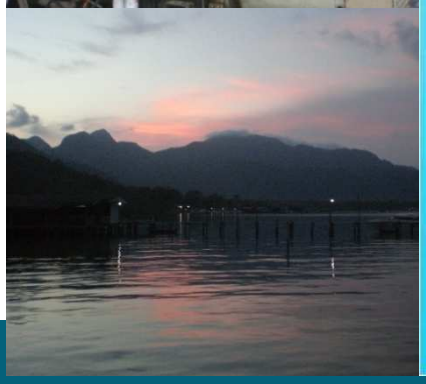
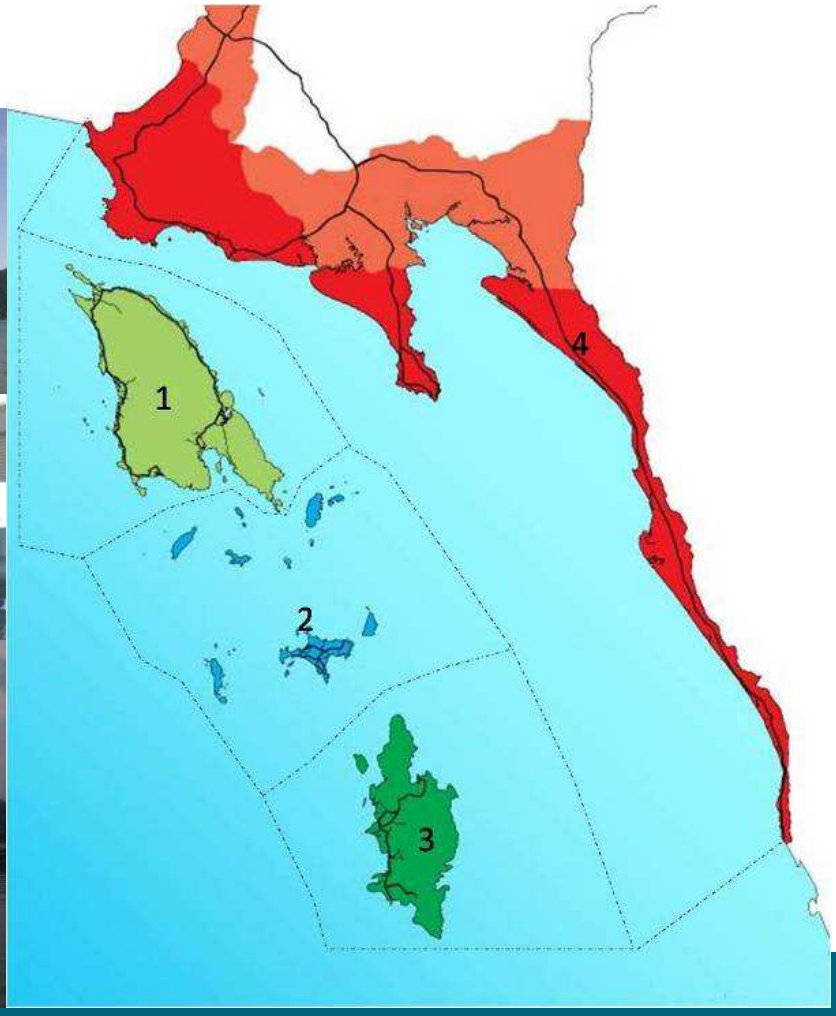
# CLIMATE PROTECTION
## IN TOURISM






A PRACTICAL GUIDE FOR

## MOO KOH CHANG DESIGNATED AREA

adelphi consult

gtz

CLIMATE PROTECTION IN TOURISM

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Photos:

Title page: Koh Chang Beach (Kabisch), Generator (Kabisch), Koh Chang Sunset (Kabisch), Map of Moo Koh Chang Designated Area (DASTA)
Page 5: Green House Effect (Energy Efficiency and Renewable Energy), Global Temperatures (IPCC 2007), Global Warming Projections (IPCC 2007)
Page 8: Coral Bleaching (Reefpix Fiji 2001)
Page 15: Thai Energy Label (UN Technical Cooperation)
Pages 16, 18, 20, 21, 25: In-house Renderings (Adelphi)
Page 24: Solar radiation (Adelphi)
Page 26: Organic Compost Pit (Georgia landscape group),Waste separation at Kho Chang (Kabisch)
Page 27: Household Hazardous Waste (Hoffman Estates)
Page28: Well Labelled Bins (Singapore National University)

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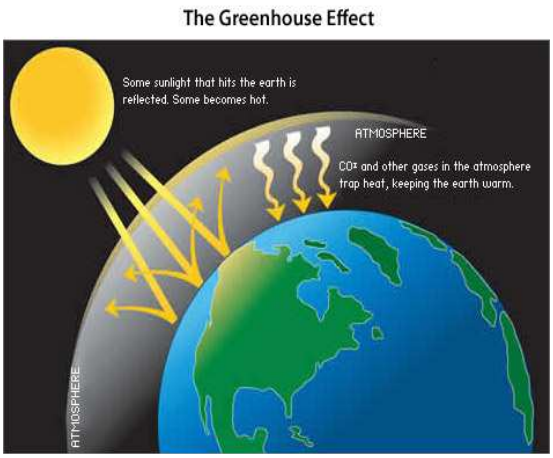
# TABLE OF CONTENTS

# 1 GLOBAL WARMING AND TOURISM

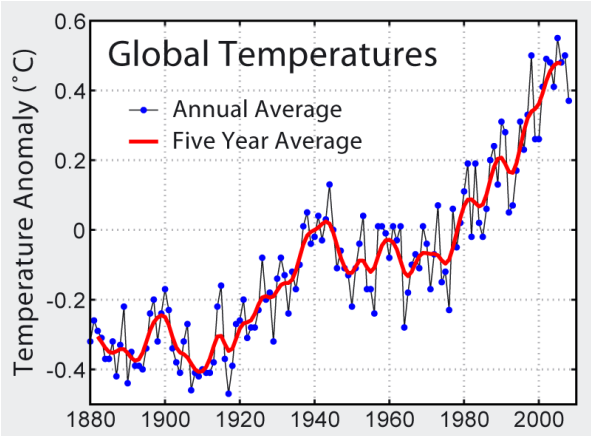
## 1.1 THE GREENHOUSE EFFECT

Most of the observed temperature increase since the middle of the 20th century has been attributed to increasing concentrations of greenhouse gases resulting from human activity such as fossil fuel burning and deforestation (IPCC, 2007). Greenhouse gases like water vapour, carbon dioxide ($CO_2$), methane ($CH_4$) and ozone are those gases that contribute to the greenhouse effect. The largest contributing source of greenhouse gas is the burning of fossil fuels like coal, gas and oil leading to the emission of carbon dioxide.

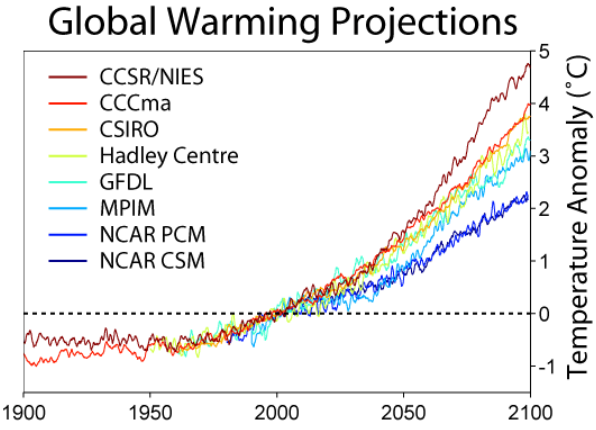
The Greenhouse Effect starts with the natural step of sunlight reaching the Earth. Parts are absorbed which warm the earth and most of the rest is radiated back to the atmosphere. Some of the longer wavelengths are absorbed by greenhouse gases in the atmosphere before they are lost to space. The absorption warms the atmosphere. These greenhouse gases act like a mirror and reflect back to the Earth some of the heat energy which would otherwise be lost to space. The reflecting back of heat energy by the atmosphere is called the "Greenhouse Effect".




The rise of the concentration of greenhouse gases like $CO_2$ leads to a rising temperature as can be seen in the following chart:




Studies have been undertaken by different research institutes on how global temperatures might develop in the next years. Because of the broad time scales and difficulties in modelling systems, the results vary widely. However, mostly all studies mention that temperatures will rise in this century as can be seen from the figure below.




## 1.2 RELATION BETWEEN TOURISM AND GLOBAL WARMING

The relation between climate change and tourism is twofold: Climate change has a direct impact on tourism and the activities generated by tourism affect climate change.

Worldwide, the tourism industry is responsible for 4 to 6 percent of total

$CO_2$ emissions. The tourism industry in the Kho Chang Designated area is responsible for 47,835 tons $CO_2$eq/year which is about 0.2 % of the total emissions of Thailand *(Adelphi Consult 2009)*.
The average tourist in the Koh Chang clustered area emits a total of 19.74 kg $CO_2$eq per day, while the average tourist in Thailand emits about 11 kg $CO_2$ eq per day.

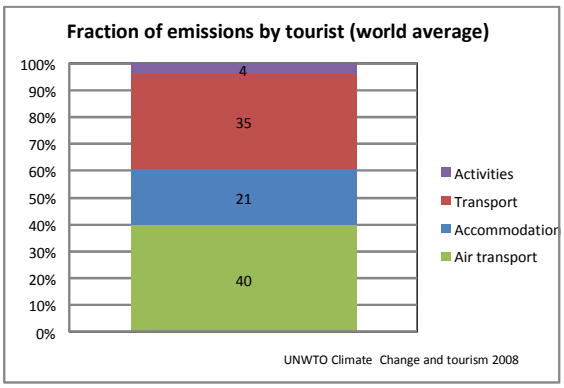
**CO2eq or what GWP100 stands for?**

Different climate relevant gases have a different impact on climate and different exposure times in the atmosphere. The Global Warming Potential (GWP100) is a figure which compares all greenhouse gases with the impact of CO2 in a time frame of 100 years. Both, the time in atmosphere and the impact of relevant gases differs widely and is quantitative comprehensible in CO2 equivalents in this way. Below table provides an overview for the green house gases covered under the Kyoto protocol.

| GWP 100- Global warming potential 100 years (2007 IPCC AR4 ) | | |
|---|---|---|
| **direct GHG (Kyoto)** | | CO2eq |
| carbon dioxide | CO2 | 1 |
| methane | CH4 | 25 |
| nitrous oxide | N2O | 298 |
| hydroflourocarbon | HFKW/HFCs | up to 14800 |
| sulfur hexaflouride | SF6 | 22800 |

All use of non renewable energy, like oil and gas lead to an increase of the concentration of $CO_2$ in the atmosphere. Also, the consumption of electrical energy affects $CO_2$ output because energy is generated mostly from non-renewable fuels like coal or gas. The $CO_2$ emissions start with the transport requirements of tourists. The airplane runs on petroleum based fuel, the train on electricity and the taxi on diesel. Furthermore, the welcome drink made with ice from the freezer, the hot shower and the air conditioned rooms, consume energy.

So every form of tourism has a direct effect on climate change.




On the other hand, climate change affects tourism in various ways.
Due to rising temperatures, parts of glaciers and the arctic are melting. This, in turn, will lead to rising sea levels and is of special concern to Thailand owing to its large coastal areas. Also, the changing temperature can lead to an increase of extreme weather conditions like storm or heavy rainfall. Islands are more affected by these impacts than the mainland.

*"Climate change is the defining challenge of our age."*
Ban Ki-moon, CMP 3, Bali, Indonesia

# 2 Potential Impact on Kho Chang Clustered Area

It is estimated that average global temperatures will increase between 1.4 and 5.8 ˚C, and sea levels will rise at least 0.09 meters and up to 0.88 meters because of the melting of polar ice and the thermal expansion of ocean waters *(IPCC, 2001)*. Predicting the exact consequences of global warming is quite a difficult task. Firstly, because the natural processes that cause precipitation, storms, increases in sea levels and other expected effects of global warming are dependent on many different and interconnected factors. Secondly, it is

difficult to predict the volume of emissions of greenhouse gases in the years to come, as this is determined to a great extent by political decisions and technological breakthroughs. Nonetheless, many of the effects of global warming have been well-documented, and observations from real life are closely consistent with earlier predictions. It is the precise extent that is difficult to predict. Among the effects that can be predicted in general, according to the United Nations Framework Convention on Climate Change (UNFCCC) are:

- More droughts and more flooding,
- Less ice and snow,
- More extreme weather incidents,
- Rising sea level.

In order to get an idea of the extent of the consequences, researchers typically work with predictive scenarios that show various possible developments. According to these scenarios, islands like Kho Chang will be affected more by climate change than the mainland.

The following chapter describes the possible impacts in more detail, how they could affect Kho Chang Designated Area and how adaptation could be carried out.

**Projected increase of average air temperature over the years 2010-2099:**

| Region | 2010-2039 | 2040-2069 | 2070-2099 |
|---|---|---|---|
| Indian Ocean | 0.51 to 0.98 ℃ | 0.84 to 2.10 ℃ | 1.05 to 3.77 ℃ |

**(IPCC 2007)**

## 2.1 Impacts of Climate Change in Thailand

It is estimated Thailand may face an increase of average temperatures from 21.5-27.5 to 25-32˚C while the amount of rainfall changes spatially (Greenpeace Southeast Asia 2006). Based on the information available, the following are the most significant effects of climate change for Thailand:

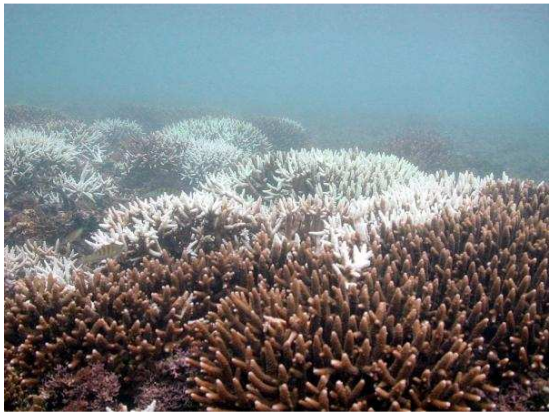
- *Water resources,*
- *Food security,*
- *Coasts, oceans and fisheries,*
- *Forests and Biodiversity,*
- *Health.*

*Water resources*- Thailand's twenty five watersheds are under threat due to changes in rainfall patterns. Climate change has the potential to affect agricultural output through drought, floods, and intrusion of salt water due to rising sea levels. Severe drought between 2004 and 2005 affected the industrial estates of the Eastern coast.

*Food security*- Thailand is among the top exporters of rice to the world. Floods, heat waves and shortage of water as a result of climate change are likely to greatly diminish agricultural production of rice and other crops. Rice production is the principal agricultural contributor to GHG emissions in Thailand.

*Coasts, Fisheries and Oceans*- Thailand's coastline of about 2,600 km provides habitats for numerous coastal flora and marine fauna that live in mangrove and other coastal ecosystems. Coastal areas are presently under threat due to severe erosion and seawater encroachment in several areas. Sea level rise may cause the extinction of coastal species and ecosystems that are unable to shift upland due to human infrastructures. In addition, more intense storm surges may damage commercial and recreational areas.
Ocean currents and the chemical composition of sea water are also expected to change and affect marine ecosystems and fisheries. Coral bleaching world-wide including in Thailand is largely related to the warming of sea water. For the islands of Moo Koh Chang, the coastal effects of climate change are the most significant. It is expected that the temperature for South-East Thailand,

where the Moo Koh Chang cluster islands are located, could rise by 4 ˚C and precipitation increase by 30% (Thailand Environment Institute, 1999).



(Image showing coral bleaching)

*Forests and Biodiversity*- The forested regions of Thailand are habitats for numerous diverse species. Preliminary studies on spatial distribution of forest ecosystems under climate change show that about thirty-two national parks and wild life sanctuaries are at risk. Forests in these areas may change from one type to another and can consequently create changes in species composition. Deforestation in Thailand is causing serious ecological, social, and economic problems, in addition to contributing to global warming.

*Health*- Increased average temperatures, precipitation patterns, storms, floods, droughts and more hot days and heat waves have direct and indirect impacts on health.
These involve, for example, heat stress or contagious diseases owing to lack of clean water, poor hygiene during and after the catastrophes, which increase the spread of cases of food and water-borne diseases.
The risk of outbreak of diseases such as malaria and dengue fever increases with changes in the habitat of disease carrying pests. In urban areas, higher temperatures due to global warming may impose additional impacts on the health of city dwellers that are already exposed to air pollution.

## 2.2 Climate Change and the Kho Chang Cluster

Densely settled and intensively used low-lying coastal plains, islands and deltas such as the Kho Chang Cluster area, are especially vulnerable to coastal erosion and land loss, inundation and sea flooding, upstream movement of the saline/freshwater front and seawater intrusion into freshwater lenses. Socio-economic impacts could be felt in cities and ports, tourist resorts, artisanal and commercial fishing, coastal agriculture and infrastructure development. International studies have projected the displacement of several millions of people from the region's coastal zone, assuming a 1-m rise in sea level. The costs of response measures to reduce the impact of sea-level rise in the region could be immense. The Kho Chang islands lie in the Gulf of Thailand. Being an isolated island cluster, it faces a high risk of flooding due to rising sea levels. Coasts are particularly vulnerable to the impacts of climate change. The coast is an attraction for tourists to the Kho Chang area, and should this be destroyed, it would be less attractive for tourists to visit.

The IPCC projection of future sea-level rise in high and middle latitudes of 31,66 and 110 cm in 100 years for low, middle and high scenarios respectively can be applicable to the Gulf of Thailand (IPCC, 2001).

The impacts of climate change will have direct and indirect impacts on the tourism sector of Moo Koh Chang. For example, diving is one of the attractions for tourists in Mu Koh Chang. Should the coral reef and sea life no longer be attractive for tourists, a drop in visitor levels may take place.

# 3 CLIMATE STRATEGIES

Regularly, climate strategies encompass the following two key components:

- **Adaptation** and/or
- **Mitigation.**

Whereas *mitigation* tries to reduce the effects on climate change and thus climate change itself, *adaptation* refers to measures to adapt to a changing or already changed environment caused by climate change.

## 3.1 ADAPTATION MEASURES


Climate change is a global issue but the impact is local.

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This translates to a bottom-up method of dealing with the impacts of climate change and coping, using measures on a local level, specifically designed for a particular region.
According to Thailand's Initial National Communication Document under the United Nations Framework Convention on Climate Change (UNFCC, October 2000) this means taking adaptation action in the following areas;

- Forests
- Agriculture
- Water resources
- Coastal resources
- Health

Some of the measures for adaptation on a national level would be:

*For Natural Forests*

- Reforestation with drought and heat tolerant species
- Prioritization of protected areas for conservation
- Establishment of gene banks and the collection of various plant cultures

*For Agriculture*

- Conservation and improvement of local drought resistant varieties
- Improvement of cropping practices to minimize water use
- Application of risk averse cropping systems
- Analysis of potential crop substitution in different regions
- Promotion of crop diversification program

*For Water Resources*

- A proposed water act
- Water resources pricing and water rights
- Integrated watershed management
- Community-based resources management
- Water conservation and crop diversification in agriculture

*For Coastal Resources*

Water and coastal resources are the most important issue of adaptation for the Kho Chang designated area. As aquaculture earns several billion dollars annually, coastal resources are very important to the Thai economy. In addition, almost one-half of the foreign tourists coming to Thailand spend their time at beaches or on islands. Diving has been one of the most popular activities among tourists. The main tourist resources related to Thai seas and coastal areas are (OEPP, 1999):

- Beaches and coastal scenery

- Islands especially those with coral reefs and clean beaches
- Protected marine parks
- Surface and underwater diving
- Marine archaeology
- Activities related to coastal tourism areas, such as fun parks, marine museums, sailing, etc

*Adaptation measures for coastal areas include:*

- Establishing a coastal hazard management subcommittee to develop policies, strategies and guidelines for coastal hazard management, to provide guidelines on management and development of coastal areas
- Improving drainage and flood control facilities
- Improving cropping systems suitable to such environmental change, using organic matter to improve salty soil conditions
- Improving crop cultural practices

*For Health:*

- Research and development of alternative approaches to cure and eliminate malaria
- An aggressive campaign of preventive measures against malaria and dengue

There are **support tools with local focus** available on the internet, for example:

UNFCC local coping strategies database http://maindb.unfccc.int/public/adaptation

UNDP Adaptation Learning Mechanism (ALM) http://www.adaptationlearning.net/

Eldis community based adaptation exchange http://community.eldis.org/cbax/

## 3.2 Gathering Information

Generally, in order to assess the impacts of and vulnerability to climate change and then to find appropriate adaptation measures, information of a high quality is required. This information includes:

- *Climate data*, such as temperature, rainfall and the frequency of extreme events, and
- *Non-climatic data*, such as the current situation for different sectors including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity, and coastal zones.

Reliable, systematic data can then help determine a region's current climate variability and model future changes.

**Climate data for Thailand** is available at the Thai Meteorological Department. There is a link for the South-East coast: http://www.tmd.go.th/en/
More information on climate change in Thailand can be obtained from the Office of Natural Resources & Environmental Policy and Planning (ONEP) http://www2.onep.go.th/CDM/en/cmc_effectthai.html

# 4 Mitigation Measures

The environment and climate itself are an essential part of the tourist attraction in Moo Koh Chang. Many tourist activities such as swimming, diving, trekking are dependent on the natural beauty of the islands and its surroundings. Preserving this is therefore essential for tourism as the economic and commercial backbone of the region.

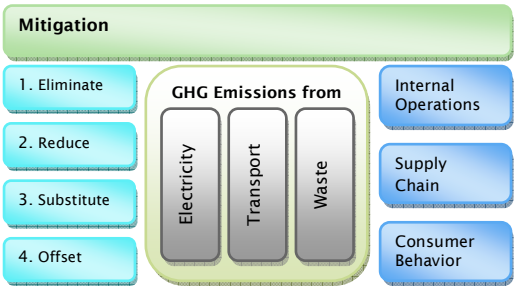
For the hotel industry in the 4 Koh Chang areas, the maximum Co2eq emission per month are produced by

heat and power generation (1,236 co2eq tonnes/month) and by transport (1,011 co2eq tonnes/month).

In order to reduce emissions from these sectors a number of measures in energy management for hotels and in the transport sector can be undertaken.

**Mitigation** can be described as an anthropogenic (man-made) intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2001).

Such mitigation of climate change could be implemented by elimination, reduction, substitution, and offsetting of greenhouse gas (GHG) emissions.




Most of the mitigation measures lead to a short- to midterm reduction of cost and emissions due to reduction of energy use, improving of energy efficiency and increasing use of renewable energies.

**Elimination** means avoiding useless production of GHG. These measures have the best proportion of cost to benefit. Savings can be felt immediately.

*Examples in electricity production and usage:*

- Regular maintenance of energy units;
- Switching off power when not in use;
- Energy Management.

*Examples transport:*

- Avoid unnecessary use of fuel driven vehicles;
- Encourage private car sharing or vehicle sharing for delivery of goods.

*Examples waste:*

- Separation of organic waste for creation of manure;
- Separation of waste streams such as paper, glass;
- Avoiding the use of small plastic bottles for drinking water.

**Reduction** can be achieved by replacing devices and/or optimizing present structures. This mitigation measure is very effective and could be integrated in the daily business with low effort.

*Examples electricity production and usage:*

- When buying new equipment take note of energy demand;
- Look for energy certificates on electronic goods and equipment.

*Examples transport:*

- Buy small vehicles with efficient engines;
- Use vehicles with maximum capacity.

*Examples waste:*

- Collect waste separately per stream such as paper, glass, metals, organic, hazardous, etc.
- Recycle waste where possible;
- Reuse waste again if possible.

**Substitution** measures usually implicate cost intensive investments. However, through substitution, the reduction potential is very high.

*Examples electricity production:*

- Use of renewable energies such as solar power, wind power or biomass.

*Examples transport:*

- Use of alternative fuels (e.g. ethanol, electric cars).

*Examples waste:*

- Buy and sell products with environmental friendly packaging.

**Offsetting** is the method with the lowest cost – benefit proportion, however is hard to practice on a smaller scale.

An example of offsetting would be to provide tourists with a method of balancing their carbon emissions from flights to the Moo Kho Chang Cluster by investing in eco-restoration projects of forests, or creation of a renewable energy source for a particular village in the area and so on. These methods require coordination and cooperation of various stakeholders on a high level.

This handbook deals with smaller scale mitigation measures that could be implemented by hotels, restaurants and operators such as tourist guide companies, or convenience stores in the form of:

1. Energy Management,
2. Waste Management,
3. Transport Management.

It must be kept in mind that these three topics are linked with each other along with management of water resources. If one reduces emissions from waste, one can simultaneously aim to reduce emissions from transport of the waste. More detailed measures for each of these topics can be found in the following chapters.

## 4.1 Energy management

In order to manage energy consumption in the hotel, restaurant, office or shop, some organization and collection of data is required.
Energy management involves paying attention to energy consumption and costs. This means looking more closely at aspects such as:

- How much energy is being consumed? What means of energy production is practiced?
- What wastes are produced? How are these disposed?
- What is the transport structure like? How much energy does transport consume?
- How is sewage water treated? How much potable water is consumed? And so on.

When energy management is integrated into the daily practice of your organisation, you can create an instrument with which your energy efficiency can be seen concretely and improved continually. This in turn will reduce the short and long-term energy costs.
Starting and introducing an energy efficiency management in your facility requires you to:

- Communicate to all staff the key aims of your energy efficiency program and your commitment to energy efficiency.
- Nominate an energy manager for your hotel.
- Encourage staff to think about energy efficiency and the ways in which they can make more efficient use of energy at work.
- Develop and encourage staff to take ownership of key action

points that are relevant to their workplace.

First of all you have to clarify key objectives for implementing an energy efficiency system:

- To power your hotel so as to make the best use of energy, thus reducing emissions of global warming gases and reducing costs.
- To identify the key action points of immediate relevance for reducing energy costs in your business and at the same time improving safety, quality and customer comfort.
- To make a commitment to reduce the energy consumption year-by-year by using energy more efficiently, whilst maintaining high standards of guest comfort.

Each one of the employees can make a contribution. However small an issue may seem (turning down air conditioner for example), they soon add up to large savings in energy consumption, greenhouse gas emissions and cost. All staff in each area of the operation can contribute to reducing energy consumption. Switch-off is a simple no-cost action that everyone can take.

**Energy Management Checklists** sheets for monitoring energy use within your hotel, restaurant, shop or office are available with the GTZ Bangkok office or the UNWTO Bonn (Germany) office.

What are the main steps?

- Train and motivate your staff to keep energy consumptions low.
- Start monitoring energy consumption throughout your operation and set your own targets for reduction.
- Keep up-to-date with the latest grants and loans available for new technology.
- Stay informed about best practice and how others are achieving energy savings.
- Research the most energy-efficient and appropriate plant and equipment when replacing old or making new investments.

There are several standards on energy management available: A national Thai standard introduced per ministerial decree in 2009, the European standard EN 16001 which was also issued in 2009, and the ISO 50001 which is still being developed and likely to be issued in 2011.

### *4.1.1 Identify your consumption*

In order to reduce energy costs at a hotel, restaurant or operating facility in Koh Chang area, one must find out where the most energy is consumed. An average Thai hotel in the Koh Chang district uses three main energy sources within the hotel:

- Diesel (for generators)
- Gas (bottles of Liquefied Petroleum Gas) and
- Electricity

**Diesel:**

Find out the monthly diesel consumption? If there is a meter installed it is easy to measure. Just subtract the last meter reading from the new meter reading. If there is no meter installed, you can infer the monthly consumption from the purchase of diesel. Another possibility is to mark the fill level of the diesel tank. In the next month, you can see the change of the fill level. If there is a scale you can easily subtract the last level from the new level. If there is no scale you can simply multiply the change of the height with the area of the tank and get the change of the content.

**LPG Gas:**
To calculate LPG usage, count the number of bottles you need per month. The content in kilograms (kg) is written on the bottles. If you use different sizes of bottles make sure that your count is accurate.

**Electricity:**
Calculating the electrical energy consumption is a bit more complex. There are 3 types of costs in the electrical bill: A) The electrical power demand, B) electrical work and C) the service fee.

*A) The electrical power demand*
This is the maximum power you need during one month. The unit of the power demand is *kilo Watt (kW).* If you have 30 air conditioners with 1 kW power each and they are all running at the same time, you will have a maximum power demand of 30kW. Each kW of maximum power demand is charged with 70 to 210 Thai Baht (TBH) each month, depending on the voltage of your connection power. Only the maximum demand from the peak hours is used for the calculation of the maximum power demand.

*B) The electrical energy*
This is what the electrical meter shows. If an air conditioner with 1kilo Watt power runs for 1 hour you have to pay for 1 kilo Watt hour. The unit is *kWh.* There are different prices if you use it during peak (Mon. – Fri. 09.00 a.m.–10.00 p.m.) or during off peak times (Mon.–Fri. 10.00 p.m. – 09.00 a.m. and Sat.-Sun. and holidays). Peak time consumption is more expensive and costs twice as much as off peak times.

*C) Service Fee*
This is a service charge for delivering the electricity. It is fixed, and in August 2009 it was 228 THB per month. Normally, there are two bills from the Provincial Electricity Authority [PEA]. One is the receipt. The receipt shows only your overall consumption and how much you have to pay. The other bill is the invoice. In this invoice you can see all the details like peak, off-peak, holiday consumption and the power demand. If you do not receive an invoice, you can ask for it at PEA or your local electricity provider.

### 4.1.2 Collecting data
In the first step to collecting data, you write down the consumption of the different energy sources. Then you find out how many room-days you had in a specific month and write it down. For example, if you rented 4 rooms out for 25 days then you had 100 room-days.

Then you have to calculate. Divide the electrical, gas and diesel costs by the room-days. In this way you get the different energy costs per booking. Now you can compare the results from a different month and see how your energy saving measures affect your energy consumption.

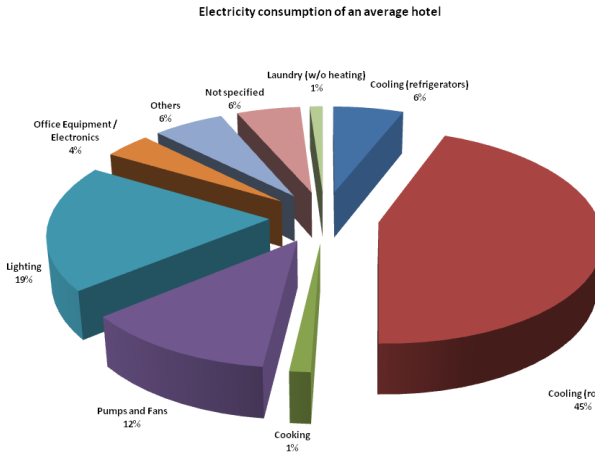
The template at the end of this handbook could assist you with your monthly and yearly calculations for energy.

## 4.2 Energy efficiency

### 4.2.1 Introduction
Main line energy supply is the main source of energy for the Kho Chang Island cluster. As shown below, electricity generators make up a large part of energy requirements, while solar energy supply constitutes, on average only 5% of energy supply in hotels and 0% in restaurants. There is a large potential for development in this area of energy supply in the Kho Chang cluster.

Energy costs make up a large portion of a hotel's total expenses.
In light of rising energy prices and increasing global warming, it is worth taking a look at energy efficiency measures. Many of these measures

can be implemented with relatively low investment costs. Measures requiring higher costs are usually balanced quickly through the savings of energy costs.
An average hotel needs gas for cooking and partially for hot water. Electrical energy is required mainly for cooling (air-conditioning and refrigeration), lighting and ventilation as shown in the pie chart below.




## 4.2.2 Energy prices

The average price for 1 kWh amounted to between 2.70 and 3.50 THB in 2008.
The prices of electric energy vary depending on:

- Time of consumption
- Size of the transformer
- FT charge

The prices for electricity are higher during peak times (Mon. –Fri. from 09.00 a.m. to 10.00 p.m.) and cheaper during off peak times (Mon. – Fri. from 10.00 p.m. to 09.00 a.m.; Sat. Sun. and official holidays).
The FT charge is the additional expenditure which is altered by the oil price. PEA will calculate this by using the ratio of cost of production that is increased in the period.
For further information please see the homepage of the Provincial Electricity Authority http://www.pea.co.th

Natural gas is normally used for cooking and heating water. The gas is delivered in bottles.
The average price for bottled natural gas amounts to 18.33 THB for one kg gas or 1.43 THB for one kWh.

## 4.2.3 Energy Labelling


(Thai energy label)

An important aid for energy saving measures is the Thailand Energy Label. This Energy Label is easy to understand. The energy efficiency is rated from 1 - low to 5- excellent. The label also shows consumers the average energy consumption per year (kWh/year) and the average electricity price per year (Baht/year).

## 4.2.4 Green Leaf

Green Leaf Foundation is a Thai initiative which sets standards for hotels and tour operators in ASEAN countries. The Green Leaf Program was initiated at the end of 1997. Its prime objective is to help hotels improve their efficiency in saving energy, water and other resources. It focuses on facilitating the efficient use of energy and natural resources under the theme “Save Money, Save Environment.” The Green Leaf Standard for hotels offers a certificate

of 1- 5 leaves according to performance. A hotel can apply for this certificate online on the Green Leaf website: http://www.greenleafthai.org/th/index.php

The certification program rates hotels on environmental best-practice in topics such as waste management, energy performance, noise pollution and water quality. There are eleven such categories where a hotel can carry out a self- audit in operational processes. This program was also designed to lower operational costs and pass cost-savings on to customers. There are over 400 hotels registered with the program. Similarly tour operators also have the opportunity to register with Green Leaf and get certified.

You could make certification with the Green Leaf Program a goal for your hotel or tour operation. In this way you will not only save costs but also get recognition which will improve your competitiveness in the industry.

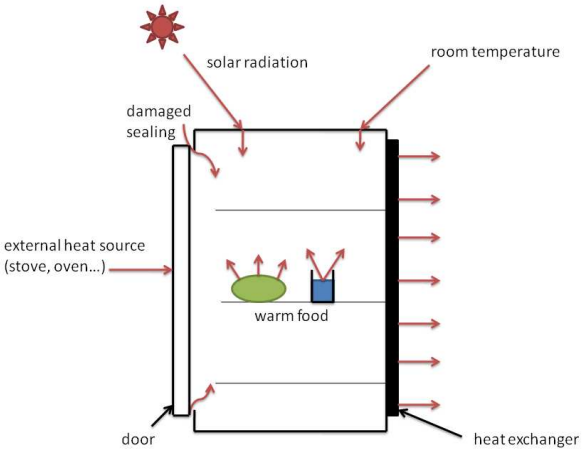
## 4.3 Energy efficiency measures

In the following chapters, energy use for the following types of uses is explained:

1. Refrigeration
2. Air conditioning
3. Ventilation
4. Water heating
5. Lighting
6. Building

### *4.3.1 Refrigeration & Freezers*

Refrigeration takes up a large amount of energy in hotels and restaurants. Almost all refrigerator equipment works in the same way. It transfers the heat from the inside to the outside as shown in the image below. Therefore it consumes electrical power. The more heat it has to transfer out the more energy it consumes.




(Heat transfer of a refrigerator)

Freezers usually work lower temperatures than refrigerators (around -18˚C). This temperature assures freshness of perishable food for a long time period. Chest freezers are more energy efficient than upright ones. Use units with self-closing devices or alarm devices to ensure that doors are not left opened by mistake for too long.

#### The Mini bar

The mini bar is a small refrigerator inside the guestroom to provide the guests with cold drinks and snacks. Mini bars not only need electric energy but also heat up the guest room and lead to higher electrical consumption for the air conditioner.

#### 4.3.1.1 Energy Saving Measures in Refrigeration

**Avoid external heat:**

- Do not put warm food inside the refrigerator because the heat has to be transported out by the use of electrical energy.
- Avoid external heat flows towards the refrigerator from the sun or other electrical equipment like ovens and stoves.
- Keep the refrigerator away from hot equipment and direct solar

radiation. Place the refrigerator in a cool and shady room.

- To save energy it is important that the temperature settings are correct for the content of the freezer. Avoid over-cooling. Just 5˚C below the required temperature can add 10-20% to the operating costs.

**Avoid air influx:**

It is also essential to keep air influx to a minimum. This can be achieved through the following measures:

- Keep freezing rooms and freezer doors opening times to a minimum. The air temperature in the unit can increase by as much as 0.5 ˚C for every second the door is kept open. In older equipment, this will also lead to ice formation and lower energy efficiency. Frequent openings will also mean more frequent defrosting, again, a very energy intensive operation that should be kept to a minimum.
- Check the sealing regularly. If the sealing is in bad condition and does not close tight, repair or replace it.
- Take a look at the closure mechanism. Does it work properly? Are the doors closed tightly? If not repair it immediately because otherwise warm air will constantly flow inside the refrigerator and lead to high energy costs.

**Ensure proper ventilation:**

To ensure high efficiency, the cooling mechanism has to transport the heat from the inside to the outside without any problems. It is therefore essential to provide good ventilation at the location where the heat is brought out. In general, it is located at the back of the equipment. Clean aggregates, grid and condensers regularly, as blocked condensers will increase operating costs by up to 5%.

**Turn off equipment:**

Refrigeration should be organized so that only a minimum number of refrigerators would be operated at any given time. During periods of low occupancy, switch off units that are unlikely to be used for more than one week. Also switch off the mini bar in unoccupied rooms.

**Replace old equipment:**

Due to long operational hours (24h/day) of refrigeration equipment and the large amount of energy that can be saved, investing in new units can be profitable over a short period of time. Equipment that is older than 10 years should be replaced. New technical generation of equipment could be up to 30% cheaper to run. Make sure that you dispose of your old refrigerators correctly, at best at a waste collection site for electrical goods with a recycling facility.
Buy the most energy efficient equipment. The equipment is labeled with the Thailand Energy Label from class 1 (low efficiency) to 5 (high efficiency). The additional costs of the purchase will be recovered very fast by the saved energy costs.
If you want to be sure about how much saving can be made, install an electricity meter and measure the consumption of your equipment. An electric meter does not cost very much and is easy to install. After some days, you can estimate yearly consumption. Compare your yearly consumption with the consumption of the new equipment. The yearly consumption of the new equipment is written on the Thai energy label.

### *4.3.2 Air conditioning*

Air conditioning is one of the largest items of energy costs. Often up to 50% of the energy demand is used for air

conditioning. Hotels can reduce the energy consumed by operating existing equipment more effectively and identifying the best type of air conditioner for their property. It is important to work with your maintenance manager or housekeeping staff to integrate some general principles into day-to-day management and maintenance.

The average air conditioner consists of an indoor and an outdoor unit. The indoor unit circulates and cools the room air. The outdoor unit transmits the heat to the ambient air.

(Air conditioner – outdoor unit)

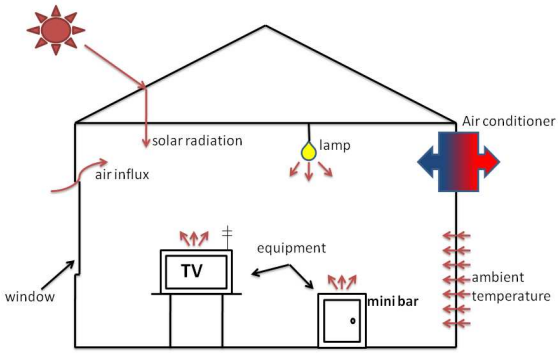
(Air conditioner – indoor unit)

Similar to a refrigerator, air conditioners transfer heat from the inside to the outside by using electrical energy. The energy consumption rises with the amount of heat that has to be transferred.

### 4.3.2.1 Energy Saving Measures in air conditioning

**Guests:**

Many hotel guests coming from cooler climate zones (e.g. Europeans) are not used to air conditioning. For their comfort and for energy saving reasons, it would beneficial if they were able to lower or turn off the air conditioner. Also, many guests from cooler climate zones prefer to sleep without air conditioning. To improve their comfort without air-conditioning, beds should be covered with thin blankets by default and extra blankets should be offered additionally, e.g. stored in the closets. Inform your guests about your climate protection efforts through energy efficiency measures when they check into your hotel. That way they can appreciate these measures.



(Air conditioned room with heat flows)

**Organization:**

Book guests into blocks where possible – i.e. rooms next to each other to cool one part of the building through the rooms and achieve one temperature level in a concentrated part of the building. Unoccupied offices, meeting and conference rooms, special function rooms or store

rooms do not require constant air conditioning. Also, adjust thermostats in unused areas and watch out that furniture or curtains are not placed in front of air conditioners as this will impair their effectiveness.

Ensure that air conditioners are only operated with closed windows. If windows are frequently open when air conditioning units are in operation, explore possibilities to install automatic cut-off switches. If that is not possible, inform the guests through signs or brochures. Check if large windows, which have a high solar radiation, are supplied with curtains to avoid high air conditioning consumption and guest discomfort from excessive light or overheating. Also avoid over-cooling the building. This is expensive. Ensure that temperatures match recommended temperature standards as closely as possible. Increasing the temperature even by 1˚C reduces the energy consumption by 6%. Comfortable temperatures for the human body have been identified between 24-27 degrees Celsius. Air conditioning should operate within this range to avoid overcooling.

**Technical:**

Before investing in any air conditioning unit or additional capacity, ensure that it is really necessary. In some cases, ceiling fans can be used to supplement air conditioning units, especially when combined with other and often cheaper measures like outside window shades and/or solar film and shading by plants. Ceiling fans use only a fraction of the energy that air conditioning units use and often provide higher levels of guest comfort.

When you choose to purchase an air conditioner, buy the most energy efficient equipment being aware of the right efficiency class. The Thailand Energy Label (5 = efficient) and the COP (coefficient of performance = the higher the better) are indications for efficiency.

Well maintained cooling installations are the most energy-efficient. Inspect and clean the air conditioner continuously. Dirty condensers can reduce efficiency by as much as 15%. Check the air filter inside the indoor unit. Also proper ventilation for the outside unit must be assured.

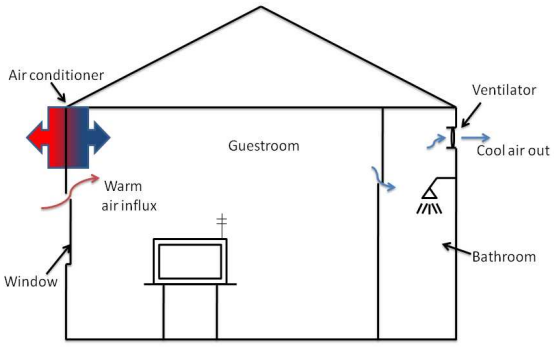
Decrease the energy consumption of the equipment in the air conditioned rooms. All energy usage inside the room turns into heat and must be brought out by the air conditioner. Also try to avoid direct solar radiation. Heat that does not reach the room needs no air conditioning power. Install sun-blinds or plant trees in front of big windows. Indoor sun-blinds can save 25% and outdoor sun blinds 75% of air conditioning energy.

Standard chillers produce cold air with electrical energy. But there are also absorption chillers available. These chillers use hot water to produce cooled air. Hot water, in turn can be produced for free via solar collectors that can be roof-mounted. So if you use a central chiller it is worth taking a closer look at this option.

### *4.3.3 VENTILATION*

Although ventilation does not consume the most amount of energy, it is worth taking a closer look at it. Ventilation, in itself, needs energy and also expels the cooled air and leads to higher consumption of the air conditioner. Therefore, savings in

ventilation are a benefit for the energy balance of the entire air conditioning system.




(Ventilation in a guestroom)

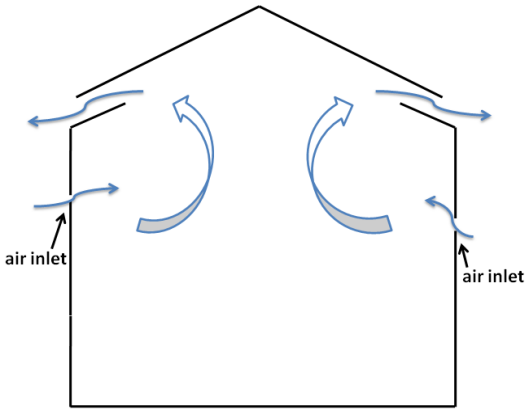
Ventilation is often used in bathrooms and toilets. The ventilator transports the used air out and fresh air streams in.

#### 4.3.3.1 Energy saving measures through ventilation

Ventilation in bathrooms and toilets is only necessary when the rooms are occupied. The installation of movement sensors can reduce the operating time of the ventilator. In bathrooms and less frequently used rooms, ventilation will only work if someone is inside. It is also possible to combine the ventilation sensors with light fixtures.

Ventilation should be regulated according to occupancy levels as well. The amount of ventilation needed in a half-full building will be less than that required by a facility working at full capacity. By regulating the levels according to actual needs, large energy savings can be achieved.

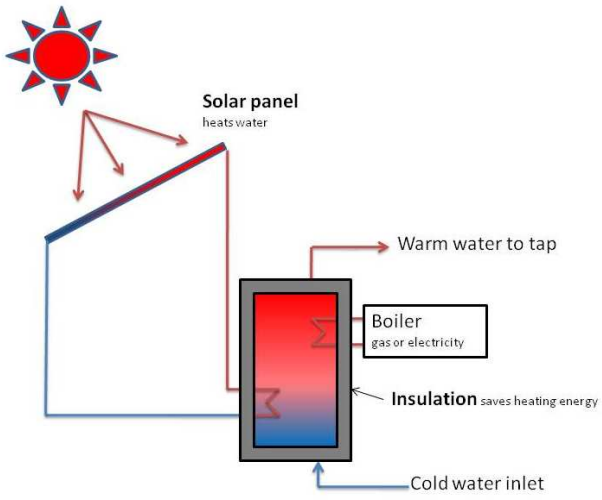
In rooms and buildings without an air conditioner, you should think about the possibility of natural ventilation. Natural ventilation can secure a comfortable indoor environment without the use of energy.




(Natural ventilation)

### 4.3.4 Water Heating

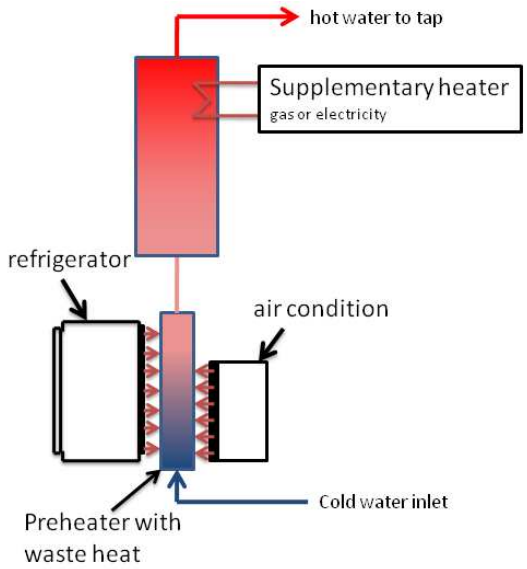
Heating water is a key contributor to energy consumption at all hotels and restaurants. The hot water boiler is a large energy user in the hospitality business. Guests take a shower every day and the pool needs warm water. Also in the kitchen a lot of hot water is used. Small changes here can save a lot of energy and money so take a closer look at water heaters.
In the Kho Chang Province, hotels and restaurants can reduce their dependency on mainline electricity by installing solar water heating using solar panels as shown below.




(Water heating with solar thermal power)

To heat water it is possible to use a number of heat sources. For example gas, electricity, solar, biomass or waste heat. Warm water can be generated centrally in large boilers or

with small boilers on demand. Central boilers are more efficient, but need circulation to provide all consumers with hot water at any time.




(Water heating with waste heat)

If a choice is available between using natural gas or electricity, especially at the time of purchasing equipment, gas will save energy costs and reduce carbon emissions by a similar amount. Use solar thermal systems or heat-recovery systems from all heat-generating installations, such as refrigeration and air conditioning. The climate in Thailand with high solar radiation and high temperatures is perfect for solar water heating. In Thailand the annual solar radiation is about 1.800kWh/m². Waste heat can also be used to pre-heat water. Where this is feasible, not only can it reduce energy consumption, but could also reduce boiler capacity. Another option is to install heat pumps. Heat pumps heat up the water very efficiently. Therefore they need only 25% of energy, compared with a standard electrical boiler.

#### 4.3.4.1 Energy saving measures for water heating

**Boiler:**

Excessive heating of hot water is wasteful. The optimum temperature for stored hot water is 60˚C which is adequate to kill Legionella bacteria and is sufficiently warm for guests and staff. Ensure that thermostats are set at a level which guards against legionnaire's disease whilst also avoiding overheating water. Also provide the hot water needed, using the least amount of boiler capacity and check the time and temperature settings of all electric panels and storage heaters.

Where hot water needs a long way to reach staff quarters and public toilets from the main boiler, the installation of heat-on-demand water heaters should be taken into consideration. Furthermore, consider whether hot water in remote areas is really necessary.

When choosing a new boiler, you should consider that you will spend far more on the energy used to power it over its lifetime than on the initial capital investment. Thus an additional investment at the time of purchase in the most efficient boiler will pay back relatively quickly. Adequate insulation of hot water tanks and hot water pipes with modern foam coating is very important and saves a lot of money and energy.

Maintain the boiler through an annual service (a poorly maintained boiler may use 15% more energy than one that is serviced annually).

**Washing and Cleaning:**

Thermostats on hot water heaters should be set to appropriate temperatures and washing water temperature settings must be checked regularly. Ensure that the lowest possible washing temperatures are selected. A 40˚C washing is adequate for most lightly soiled fabrics and is significantly more energy efficient than washing at temperatures of 60˚C. Some of the newer generation of washing detergents can facilitate washing at even lower temperatures (some are effective in cold water), offering further energy savings.

Many modern cleaning fluids, washing detergents and products do not require hot water. If you use cold water you can save a lot of money without problems with the washing.

Front loading washing machines, are more efficient than top loading washing machines.

**Kitchen:**

Dish washers should only be used when full machine loads can be processed. It is recommended to use preheated water.

Power drying cycles on some dishwashers are very energy intensive. Energy savings can be made by shortening drying times and using the residual heat from the machine to dry the dishes.

Also never use running hot water to defrost foods. Take them out of the freezer on time.

**Swimming Pool:**

Owing to the high thermal capacity of water, even a slight rise (0.5 ˚C) in the pool temperature will increase energy consumption. The temperature of pre-swim-showers should be set at 2 ˚C above pool temperatures and post-swim/exercise showers should be set maximally at 40 ˚C. Explore heating of pools through solar collectors.

**Water Saving Fixtures:**

Fit aerators or flow restrictors on all basin taps, but especially on hot water outlets. These are easily fitted to pipes or taps and consumption will be reduced without diminishing the service to the customer. Replace conventional showerheads with water efficient showerheads. These appliances will reduce the flow of water to the showers from 15-18 liters/minute to 8-10 liters/minute.

Toilets should also have a dual flush system. One knob that uses less water and one that can use more. A stop button for flushes should also be installed. Even automatic sensor flushing systems could be installed to save water. Often water is pressurized for flushing, which reduces the amount of water required for flushing toilets.

**Other water management measures:**

Apart from fixing water saving devices in the showers, taps and dual-flush toilets, some water management measures can be taken to reduce potable and fresh water consumption.

At the Koh Chang designated area, much of the drinking water is supplied by small plastic bottles. Hotels and restaurants could install water filters which treat tap water to make it fit for consumption. Alternatively, larger bottles of water should be bought. These can be reused easily as compared to the small bottles which

often litter the landscape and are energy intensive to produce.

Greywater (the water from showers and kitchen sinks) could be collected separately, filtered and used again for watering gardens or washing laundry. Of course, this will require initial installation of pipes for collection, treatment and distribution of greywater. However, a hotel can significantly reduce potable water use by reusing greywater.

Guests should be informed about water saving policies in the hotel. See more information in the communication section of this handbook.

## *4.3.5 LIGHTING*

Lighting is an important cost factor. About 20% of the total electrical consumption is used for lighting. Good lighting is essential for costumers' satisfaction as well as for the health and safety of staff and visitors. With modern technology, lighting energy costs can be reduced significantly by using energy efficient bulbs, lamps and controllers. The pay-back period for lighting conversions is short, usually under two years. Converting to energy efficient and effective lighting is one of the most cost-effective measures available to the hospitality businesses.

### 4.3.5.1 Types of Lighting

There is natural and artificial lighting available in a building complex. Natural lighting is derived from the sun and is thus free of cost. Artificial lighting, in the form of lamps, bulbs, tube-lights and so on is required at night and during the day in badly lit buildings.

Try to maximize the use of natural daylight in your hotel. Windows with a good glass coating or glazing will let sunlight in, but keep the heat out of the rooms.

### 4.3.5.2 Energy saving measures through lighting

**Avoid the need of artificial light:**

One of the best and easiest measures to save energy is simply to avoid the need for artificial light. Use natural light wherever possible and comfortable. Place work desks close to windows or under skylights. It is also important to ensure that all windows are cleaned regularly. Only clean windows let the whole natural light in. It is also beneficial if you use bright colors in all interior rooms. These colors reflect the light and lead to brighter rooms, reducing the need to turn on lights during the day. Provide guests and staff with desk lamps or independently operated task lights and avoid the need to fully illuminate the whole room when only a part of the space is in use.

**Clean the lights:**

Keep light fixtures and fittings clean. A regular cleaning routine for external lighting is equally if not more important than a routine for cleaning internal lights. Mosses, lichens, and environmental pollutants rapidly build up on lights and reduce their effectiveness by as much as 50%.

**Switch off:**

Switch off lights in vacant rooms. Ensure that "switch off" policies are in place and in operation. Inform your guests about these policies. Timing controls can be used to reduce night-

time lighting, for example, by switching off selected lights along corridor areas and in remote garden areas. Photocells and motion detectors are very effective in areas such as public toilets where the user cannot be expected to turn the lights on and off. However, sensors must be placed to turn lights on as soon as the customer enters the area and, to ensure that the customer does not enter a completely dark room.

| | Incandescent light bulb  | Compact fluorescent lamp  |
|---|---|---|
| Power | 60 Watt | 11 Watt |
| Lifetime | 1000 h | 10 000 h |
| Daily operating hours | 4 | 4 |
| Yearly energy consumption | 87.6 kWh | 16.1 kWh |
| Yearly energy costs (3 THB/kWh) | 262.8 THB | 48.3 THB |
| Savings/year (1 bulb) | | 214.5 THB<br>71.5kWh<br>80% |
| Savings/year (100 bulbs) | | 21450 THB |

(comparing costs of a low and high efficiency bulb)

**Change types of lights:**

Exchange conventional incandescent lamps with compact fluorescent lamps (CFL) in all places where the light is on for more than a few minutes. This easy measure saves 80% of costs and energy. Also, efficient lamps have the added advantage of a longer life span thus requiring less replacement and maintenance.

An average energy bulb starts at a price of 100 THB. The price rises with higher performance like longer lifetime or different shape.

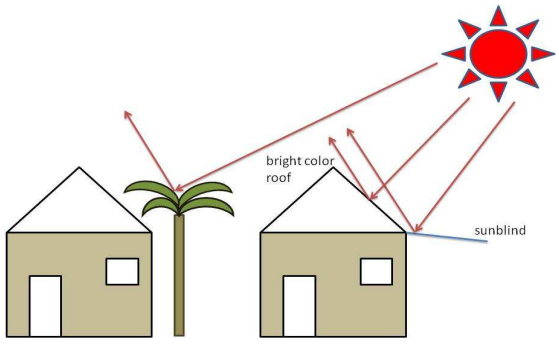
You can also use solar lamps to light public pathways. These lamps have solar panels on the top and can produce light without consuming external energy.

Take a look at the "T5 Retrofit Program" of the Electricity Generating Authority of Thailand and the Thailand Ministry of Energy.
http://www.egat.co.th/en/images/stories/pdf/eng-t5_3.pdf

### *4.3.6 Building Energy*

Significant savings in energy and water costs can be achieved by integrating energy efficiency into planning considerations if you are refurbishing part of your property or adding new facilities to your hotel.

#### 4.3.6.1 Energy saving measures in buildings

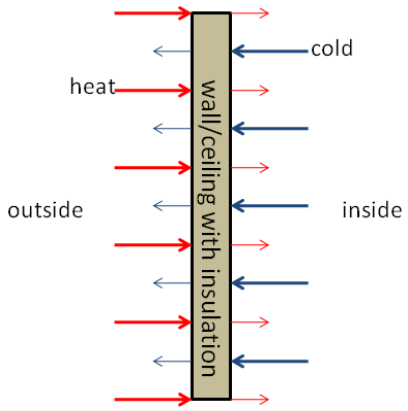



(solar radiation)

Use light colors for walls and ceilings (for example paint wooden roofs in light color). Light colors reflect the solar radiation and lead to lower air conditioning consumption. Buildings with large south or south west facing glazed windows, may suffer from excessive heat and light gain during the summer months. Trees and shrubs planted carefully in external areas can help guard against solar gain and reduce the need for costly air conditioning by providing attractive shading. Outdoor sun blinds can also help saving energy. A sunblind located outdoors can save up to 75% and one located indoors 25% of energy. Also

check the sealing of the doors and windows to ensure their air tightness. This will lead to higher comfort and reduce energy costs.

Insulation is a key issue for all hotels, even those with existing energy management programs. Effective insulation can be cheaply installed during the construction and refurbishment of hotels. If you are planning to refurbish, you should bear in mind that significant savings in energy costs can be made by integrating efficient insulating materials and building design considerations into your plans. It is worth increasing insulation levels for walls, ceilings and roofs above the regulatory standard. Effective use of insulation and design as a part of a refurbishment program can reduce energy costs as much as 50%.




Insulation separates the hot external conditions from the air conditioned indoor climate. A thicker insulation layer and a lower thermal conductivity of the insulation leads to a lower heat exchange and more energy savings.

In general, the most energy-efficient technologies should be selected and maximum use of natural light, solar energy and natural ventilation should be made.

## 4.4 Waste Management measures

### *4.4.1 Waste from Hotels and Restaurants*

Hotels and homestays together account for total emissions of 65 $CO_2$eq tonnes per month in the Kho Chang Cluster region (GTZ/Dasta/Adelphi Baseline 2009).

Although this number is significantly less than the emissions generated from energy consumption and transport from hotels, measures for waste management can contribute to reduction of total $CO_2$eq emissions from hotels, restaurants and other tourism facilities. For hotels and such, waste management can be practiced at source in order to avoid emissions.

The manufacture, distribution and use of products as well as management of the resulting waste, all result in greenhouse gas emissions. Thus, waste minimization, prevention and recycling already reduce greenhouse gases associated with these activities by reducing methane emissions, saving energy, and increasing forest carbon sequestration.

Open and unmanaged landfills are a large source of methane ($CH_4$) emissions which are more harmful than $CO_2$ emissions. Open burning of waste has also been identified as a significant contribution to increase in greenhouse gas emissions.

Firstly, in order to make recycling efficient, it is important to separate waste. Streams of waste such as

organic, paper, cardboard, glass, plastic, metal, and hazardous can be collected separately or sorted in-house. Guests should be made aware that there is a separation policy at the hotel, homestay or restaurant. At hotels, provision of at least 2 bins per room, one for wet (organic) and one for dry waste (such as packaging) could be one option to encourage guests to separate waste. A collection for hazardous waste can be made at the reception of the hotel for household hazardous waste like batteries, minor medical waste and the like.

### 4.4.2 Organic waste

This type of waste consists of biodegradable waste which is quickly broken down. This includes food wastes from vegetable and fruit, cuttings from the garden such as leaves, plant waste or twigs. Food waste constitutes the maximum waste (about 65%) from hotels and restaurants at Kho Chang. This waste can be collected from kitchens and restaurants and can either be converted to compost on a compost-pit located on-site as shown in the picture below, or sent to a municipal composting facility.

(A typical garden composting pit)

Organic waste is biodegradable and can be processed in the presence of oxygen by composting or in the absence of oxygen using anaerobic digestion. Both methods produce a soil conditioner, which when prepared correctly can also be used as a valuable source of nutrients in urban agriculture. Anaerobic digestion also produces methane gas an important source of bio-energy.

A compost pit could be built in a corner of the garden. This pit must be aired at least once a week by turning the material with a shovel. Manure from below can be removed every 5-6 weeks (depending on the weather) and used in the garden or sold.

### 4.4.3 Plastic bottles

Plastic bottles for drinking water are a major cause of waste on the Kho Chang island cluster and a lot of energy is spent on transporting these by boat to the mainland.

These bottles must be collected separately and sent to recycling plants. If possible, tap water should be filtered and made suitable for drinking. Minimizing the use of drinking water bottles should be the aim to avoid the waste and litter caused by these.

(Current recyclable collection practiced on Kho Chang Island)

### 4.4.4 Glass and Metal waste

Glass, as well as metal waste is a valuable and easily recyclable stream of waste. Glass bottles can also be

used repeatedly if cleaned adequately. Metals from food tins and soft-drink cans can also be collected and recycled effectively. Glass and metal waste from hotels and restaurants should be collected separately and sent to the nearest recycling facility. This could be collected in 'dry bins' from the guest rooms. Restaurants will also create a large amount of metal (from tins) and glass waste. This should also be cleaned, collected, stored and then taken to the nearest recycling facility.

### 4.4.5 Paper and Cardboard

Paper waste and cardboard can be collected from rooms, offices and restaurants and sent to a paper recycling facility. Guests could throw paper in the Dry Bins provided in their rooms. Housekeeping staff will have to make sure that waste which is not sorted by guests, is then sorted by the hotel and where possible sent for recycling.

Offices in hotels and home stays should collect waste paper in separate bins. Restaurants will generate more cardboard waste, from packaging of food products. Uncontaminated cardboard boxes can be used again for storage purposes or could be collected and sent for recycling.

### 4.4.6 Household Hazardous Waste

Care should be taken to dispose of household hazardous waste appropriately. These include items such as leftover or unused fuels, paints, pesticides, fertilizers, used batteries, oil, stain removers and cleaning chemicals, small medical waste such as bandages or syringes, electric goods, etc. These materials must also be stored in separately labeled, closed containers to prevent leakage to the ground. They should be sent to special facilities for disposal. If they end-up in an open landfill, there could be severe impacts on the environment such as contamination of groundwater and soil.

(Household hazardous waste)

### 4.4.7 Information & Communication on Waste

Restaurants and especially hotels must communicate their recycling and waste minimization policy to guest and staff. Brochures, leaflets etc., could be placed in hotel rooms to inform guests about the hotel recycling policy. It is important that staff is aware and involved in the waste collection and separation as this will increase the chances that waste is actually recycled Staff meetings should incorporate training sessions on the recycling and disposal policy of the hotel, how to handle the waste, separate waste correctly if guests have not done so, and dispose it in the correct bins.

Wet and Dry bins in hotel rooms and restaurants should be labeled carefully and instructions could be printed in the information brochure for the guests. Storage areas for larger bins or skips should be kept aside in order to store waste collected for rooms. In this storage area, dry recyclables such as

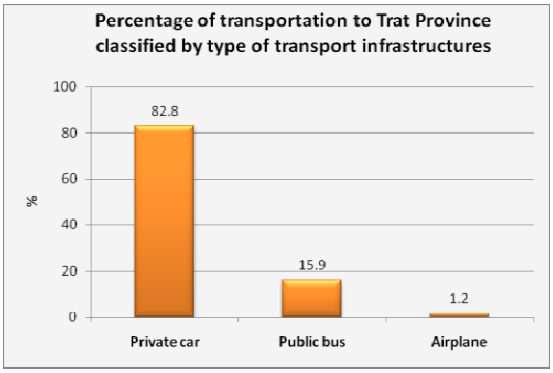
paper and cardboard, plastic packaging and bottles as well as glass can be stored too, until a sufficient amount has been collected for transport to the recycling facility or the disposal site.

(An example of well labeled bins)

## 4.5 Transport Management

### 4.5.1 Introduction

Transport at the Kho Chang island cluster consists mainly of private transport or taxi, ferry and speedboat transport to and from islands, motorcycle, and some bus transport. Speedboats consume the highest amount of fuel for hotels while cargo ships and motorboats are the main fuel consumers for restaurants in the Kho Chang Islands. The table below shows the distribution of the transport infrastructure in the Trat Province.




(source: Interim Report, Burapha University)

Transport also makes up the highest percentage of $CO_2$ emissions for hotels and operators of businesses such as groceries, tour and guide operators. For restaurants, it is not transport but energy production that creates the maximum $CO_2$ emissions. Transport alone accounts for 80% of total CO2 emissions from operators, 56% of CO2 emissions from hotels and 35% from restaurants. Transport from hotels generates a total of 1,011 $CO_2$eq tons per month and a total of 124 $CO_2$eq tons per month for restaurants.

Since transport accounts for such a large share of emissions in hotels and especially operators, measures to reduce emissions generated from transport should be implemented at the Kho Chang cluster. Measures to reduce emissions from private cars, speed boats and motorcycles should be taken. Such measures are discussed below.

### 4.5.2 Reducing Private Transport

Hotels require speedy and on-demand transport of tourists to and from tourist destinations. Thus the requirement of private cars is high in hotels. Operators require regular transport of goods and thus have higher emission rates from transport. The aim for hotels should be to maximize the tourists per private vehicle and thus reduce trips required by private cars. For example, airport pick-ups could be arranged in such a way that more guests are picked up together rather than individually. Car-sharing between tourists visiting similar tourist attractions could also be arranged at hotel reception. Scheduling and planning is important for this to work smoothly. Single

people travelling in a private vehicle should be avoided as far as possible.

Motorboats and speedboats should also operate at full capacity. Tourists could share speed boats to travel from island to island or to the mainland. Schedules for different operators should be aligned to work efficiently. Potentially, operators could work as a collective and share profits minimizing the risk for each operator not to run on full capacity. Motor boats should be maintained and checked regularly to make sure they are running efficiently. Cars and motorcycles should also be serviced regularly to make sure they are running efficiently and with low emissions.

### 4.5.3 Delivery of Goods

Restaurants, hotels and operators require a large amount of supplies of meat, seafood, fruit, vegetables and drinking water delivered from the mainland or other islands. This requires sea and land transport. Hotels as well as operators can schedule deliveries of goods such as groceries, water, laundry deliveries, etc in such a way that delivery of several items is carried out simultaneously, avoiding the need for multiple trips, especially by motor or speed boat.

### 4.5.4 Public transport

Public transport should be promoted as a means of transport for hotel guests and travelers. An up-to-date public transport schedule along with prices should be available for guests at hotels at the lobby or reception area. Bus stops and taxi pick up stands should be clearly marked on a map.

Bicycling should be encouraged among tourists and travelers. Hotels should have bicycles available on hire for guests. Maps of the area should also be provided, this makes bicycling more attractive. It will encourage tourists to opt for more sustainable transport rather than private taxis. An effort for a bicycle trail has already been made on Koh Mak.

# 5 Public communication

It is essential to communicate the environmental goals to not only guests at hotels and restaurants, but also staff members, personnel, visitors and the immediate community. When they are well informed about measures taken toward more efficient energy and water consumption and creation of less waste, it improves motivation to be personally involved in taking action. The reasons behind taking measures should be communicated to staff and visitors.

Tour operators must inform tourist about the impact of climate change on the natural environment and the actions they are carrying out to mitigate this. A list of options must also be provided to tourists for car sharing possibilities, public transport routes, hiring bicycles and so on.

Also, communicate your efforts to the international tourism organizations and tours operators that advertise your facility to potential customers. The Green Leaf Initiative would be another way to get your efforts recognized.

## 5.1 Information for Tourists

Tourists should be informed of the activities undertaken by hotels, homestays, restaurants or operators to reduce emission rates.

Hand-outs, brochures, or leaflets could be kept in hotels and guest rooms to inform the guests about environmental policy of the hotel or homestay. Basic information on turning off water taps when not in use, turning off lights and air conditioning in the room should be provided to guests.

Many guests will appreciate the energy saving contribution of the hotel and will be more likely to engage in energy and water saving if they have the right information.

## 5.2 Information for staff and personnel

It is equally important to involve staff especially housekeeping staff about mitigation measures being taken in hotels and restaurants. Reasons for changes in operation or acquiring new equipment must be given. Training sessions and workshops could be organized to inform staff about equipment maintenance and upkeep, and the need for waste separation. You could also include a point system or star system for the “most environmental coworker of the month” award to motivate staff to participate actively in management of energy, water, waste, and transport systems.

# 6 Basic Calculations

## 6.1 Payback Period

### *6.1.1 Calculations*

The payback period is a calculation method which is easy to use. This method indicates the economic efficiency of investments in energy efficiency measures. This calculation can be undertaken by the hotel/restaurant owner or the technical staff – i.e. the person responsible for budget for buildings and machinery.
The **payback period** is the amount of time an energy efficiency measure needs to cover its costs.

$$payback\ period = \frac{total\ investment}{yearly\ cost\ savings}$$

First you have to identify the current yearly consumption of your existing (old) technologies. This can be done through measurements or estimations. If you undertake measurements only for a certain time period (in days) you have to calculate the yearly consumption as follows:

$$yearly\ energy\ consumption = \frac{consumption\ (period)}{period} \times 365\ days$$

Now this must be compared with the yearly consumption of the new equipment. This is written on the energy label.


The **yearly energy saving** is the difference between the old yearly energy consumption and the new energy consumption.

*old yearly energy consumption - new yearly energy consumption*

*= yearly energy savings*

The yearly energy savings have to be transferred into **yearly cost savings** by multiplication with the energy costs. The energy costs are depending on the source of energy. The electrical costs are written on the electrical bill. The electrical price currently (Nov. 2009) ranges from **2.7 THB to 3.5 THB per kWh.**

The cost of gas in bottles (LPG) is **1.8 THB per kWh**

$$yearly\ cost\ savings = yearly\ energy\ savings \times price\ per\ kWh$$

With the required cost of investment and the annual cost savings the payback period can easily be calculated. This method shows if it is worth to replace old working equipment with new efficient equipment. If the old equipment must be replaced anyhow and there are different possible options for new equipment the payback time can also help with the decision:

$$payback\ time = \frac{price\ of\ product\ A - price\ of\ product\ B}{[energy\ consumption\ (product\ B) - energy\ consumption\ (product\ A)] \times energy\ price}$$

### 6.1.2 EXAMPLE

Replacement of a refrigerator:

To identify the consumption there are plug-in electrical meters available. These meters can plug between the electrical socket and the plug and display the energy consumption. After 5 whole days the meter reading is 10 kWh. With the formula the yearly energy consumption is calculated.

The **payback period** is the amount of time an energy efficiency measure needs to cover its costs.

$$yearly\ energy\ consumption = \frac{10\ kWh}{5\ days} \times 365\ days = \mathbf{730\ kWh}$$

The yearly energy consumption is written on the energy label of the new refrigerator. In this example it is 420 kWh per year.

$$yearly\ energy\ saving = 730\ kWh - 420\ kWh = \mathbf{310\ kWh}$$

The price of the electrical energy is shown on the electricity bill and in this example 3.5 THB per kWh.

$$yearly\ cost\ savings = 310\ kWh \times 3.5\ \frac{THB}{kWh} = \mathbf{1085\ THB}$$

The investment costs for a new refrigerator are 7500 THB.

$$payback\ period = \frac{7500\ THB}{1085\ THB} = \mathbf{6.9\ Years}$$

### 6.1.3 TYPICAL PAYBACK PERIODS

The savings and costs vary according to the application. The following table shows typical values of payback times for Thai hotels.

| Measure | Payback time |
|---|---|
| **Roof and wall insulation** | 5 – 15 years |
| **Solar water heating system** | 5 – 12 years |
| **Heat recovery** | 3 – 12 years |
| **Compact fluorescent bulb** | 0,5 – 3 years |
| **Install variable frequency drives on motors and pumps** | 2 – 5 years |
| **Efficient shower heads** | 0,5 – 2 years |
| **Aerator** | 0,5 – 3 years |
| **Energy efficient refrigerator** | 5 – 12 years |
| **Movement sensor** | 1 – 5 years |
| **Energy efficient air condition** | 3 – 10 years |

## 6.2 Other Calculation Methods

The payback period is a static calculation. Therefore it is a fast and easy method to get an overview of the investments profitability. Beside this method there are other, more complex calculation techniques available, which are shown briefly here.

$$NPV = -Investment + \left(yearly\ savings \times \frac{(1+i)^T - 1}{(1+i)^T \times i}\right)$$

### 6.2.1 Net Present Value (NPV)

The NPV shows how much an investment is worth at the present time. It also considers the interest rate.

$$NPV = -300\ THB + \left(200\ THB \times \frac{(1+0.05)^3 - 1}{(1+0.05)^3 \times 0.05}\right) = \mathbf{245\ THB}$$

i = interest rate in decimal digit (5% = 0.05)
T = lifetime (years)

Example: An energy saving light bulb with a lifespan of 3 years costs 300 THB. This lamp saves electricity worth 200THB every year. The interest rate is 5% = 0.05.

This means the bulb is worth 245 THB now. All investments with a NPV > 0 are economically reasonable.

### 6.2.2 Annuity

The annuity is the yearly costs of an investment with the interest rate involved. The annuity can check against the yearly savings. So I can be seen if an investment should be made.

$$Annuity = Investment \times \frac{i \times (1+i)^T}{(1+i)^T - 1}$$

i = interest rate in decimal digit (5% = 0.05)
T = lifetime (years)

Example: With the example above we have investments of 300THB, 3 years lifespan, 200THB yearly savings and 5% = 0.05 interest rate.

$$Annuity = 300\ THB \times \frac{0.05 \times (1+0.05)^3}{(1+0.05)^3 - 1} = \mathbf{110\ THB}$$

Now we compare the yearly savings with the yearly costs (annuity)

$$yearly\ earnings = 200\ THB - 110\ THB = \mathbf{90\ THB}$$

This method shows that yearly earnings of 90 THB can be made.

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| Year: | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electrical energy consumption [kWh] | | | | | | | | | | | | |
| Electrical energy costs [THB] | | | | | | | | | | | | |
| Gas consumption [kg] | | | | | | | | | | | | |
| Gas costs [THB] | | | | | | | | | | | | |
| Diesel consumption [l] | | | | | | | | | | | | |
| Diesel costs [THB] | | | | | | | | | | | | |
| Room-days | | | | | | | | | | | | |
| Calculate ratios | | | | | | | | | | | | |
| $\frac{Electrical\ costs}{Room-days}$ | | | | | | | | | | | | |
| $\frac{Gas\ costs}{Room-days}$ | | | | | | | | | | | | |
| $\frac{Diesel\ costs}{Room-days}$ | | | | | | | | | | | | |
| $\frac{Overall\ energy\ costs}{Room-days}$ | | | | | | | | | | | | |

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