency room, operate room, pipeline system, autopsy room and library room which can serve several cases of accident. The hospital consumes 3 main types of energy which are electricity, diesel and LPG. The average total energy is **6,043,573.90 MJ/year**. Energy conservation has been operating since 2010 to present. As the result, the trend of energy dramatically decreased.

1. Impact

1.1 Energy Saving

Energy conservation of Kantang hospital has been operating since April 2010. This hospital is a small community hospital (non-controlled building). However, the hospital did willing to conserve the energy so energy conservation team has started operations of policy announcement, training, investigation, doing process analysis and studying successful hospital for creating idea and sustainability. The result of operating energy conservation can save **15,008.02 kWh per year** of electrical unit and **64,834.65 baht per year** of electricity cost by non-investment.

Table 1 Energy consumption and in-patient amount of Kantang hospital from 2011 to 2013

Year	Electricity		Thermal (MJ/year)		Total energy (MJ/year)	In-patients (Bed-Day/year)	Energy efficiency index (MJ/Bed-Day)
	(kWh/year)	(MJ/year)	Diesel	LPG			
2011	453,350.00	1,632,060.00	10,926.00	277,068.68	1,920,054.68	18,627.00	103.08
2012	501,575.03	1,805,670.11	14,568.00	255,570.24	2,075,808.35	19,347.00	107.29
2013	486,567.01	1,751,641.24	16,389.00	279,680.64	2,047,710.88	20,220.00	101.27
Total	1,441,492.04	5,189,371.34	41,883.00	812,319.56	6,043,573.90	58,194.00	-
Average	480,497.35	1,729,790.45	13,961.00	270,773.19	2,014,524.63	19,398.00	103.85

1.2 Environmental Effect

1.2.1 Reduced carbon dioxide (CO₂) evaluation from energy conservation

Global warming caused by human impacts on climate change. Mankind consume too much energy to serve their need. Carbon dioxide (CO₂) is most important greenhouse gases that is ranked as the indication of energy using by human. The more CO₂, the more energy that is used. Human activities use energy such as transportation and production which produce CO₂. Kantang hospital operated the energy saving which can lead to the reduction of CO₂ releasing **61,641.94 kgCO₂ per year**.

1.2.2 The management of waste and pollution

Kantang hospital has a policy to manage waste disposal from the operation, especially infectious waste, hazardous waste and general waste which are managed in waste sorting station before the outsource will operate its. The hospital has a campaign on managing recycle waste from different sections in the hospital by recording the weight of recycle waste and the weight of the overall waste to evaluate how much each section can save. Hospital will give the money from selling recycle waste back to each section in form of green technology products.



Storage and sorting of garbage in Kantang hospital

1.2.3 Reuse

Recyclable materials are used regularly, as A4 paper, cardboard, packaging of gloves used in surgery and plastic water bottles. The efficiency energy using member (EEUM) use recycles to decorate the bulletin board in terms of energy conservation and other works.



The competition of recycle clothes



Flower from plastic bottle



Bag from fabric scraps



Tissue box from saline water bottle

1.3 Economic Effect

In first 3 month, the committee has launched energy conservation projects which are used less budget. In the next period, the committee will considered bigger investments which have short payback period or less than 3-3.5 years (such as changing the high efficiency air-conditioning or investing on tools and machine).

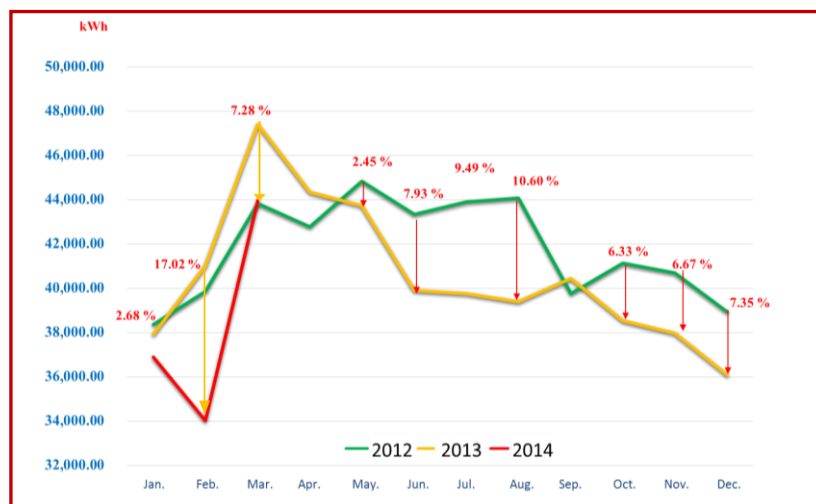
Table 2 Energy conservative results (2011 – 2013)

Energy conservative operation within 3 years	Energy conservative results per year					Investment (baht)	Pay back period (year)
	Electricity						
	Power (kW)	Electrical Units (kWh)	Cost saving (baht)	CO ₂ Emission Coefficient	CO ₂ reduction		
1st year 2011							
Non-investment							
Campaigned turning on lighting only using area	-	-	-	-	-	-	-
Air-conditioning							
Adjusted air temperature which should be more 25 °C excepting server room	5.04	7,358.40	22,075.20	201.81	5.35	-	-
Kept exhausting cooling air by closing door and window	-	-	-	-	-	-	-
Exploded and repaired leakages for cooling loss	-	-	-	-	-	-	-
Changed time to turn on air-conditioning from 8:00 AM to 9:00 AM	-	-	107,792	-	-	-	-
Campaigned turning off air-conditioning before 30 minutes of clock out	-	-	-	-	-	-	-
Cleaned filter every a month	-	-	-	-	-	-	-
2 times of big cleaning per year for air-conditioning by professional technician	-	-	-	-	-	-	-
Set amount of people to use meeting room	-	-	-	-	-	-	-
Marked time of the truing on/off air-conditioning	-	-	-	-	-	-	-
Lighting							
Changed the time of turning on/off lighting at outside building	14.08	37,230	111,690	201.81		-	-
Campaigned turning off lighting when non-working time	-	-	-	-	-	-	-
Reduced lighting surplus if the working area has more than lighting standard	-	-	-	-	-	-	-
Discharged lamps for unnecessary area	-	-	-	-	-	-	-
Marked lighting switch that match between lamps and switch	-	-	-	-	-	-	-
Other operations							
Unplugged television	-	-	-	-	-	-	-
Did not use remote control to turn off TV	-	-	-	-	-	-	-
Cleaned fan at least 1 times per month	-	-	-	-	-	-	-
Filled properly water into electric kettle	-	-	-	-	-	-	-

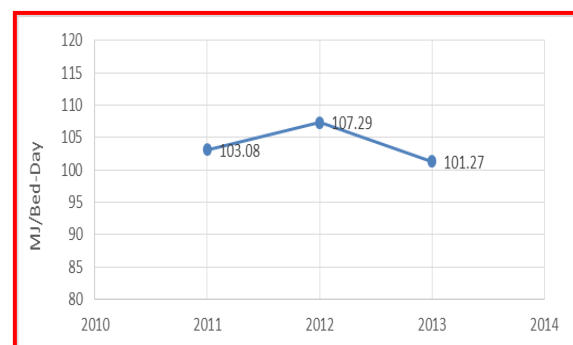
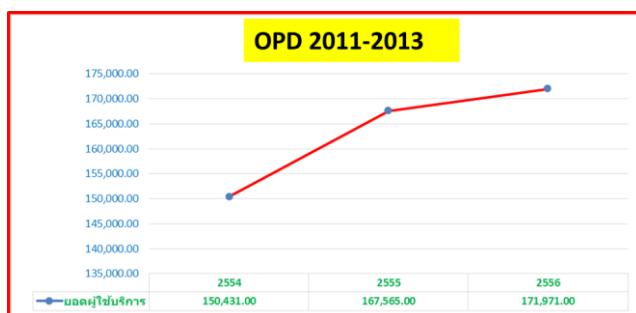
Energy conservative operation within 3 years	Power kW(	Electrical Units (kWh(	Cost saving (baht)	CO ₂ Emission Coefficient	CO ₂ reduction	Investment (baht(	Pay back period (year(
Unplugged electric kettle when non use	-	-	-	-	-	-	-
Thawed ice of refrigerator	-	-	-	-	-	-	-
Logo contest slogans campaign to save energy	-	-	-	-	-	-	-
Used Energy Saving mode for computer	-	-	-	-	-	-	-
Set time to service out-patient	-	-	-	-	-	-	-
Adjusted properly refrigerant temperature	-	-	-	-	-	-	-
Investment							
Separated switching lamps on second floor	-	11,047.33	33,141.99	201.81	8.03	549	0.02
Set personal switch for lighting on second floor (Back Office)	-	3,312.00	9,936.00	201.81	2.41	1,000	0.10
Managed switch and lamp at meeting room	-	7,153.00	21,459.00	201.81	5.20	654	0.03
To set film at rental room, IT room, financial room	-	NA	NA	201.81	NA	34,000	NA
Replaced standard ballast with electronic ballast (Low Loss)	2.18	106,228	347,662	201.81	77.88	No data	-
Total saving in 1st year	21.3	172,328.73	653,756.20	1,210.86	98.87	2,203	0.15
2nd year 2012							
Non-investment							
Changed time of turning on/off of light on billboard at terrace	-	2,920	8,760	201.81	2.12	-	-
Adjusted transformer voltage to be suitable use	-	-	-	-	-	-	-
Set time of turning on/off aeration pumps, water treatment systems	-	-	-	-	-	-	-
Tested rechargeable emergency light on Saturday and Sunday	-	-	-	-	-	-	-
Set time of turning on/off autoclave	-	-	-	-	-	-	-
Served appointment to reduce waiting time	-	-	-	-	-	-	-
Set the air flow and increasing temperature of air-conditioning	-	-	-	-	-	-	-
Set area to take natural light	-	-	-	-	-	-	-
Total saving in 2nd year	-	2,920	8,760	201.81	2.12	-	-
3rd year 2013							
Non-investment							
Changed operating time of air-conditioning at meeting room	33.9	61,867.5	190,108.00	201.81	44.95	-	-
Turned off some lamps at hospital entrance after 9:00 PM	-	12,045.00	36,135.00	201.81	44.95	-	-
Investment							
Set personal switch for lighting (Back Office)	3.6	3,312.00	10,415.00	201.81	2.41	1,000	0.10
Separated switching lamps at medical records department	8.4	7,153.00	22,576.00	201.81	5.2	654	0.03
Set solar cell for officer car parking	0.17	1,261.44	5,449.42	201.81	3.95	5,000	0.91
Replaced fluorescent T8 (36w) with LED T8 (20w)	0.72	4,043.52	17,468.00	201.81	12.70	19,000	1.08
Replaced halogen (50w) with LED (5w)	0.02	86.40	373.30	201.81	0.27	500	1.33
Total saving 3rd year	46.81	89,768.86	282,524.72	1,412.67	114.43	26,154	3.45
Total saving within 3 years	68.11	265,017.6	945,040.92	2825.34	212.42	28357	3.6

1.4 Energy Efficiency Index

Energy efficiency index (EEI) of community hospital (non-controlled building) is evaluated by energy use (MJ) per in-patient (bed-day). Kantang hospital serve 60 beds. In 2013, EEI of the hospital was **101.27 MJ per bed-day**. It decrease **5.61 percentage** of EEI in 2012. (EEI standard of government hospital is 262 MJ/per-day, Source: Project of energy using standard in industries and buildings (Specific Energy Consumption (SEC) in hospital case) from Department of Alternative Energy Development and Efficiency)



Energy Consumption in 2012-2014



The quantity of OPD(people) and Energy Efficiency Index (MJ/Bed-Day) in 2011-2013

2.SUSTAINABILITY

2.1 Level of Participation and Involvement

Energy conservative implementation is committed to the efficiency use of energy by drastic reducing unnecessary energy use by participating of all officers to save the energy. Energy conservation team has been setup and divided into the energy committee, subcommittee on energy saving (Academic, Public relations, Engineering, Information technology, Management, Environment, the committee on tracking energy consumption and efficiency energy using member (EEUM)) which will support, promote, and present the energy conservation. In addition, there were many external agencies support such as donating solar cell and cost subsidizing for solar collector.

2.2 Top Level Management Commitment

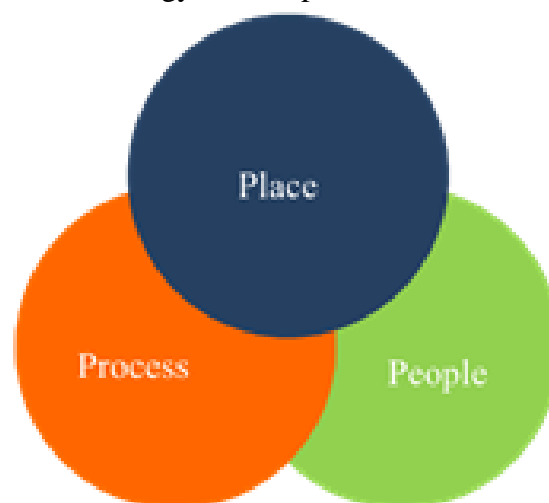
Dr. Yodsagorn Nedsaengtip, MD., a director of Kantang hospital, has started energy conservation by analyzing the cost of hospital operations. The result has shown that the energy cost is high, especially electricity cost. It is about *2,102,356.96 baht per year*. However, the energy consumption has been reduced drastically according to whole officers of Kantang's participating on energy saving. Moreover, due to the setting of the energy conservation team and the director of the hospital who combine energy conservation and saving energy policy into managing Kantang hospital strategy, the hospital can save the energy cost dramatically. The main target is that the hospital will be the model of energy conservation for external agencies and community hospitals within 2015. All results will be followed and assessed.

2.3 Short and Long-term Plan

The plan for energy saving is to create attitude, behavior and awareness of the employee. Recruiting volunteers is a major force in the implementation of the project promoting activities to conserve energy which causes the savings of electricity costs explicitly using simple methods. The saving cost would be used to replace low efficiency machine with high efficiency machine.

KanTang hospital has "applied and developed" with excellent and fast by "the key" that will lead to "success and sustainability" *The Key is "3P" which is Place - People - Process*. The definition is described as below.

Place defines as working layout, electrical appliances and equipment for example; an air-conditioning is used more than 10 years and the efficiency of one will decrease with increasing lifespan . This means that it consume high energy while it produces less ton of cooling. Hence, the new air-conditioning which has high Energy Efficiency Ratio (EER), should be instead of the olds. People define as users who are staffs, patients, relatives of patients and contractors. It is difficult and important because if users have high efficiency equipment but they did not understand to operate equipment properly. The equipment might not be usefulness for saving energy. Thereby, training course, operating in real situation with small group, analyzing the problem by using Life Cycle Assessment (LCA) and following the energy assessment are significant. Process defines as technical process or every other process which will be able to reduce the energy consumption of Place and People.



Concept of energy management

Table 3 Energy conservative operation in the future

No.	Energy conservative operation	Operating period)M / Y(		Target of energy conservation per year			Investment)baht(	Payback period)year(
		Start	End	Power)kW(	Electrical units)kWh(	Cost saving)Baht(
Year 2014									
1	Replaced fluorescent T8 (36 W) with LED T8 (20 W)	Jan	Mar	0.02	7,153.92	16,255	21,600	1.32	
2	To improve electricity transmission in hospital	Mar	May	-	-	-	798,394	-	
3	To set energy management system	Mar	May	-	-	-	830,225	-	
4	To recruit EEUM	Apr	May	-	-	-	-	-	
5	To build condensing unit base at outside for good ventilation	Apr	Oct	-	-	-	10,000	-	
Year 2015									
1	To set energy management system to all departments	Jan	Mar	-	-	-	500,000	-	
2	To set LED street light	Jan	Apr	0.55	2,376.00	94,647	250,000	2.64	
3	To increase setting LED that it operate more than 12 hours	May	July	0.02	-	-	-	-	
No.	Energy conservative operation	Operating period)M / Y(		Target of energy conservation per year			Investment)baht(	Payback period)year(
		Start	End	Power)kW(	Electrical units)kWh(	Cost saving)baht(
4	To replace air-conditioning (lifespan > 10 years) with the new air-conditioning (high EER)	Jan	Dec	54.00	388,800.00	1,671,840	750,000	0.44	
5	To set water meter at each department	Jan	Dec	-	-	-	-	-	
Year 2016									
1	To set solar cell to produce electricity for lighting around building	Jan	Dec	2	-	-	1,000,000	-	
2	To use hot water from solar collector for new patient building (30 rooms)	Jan	Dec	-	-	-	-	-	
3	To set insulation and film at new patient building	Jan	Dec	-	-	-	-	-	
Total						9,529.92	1,782,742	4,150,219	4.4

2.3.1 Organization



Energy conservation team

2.3.2 Establishment of Organization of Energy Management

Energy conservation team has been set up and divided into the energy saving directing committee, subcommittee of energy saving (Academic, Public Relations, Engineering and Information Technology, Management, Environment), the Committee of energy consumption tracking, and efficiency energy using member (EEUM). In summation they are **15.2 % of the totally employees**.



Announcement of energy conservative policy and conclusion of energy conservative operation

2.4 Capacity building

2.4.1 Activities: Projects / activities applied for internal and external of organization

Energy conservative activities are focused on participating officers in Kantang hospital by creating awareness and ongoing activities within the hospital. Next, the knowledge of energy saving activities will be shared to people as Corporate Social Responsibility (CSR) such as

- Logo and slogans about energy saving contest
- Energy saving booth
- Energy saving board competition
- Best department in energy saving competition
- Present the energy saving programs via the internal radio
- Activity to discover the energy saving procedure
- Present the energy saving procedure
- Tracking on the energy saving activity
- Visit and seminar at Hat Yai hospital



Recycle innovations for training and contest



Studying model places at Hat Yai hospital



Making logo and polo shirt for energy conservation



Walking and inviting for campaign and relation public in internal and external district level

2.4.2 Educational Training

Energy conservation team has been set up and divided to the energy committee (Dr. Yodsagorn Nedsaengtip, MD. as a director of Kantang hospital is a president of the team), subcommittee on energy saving (Academic: To provide update of energy conservation and exhibition, Environment: To find the risk and take care of environment and safety, Engineering and Information technology: To maintain and validate equipment and provide the new conservative energy, Fuel Management: To collect documents on energy data, Public Relations: To provide energy saving and environment information on media such as PR broad or internal radio) and efficiency energy using member (EEUM)) which will support, promote, and present the energy conservation.

Table 3 Training courses on energy conservation

Course title	D/M/Y and Place	Participants	Times
Internal training			
1. Practical training on energy conservation	13-14 Jan 2011 Meeting room, Kantang hospital	45	1
2. Energy management in Kantang hospital	Nov 2010-Dec 2011	45	2
3. Energy conservation on participating in Kantang hospital	Jan-Sep 2013 Meeting room, Kantang hospital		
<i>Course 1</i> : energy management in Kantang hospital	1 st (28 Jan 2013)	50	1
	2 nd 4 shifts with half day 1,2 shifts: 26 Feb 2013 3,4 shifts: 27 Feb 2013	250	1
<i>Course 2</i> : Technology management for participation and sustainability of energy conservation	1 st (20-22 Mar 2013) 2 nd (15-17 May 2013) 3 rd (21-23 Aug 2013)	50 50 50	1 1 1
<i>Course 3</i> : Following and assessing of practice for sustainability	1 st (19 Apr 2013) 2 nd (21 Jun 2013) 3 rd (19 July 2013) 4 th (20 Sep 2013)	50 50 50 50	1 1 1 1
External training			
Using carbon footprint program in Health service	23 May 2012 Nakornratchasima	1	1

3. REPLICABILITY

3.1 Management Practices and Measures

Kantang hospital has determination to the energy saving concept. Therefore, administrators and representatives have tried to learn how to save energy from other successful hospitals by participating in the workshop “Saving energy for the King 4th at Wachira Phuket hospital“. After that the hospital has planned to have all officers instructed on energy conservation awareness. Moreover, the hospital has opened for the volunteers who interested to be an efficiency energy using member (EEUM) representing and managing following operation as below.

- To survey and follow on energy using
- To set a campaign to present the saving procedure of each department
- To award to the model department
- To mark the all positions of lighting switch matching with lighting lamp
- To set the time for turning off/on air-conditioner

3.1.1 To make positions emblems of lighting on – off switches

The area of meeting room in Kantang hospital is large. And there was many Fluorescent T8 lighting lamps, which meant many on – off switches. The problem is that each switch has to be turn on or off manually. This brings high chance of turning the switch that is not coincided the lighting position they needed, to reduce the loss of energy in this section and also to extend the lifetime of the bulb. The team has opinion that should make logos or red bars to show switch positions to avoid turning switch.



Implementation to make logos

3.1.2 Publicizing of energy conservation projects with participation in the hospital.

Since the implementation of Kantang Hospital’s energy conservation idea had been implemented for a while, but number of the people with energy saving mind is still little, the committee has an idea of publicizing energy saving ideas and projects to hospital’s staff and patients. By publicizing other users will understand concepts and importance of energy conservation and can take part in energy saving in the future



Figure of the publicizing within the hospital

3.1.3 Publicizing to energy conservation project that involvement outside hospital join with community hospitals and schools within the district.

Due to implementation of energy conservation in Kantang hospital that had been publicized in the hospital for all personnel had been known. The team of Kantang hospital energy conservation wanted sustainability ideas to expand into all areas of Kantang district. They came to plan to the project by inviting other health care district hospitals and nearby schools in Kantang district to join marching to promote around Kantang downtown. By this every household can learn ideas, guidelines and easy energy saving methods.



Publicizing to energy conservation project that involve outside the hospital in the district

- Invested in the vinyl boards preparing for publicized the project 10,000 baht.

3.1.4 Cancellation of 12 units 600 watts kettles and used 2 units 3,000 watts central water boilers.



Male and Female wards



Energy saving 18,216 kWh/year
Cost saving 80,150.4 Baht/year
CO₂ reduction 10,219.18 kg.CO₂/year

3.2 Technology

3.2.1 Improvement of illumination to use LED bulbs of 20 watts 31 units to replace Fluorescent Lamps bulbs of 31 units 36 watts in OPD Building.

31units 36 watts Fluorescent lamps are used in areas of OR room around OPD building. These lamps were opened during the night for 12 hours which consume much energy. Due to analysis of process of energy consumption reducing, 36 watts Fluorescent lamps are changed in to LED bulbs of 20 watts to reduce the energy usage while illumination efficiency is still same.



Implementation to change FL T8 to LED

- | | | |
|------------------|-----------|-------------------------------|
| • Energy saving | 5,026.32 | kWh/year Or 18,094.18 MJ/year |
| • Cost saving | 21,613.18 | Baht/year |
| • Investment | 16,864.00 | Baht |
| • Payback period | 0.78 | year |

3.2.2 Improvement of illumination, using of 2 units 5 watts LED bulbs replaced 2 units 50 watts Halogen lamps at the showcase in OPD building.

The showcase of success and awards that Kantang hospital had received originally used showcase lighting of 2 units 50 watts Halogen which had losses of heat mix to the lighting and much energy consumption. 2 units 5 watts LED are replaced 2 units 50 watts Halogen changing the area to become more bright with less heat loss and more energy saving



Before improvement

After improvement

- | | | |
|------------------|----------|-----------|
| • Energy saving | 339.83 | kWh/year |
| or | 1,223.38 | MJ/year |
| • Cost saving | 1,461.31 | Baht/year |
| • Investment | 500 | Baht |
| • Payback period | 4.08 | Years |

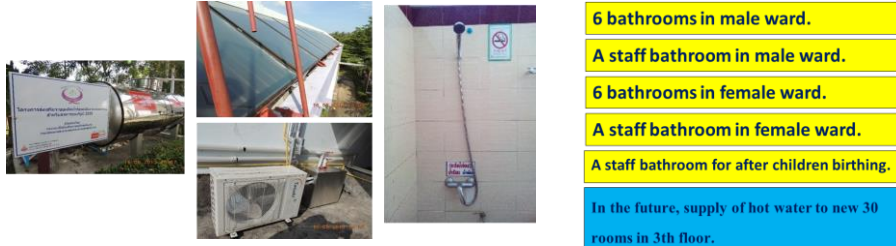
Figure of implementation changed Halogen to LED

4. ORIGINALITY

4.1 Hot water using solar energy and waste heat from air conditioning units in patient ward and delivery room.

To replace the water heater 3.5 kW 15 units, the average time of use 16 hrs/month.

Energy saving	10,080	kWh/year
Cost saving	43,344	Baht/year
CO ₂ reduction	5,201.28	kg.CO ₂ /year



4.2 Using hot water with solar energy and waste heat from air conditioning in CSSD agency and detergents agency.

Cost saving	41,805.57	Baht/year
CO ₂ reduction	3,859.86	kg.CO ₂ /year



4.3 Solar Cells ventilation fans in OPD's bathroom

Energy saving	345.60	kWh/year
Cost saving	1,486.08	Baht/year
CO ₂ reduction	193.88	kg.CO ₂ /year



4.4 Solar fountain, solar energy for fountain pump.

Energy saving	276.48	kWh/year
Cost saving	1,188.86	Baht/year
CO ₂ reduction	155.10	kg.CO ₂ /year



4.5 Replacing gel pack with cool-splint

	Idea concept	Price (Baht)	Convenience	Effect to patient	Environmental effect
Cool-splint	Patients who have swollen injuries have to use gel pack to reduce those injuries, but the Gel pack is slippery when patients move their bodies and expensive. Due to the problem, Kantang hospital has invented cool-splint to replace the old gel pack.	50	Not slippery	Reduce swollen injuries	Easy to decay
Gel pack		120-250	Slippery	-	Uneasy to decay



4.6 Replacing air bed with gel bed

	Idea concept	Price (Baht)	Convenience	Repairing	Effect to patient
Gel bed	Patients with spinal injuries have to use air beds, but air bed is expensive and pharmacy section has waste snow pack containing frozen gel which is used in delivering some medicine. Snow pack has high flexibility and high durability ,thus Kantang hospital made gel bed for patients with spinal injuries using these snow pack.	500	No electrical power supply is needed	Easy	Distributing the load of patient's body
Air bed		20,000	Electrical power supply is needed	Complicate	Distributing the load of patient's body

