

A Manual for Cleaner Production in Hotels



United Nations Environment Program



**Canadian Universities Consortium
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CLEANER PRODUCTION

IN HOTELS AND RESORTS

List of Abbreviations

AHU	-	Air Handling Units
BOD	-	Biological Oxygen Demand
CFCs	-	Chloro-Fluoro-Carbons
CO	-	Carbon Monoxide
COD	-	Chemical Oxygen Demand
CP	-	Cleaner Production
CUC UEM	-	Canadian Universities Consortium Urban Environmental Management Project
EMS	-	Environmental Management Systems
HVAC	-	Heating Ventilation and Air Conditioning
IRR	-	Internal Rate of Return
NPV	-	Net Present Value
O ₂	-	Oxygen
ODS	-	Ozone Depleting Substances
PAU	-	Primary Air Handling Units
PW	-	Present worth
SS	-	Suspended Solids
TTTP	-	Training and Technology Transfer Program
UNEP	-	United Nations Environmental Program
UNIDO	-	United Nations Industry Development Organization
VOC	-	Volatile Organic Carbons

Cleaner Production in the Service Industry

The cleaner production (CP) concept was first introduced in the industrial sector more than a decade ago and since then has been popularly accepted by industries worldwide. Because the word 'production' is used in the term 'cleaner production' many people at first misunderstood this to be a tool with application only in the industrial sector. However, CP is a concept and management practice with far wider application than the industrial sector. In essence it is a proactive approach to reducing environmental impact while managing resources more efficiently, thus striking a golden balance between economic and environmental performance.

“Cleaner Production is the continuous application of an integrated preventive environmental strategy to processes, products and services to improve eco-efficiency and reduce risks to humans and the environment.” For processes (manufacturing and delivery of products and services) cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and waste before they leave a process. For products, the strategy focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product. CP is essentially an approach to environmental management that emphasize prevention, based on the idea that it is cheaper and easier to prevent generation of waste and pollution than to handle the waste and pollution once it has been generated. The prevention or minimization of waste and pollution generation is achieved by improving the efficiency of the production and service processes in a company. Since CP is basically achieved by improving the efficiency of an operation, it usually not only results in an improved environmental performance but also in considerable economic savings as well.

This concept can be used by any organization, as every organization utilizes natural resources and discharges waste in some form or another and thus exerts an impact on the environment. Hotels, as a part of the larger tourism industry, must be aware that excessive waste generation can have serious implications for the entire industry because a polluted destination will not attract tourists.

In many respects the hotel industry resembles any traditional industry in terms of resource consumption and waste generation; the only difference is that it does not manufacture a material product, but instead provides services to its guests. The key issues in such a scenario are how to minimize resource consumption, waste generation and overall impact on the environment while maintaining the highest possible quality of service.

About this Manual

This document is a joint effort between the Canadian Universities Consortium (CUC) and the United Nations Environment Program (UNEP).

This is the first of two documents on the topic of environmental management in hotels and resorts which are intended as practical handbooks for hotels and resorts interested in implementing a CP program within their facilities. This manual introduces methods for conducting a CP audit in a hotel. Some useful checklists are also included for CP auditors along with a list of CP options for hotels. This document is thus expected to be a useful resource for both hotel CP auditors and hotel environmental managers.

The other manual focuses on the solid waste component of an overall environmental management program and is intended to be a practical handbook for the hotels and resorts that are interested in implementing solid waste composting. The composting manual targets hotel technical managers/engineers as well as the field operators who will implement the composting activity in the hotels. For this reason, theoretical background is only briefly touched upon, and practical aspects are emphasized.

While the CP concept primarily focuses on how to prevent waste from being generated in the first place, a discussion of waste handling has to be included in any integrated waste management system. For this reason both manuals consider end-of-pipe approaches to waste management.

CP is also related to a number of other environmental tools, such as eco-labeling, ISO 14000 certification and green purchasing. A brief introduction to how these may benefit, or benefit from, applying CP in a hotel or at a resort is also included in this manual.

This manual has been developed largely from the experience gained while implementing CP projects in Thai hotels. The Canadian Universities Consortium supported this project aimed at promoting CP and Integrated Waste Management concepts in the Thai hotel industry. Many other informative resources have also been used to produce this manual.

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About the TTTP CUC UEM Project

The Implementation and Demonstration of Cleaner Production for Hotels in Hua Hin, Thailand

The Training and Technology Transfer Program (TTTP) of the Canadian Universities Consortium Urban Environmental Management Project at the Asian Institute of Technology, in partnership with the Thailand Environment Institute, has carried out environmental audits in five hotels in the resort area of Hua Hin. The completed audits and interpretation of results were shared with participating hotels, adding to the hotel operators' understanding of the CP process. This emphasis on information sharing and participation in the CP process is based on the rationale that knowledgeable hotel managers and staff are essential to program sustainability and, indeed, to the initiation of other improvements to their hotel's waste management efforts. On-site demonstrations and training sessions were led by Canadian experts in aspects of CP such as organic waste composting and environmental management systems.

There is increasing concern about the impact of hotels on local communities and environments. In large part, the degradation of these destinations is a consequence of inadequate or inappropriate environmental management practices. Reducing the waste streams of hotels at the source, through CP practices, should be the primary strategy for environmental management. With organic wastes accounting for over half of a typical hotel's solid waste composition, this project focused on reducing waste, recycling and converting the organic waste stream into a valuable resource (compost used for soil amendment), which helps close the loop between resource consumption and waste generation.

Demonstration and training were accompanied by ongoing program supervision and monitoring. The TTTP demonstration in Hua Hin will provide examples and lessons for other hotels in Thailand and the South East Asian region, and will serve as a basis for further improvements in the participating hotels' waste management and cleaner production techniques and processes.

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Significant Environmental Issues in Hotels

Hotels and resorts constitute a very important part of the tourism industry and urban life. While modern hotels are designed to cater to the needs of their guests and offer a comfortable stay, they also make a significant impact on the environment, irrespective of the size, scale and level of operation.

Hotels increase the demand on existing sewer, water, waste disposal, and power facilities and can cause serious deterioration in the physical and/or social environment. Air emissions from boiler stacks can pose air pollution problems, while food waste and other organic waste may cause odor problems. Hotels consume a substantial amount of fresh water and discharge a corresponding amount of wastewater into the environment.

As with other industrial and service sectors, governments have addressed the environmental problems posed by hotels and resorts by enforcing legislation and discharge standards. By charging a higher (commercial) rate for resources such as water and energy, a rational use of these resources is encouraged. In addition to government expectations, there have been growing expectations from the guests about sound environmental management practices in hotels and resorts — especially in ecologically sensitive areas.

Significant environmental issues in the context of daily hotel operations include:

- I Energy consumption and associated costs (electrical and steam) including Heating, Ventilation and Air Conditioning (HVAC) and kitchens.
- II Water consumption and wastewater generation.
- III Solid waste management.
- IV Air quality (indoors and outdoors).
- V Ozone Depleting Substances.

I Energy Consumption and Costs

Energy consumption usually makes up a large part of the costs of a hotel and substantial savings can often be achieved. Energy consumption and hence the cost for heating, ventilation and air conditioning (HVAC) can range from 25-50 % of the total energy costs of a hotel. The higher figure applies to luxury hotels in hot and tropical climates which require heavy air conditioning. Lighting generally accounts for 15-25% of a hotel's electricity consumption.

Generally, of the types of energy supplied to a hotel building, electricity dominates in terms of both units consumed (GJ) and cost. Hence measures to cut electricity consumption can result in a direct and significant impact on total cost of energy consumption of a hotel. Other forms of energy used include steam for laundry and hot water for guest floors, which is typically produced by using a boiler which operates on low-grade fuel oil.

II Water Consumption and Wastewater Generation

Hotels consume a significant amount of water for various activities. The following figures give some indication of the volume of water used by different sizes of hotels in Thailand:

- Hotel Size: 150 - 200 rooms — 50,000 - 100,000 m³/yr
- Hotel Size: 200 - 300 rooms — 120,000 - 180,000 m³/yr
- Hotel Size: 300 - 400 rooms — 180,000 - 250,000 m³/yr
- Hotel Size: 400 plus rooms — 300,000 - 500,000 m³/yr

The amount of water consumed is a direct indication of the wastewater generated and treated in the treatment plant. The wastewater from hotels is primarily domestic in nature and hence is not difficult to treat. Technologically, this is not considered an area of concern. Most hotels have their own wastewater treatment plants for treating raw wastewater to meet the stipulated discharge limits. This is the only direct wastewater management cost borne by the hotels (and this is, of course, a major concern). In many developing countries in Asia there are no sewer charges for discharging the treated wastewater into the municipal sewers. Wastewater generated in hotel kitchens can be substantially polluted with oil and grease and high loads of BOD, COD and SS. The laundry operation of a hotel can also have an enormous impact on the environment. A large amount of energy and water are used for various cleaning and finishing processes, while the chemicals used can cause air pollution, toxic waste and sewage problems.

III Solid Waste Management

A hotel's solid waste stream is as diverse as it is enormous. Office paper, restaurant food waste, amenity bottles, plastic and aluminum beverage containers, countless cardboard packaging boxes, heavy machinery, and guestroom furnishings all find their way into a property's dumpster. Although this waste is diverse, the hotels typically generate a fairly consistent type of waste. The majority is paper and food waste, and there are lesser amounts of metal, plastic and glass. This profile is similar to the standard municipal solid waste stream from residential communities, largely because a hotel is much like a big house.

Variation in a hotel's waste composition can be attributed to differences in the scope of operations and target market of the hotel. For example, limited-service hotels and motels often do not offer an on-site restaurant. This eliminates most of the food waste that makes up a large portion of a full-service hotel's waste stream. Some hotels cater to business travelers who leave paper-type waste behind; other hotels cater to families on vacation who leave a lot of container waste (take-out boxes and bags, soda bottles and cans); and others cater to the convention and trade-show market which generates significant cardboard waste.

IV Emission of Air Pollutants

External Air Emissions

Air emissions to the outside atmosphere are potentially harmful to human health as well as to the general environment. Below are some of the emissions that hotels contribute to air pollution and their common sources:

- Chloro-fluoro-carbons (CFCs): CFCs are substances that negatively affect the ozone layer in the atmosphere which protects the Earth from harmful levels of ultra-violet radiation. CFCs are included in: freon from refrigerators, freezers, chillers and self-contained coolers; spray cans; fire extinguishers; halon computer room protection; foam insulation; Styrofoam cups and packaging.
- Particulates, sulphur and nitrogen oxides emissions from burning of fossil fuels/gas: Emissions from the use of fossil fuels have proven to have negative effects both on the environment (visible pollution, acidification, climate change, etc.) as well as on human health (especially by triggering respiratory diseases and allergies). Fossil fuel is used in boilers for generating steam, by cars and buses in a hotel fleet; in gas-fired equipment in the kitchens and laundries, and in generators for emergency power supply.

- Odors, vapors and mists: This kind of emission may cause foul smells and, in the case of solvents or paints, also affect the breathing and central nervous systems of people exposed to the vapors. Sources include kitchen and laundry exhausts; toilet exhausts; paints (especially spray) and solvents.
- Miscellaneous gases: These gases are typically irritating for the eyes and the respiratory tract and may have similar effects as vapors from solvents. Gases include formaldehyde (plywood, chipboard), trihalogen-methane, chlorine (swimming pools), and perchloroethylene (laundry).
- Particulates: These represent primarily a comfort and health problem for staff members who may be exposed to them over a long time. Some kinds of particulates (e.g. asbestos) may also cause breathing problems and lung cancer. Included in this group are asbestos, stonedust, lint (laundry), and sawdust.

In addition, accidental emissions from accidents such as fire may result in severe air pollution problems. An issue of primary concern is boiler stack emissions and malodors that may occasionally annoy neighboring communities. Given the amount of air-conditioning and refrigeration used in tropical hotels, CFC issues are generally also a priority.

Indoor Air Quality

Potential sources of indoor air pollutants include:

- Combustion: Combustion emissions may include gases (such as carbon monoxide, nitrogen oxides, sulfur dioxide, or hydrocarbons) and suspended particulate from boilers, cooking stoves, vehicle engines in garages and other combustion sources.
- Chemical Vapors: Solvents from detergents, pesticides, paints and varnishes.
- Tobacco: People are adversely affected by 'passive smoking'. Building decorations and fittings are degraded by tobacco smoke.
- Dust: Dust introduced from outdoor or indoor activities can be an irritant, especially to people with allergies or respiratory problems. It can also damage equipment and décor and increase cleaning requirements.
- Odors: Even at concentrations below health concern, pollutants can cause annoying odors. Besides chemicals such as those listed above, natural odors from sanitation and cooking can also contribute to poor air quality.

It can be observed that most of these emissions do not interfere directly with the guest areas and are primarily confined to the service areas of the hotel, hence indoor air quality issues become more relevant for the occupational health and safety of the hotel employees rather than the guests.

V Use of Ozone Layer-Depleting Substances

Emissions of man-made chemicals collectively known as ozone-depleting substances (ODS) are depleting the stratospheric ozone layer which protects life on Earth from the sun's harmful ultraviolet radiation. Depletion of the ozone layer has a direct effect on food production, health and ecosystems worldwide.

Hotels use ODS in refrigerators in the kitchens and mini-bars, air conditioning in the guest rooms and public areas, aerosol sprays in cleaning products, fire protection equipment, and foam mattresses. Following is a summary of most significant sources of ODS in hotels:

- Refrigeration: refrigerators, cold storage, display cabinets, freezers, ice machines and mini-bars.
- Air conditioning in buildings: general amenity areas, conference and meeting facilities, individual room units.
- Air conditioning in vehicles: mobile units in cars, vans and trucks.
- Dry cleaning and degreasing: solvents used in dry cleaning and special cleaning applications.
- Aerosols: spot cleaning, bathrooms and other surface cleaners, small area paints, adhesives, insecticides and pesticides, air fresheners.
- Foams: food packaging, trays and containers, pipe insulation, seat and back cushions, head rests, bedding and other upholstery uses, carpet underlay, car and bus interiors, protective packaging for a variety of goods.
- Fire Extinguishers: halons are used in fixed and portable fire extinguishers.

In response to the growing threat from ozone depleting substances, the world's nations have taken action to solve the problem through the Montreal Protocol on Substances that Deplete the Ozone Layer (1987), an international treaty that requires countries to phase out their production and consumption of chlorofluorocarbons (CFCs) and other ODS according to precise deadlines. This also includes the use of ODS in hotels and resorts, so special attention should be given to this matter when investing in new equipment, or retrofitting older equipment that may contain ODS.

IMPLEMENTING CLEANER PRODUCTION IN HOTELS AND RESORTS

UNIDO-UNEP Methodology for CP Implementation

One of the most common and widely accepted ways of implementing CP in companies is the 'CP audit'. This 6-step methodology, jointly developed by UNEP and UNIDO, aims to identify causes of unnecessary waste generation and to take remedial action.

CLEANER PRODUCTION METHODOLOGY

STEP 1 GETTING STARTED

- Assemble a CP team
- List process steps and general information
- Identify wasteful processes and focus

STEP 2 ANALYZE PROCESS STEPS

- Prepare process flow charts
- Prepare a material balance
- Assign costs to waste streams
- Identify the sources of waste

STEP 3 GENERATING CP OPTIONS

- Develop CP opportunities
- Select workable options

STEP 4 SELECT CP SOLUTIONS

- Technical aspects
- Economic aspects
- Environmental aspects
- Select solutions

STEP 5 IMPLEMENTATION

- Prepare for implementation
- Monitor and evaluate

STEP 6 MAINTAINING CP

- Sustain CP

CP Methodology for Hotels and Resorts

While the UNIDO-UNEP methodology has been recommended for industrial waste audits *per se*, experience shows that the same methodology, with minor modifications, can be easily applied to the case of hotels.

Implementation of a CP program in a hotel or resort is a systematic and continual process. Conducting a CP audit is the important first step in implementing a CP program. The CP audit methodology in the case of hotels consists of the following steps:

1. Planning and Organization
2. Pre-assessment: Identifying the Priority Issues
3. Assessment: Investigating the Issues
4. Identifying CP opportunities/ Conducting feasibility study
5. Technical, Economic and Environmental Evaluation of Cleaner Production Options
6. Implementing CP Options and Maintaining the CP Process

It is only after this audit that various CP options are selected for implementation.

Step 1: Planning and Organization

Form an Audit Team

The very first step in conducting the CP audit is to form an audit team with diverse expertise and which represents the various operational areas in the hotel. A typical composition of a hotel audit team would be:

- General Manager / Representative of CEO as team leader or advisor
- Chief Engineer / Environmental Manager as lead auditor
- Food and Beverage Manager
- Housekeeping Manager
- Chef
- Chief Steward
- Stores/Purchasing Manager
- Personnel Representative
- Security/Safety Officer
- Gardener

The actual size of the audit team depends on the size of a hotel. In a smaller hotel the audit team may very well be composed of only three or four persons. Help from an external consultant/advisor could be sought in the initial stages, or when the hotel team is conducting the audit for the first time.

Environmental Policy

It is advisable at this stage that the hotel management develop an environmental policy (if one does not already exist). This can facilitate defining objectives and targets and may institutionalize environmental activities in the hotel to a certain extent; this is crucial when seeking cooperation and support from all the staff members.

Sample Environmental Policy for Happy Hotel

Happy Hotel will minimize the environmental impact of our activities and products on the public, employees, customers and property and will comply with all relevant legislation.

It is the policy of Happy Hotel to:

- Minimize costs by reducing all forms of waste and by preventing pollution.
- Apply effective environmental procedures and management systems in all of our activities.
- Assess the environmental risks of new and existing projects, processes, and products so that we can take effective control measures and all parties can be made aware of the situation.
- Periodically audit our environmental performance and provide timely reports to the Board of Directors.
- Communicate our environmental policies, programs and progress to all employees, customers, suppliers and other interested parties.

Date:

Signed by CEO

Audit Objectives

It is important to define the audit objectives and scope in the initial phase of an audit. In the case of a very big hotel and resort with multiple units or buildings it might be a good idea to conduct the audit in a phased manner thus concentrating on one unit at a time.

Top management should set up objectives and targets for the audit team. This can help encourage the audit team to conduct a very focussed and efficient audit in line with environmental policies and management priorities.

Typically, hotel management may set up objectives and targets such as “reduction in water consumption by 20% in one year”, or “energy conservation of 25% within two years.” However, the objectives and targets are site specific and need to be adopted to local conditions and requirements.

Step 2: Pre-assessment: Identifying the Priority Issues

Pre-assessment Questionnaire

In order to gain a good understanding of hotel activities and the associated environmental impacts, the pre-assessment phase starts with a compilation of available data from the hotel records. The data that should be collected at this stage is primarily related to consumption of raw materials, discharge of wastewater and waste generation. The aim is to get an idea about where major resources are lost or major problems occur. Since most of the data is scattered in different sections in different places, it is a good idea to start compiling this information in one file. This then becomes the baseline information for the hotel audit. This information serves as a useful pointer for planning the data collection program in the next step.

A suggested pre-assessment questionnaire for the hotels is enclosed in Annex 1.

Comparison with Benchmarks

Once the available baseline data is compiled, it is important to take a look at the available benchmarks or standard norms to assess the hotel's performance against these norms. This comparison can then pinpoint opportunities for improvement. The benchmarks could be in terms of raw material/energy consumption or waste generation and could be local, national or international benchmarks.

Hotel Walk-through

A thorough walk-through of the hotel by the audit team is an essential part of the pre-assessment phase. The visual observations supplemented by the preliminary data collection in the pre-assessment questionnaire helps the auditors to set the audit focus.

If this typically two-to-four hour audit exercise is conducted with the help of an external consultant, it can become an exercise for familiarizing the consultant with hotel activities. However, if the audit is conducted in-house, all the members of the audit team will be fairly conversant with the hotel and may tend to drop this step of pre-assessment. This step is recommended, however, as new ideas and observations always emerge as a group walk-through is done in the various activity areas.

There are many reasons for doing a walk-through. First, it is quite likely that the members of the audit team will not be very familiar with the activities in the departments of the hotel other than their own.

This walk-through is essential as an opportunity to become familiar with the entire operation of the hotel. Secondly, when the audit team is conducting this walk-through, motivated by the specific objective of identifying waste reduction opportunities, more and more avenues for improvement which might have been simply overlooked in the past become more visible. Thus conducting a walk-through is a very important stage in planning as well as implementing the CP audit.

All the members of the audit team should conduct this walk-through in a group with a pad and pen in hand. All observations, including ones which seem very minor and trivial, should be noted down. Some quick schematic sketches of the site also should be made. If possible, a site plan should be carried during this walk-through exercise and necessary markings be made on the drawing for further action. The points that need special attention from the members of the audit team during the walk-through include:

- Leaks/overflows in service areas or guest rooms.
- Transportation practices for raw material and material handling and storage of the same.
- Working conditions, ambient temperature levels, noise levels etc.
- Safety and hygiene issues.
- Disposal practices for wastes, reject raw materials, packaging materials etc.
- Optimum operating conditions (as per design) vs. actual operating conditions and discrepancies (e.g. washing machine temperatures and cycle times).
- Possible internal recycling and reuse opportunities.

The engineering section staff are likely to know more than other team members about waste discharge points and unforeseen waste-generating operations such as spills and washouts, and can give the team a good account of actual operating situations. It is therefore necessary to talk to the operator-level staff during the walk-through and collect as much information as possible.

The walk-through should immediately be followed by a meeting of the audit team where all the observations are discussed and compiled by the team leader. This is very important as a number of immediately implementable options (mainly housekeeping-related) will likely emerge after the walk-through and these can be addressed immediately. Significant waste reductions can often be achieved by implementing options that are easily adopted at a low cost, e.g. by improving day-to-day management practices. This initial discussion will also help in identifying the needs of data collection. This meeting thus may be useful as a starting point for the planning of the field sampling program.

Implementing Initial CP Options

After carrying out the hotel walk-through and making detailed notes the audit team should discuss the various observations made and should identify a number of simple and obvious measures to reduce waste generation.

Many times these kinds of 'easy-to-do' options do not need any more thorough analysis to be identified as beneficial to the hotel/resort. These options can be implemented without any further delay.

Following are a few examples of obvious cleaner production options that could be identified during the course of the audit exercise. These options in most cases will not be capital intensive and thus can lead to substantial dividends with marginal capital investment and recurring expenses. Such options, therefore, must be given a high priority while developing an implementation plan.

- Install level controls on bulk tanks to avoid overflows.
- Build tanks to contain spillages.
- Minimize the number of times materials are moved on site, regularly check on transfer lines for spills and leaks.
- Reduce water quantity for washing and rinsing by using nozzles and sprays.
- Install self-sealing valves and flow restrictors in water pipes/hoses.

These options might appear minor, but in many instances will result in substantial savings. Besides, by implementing these options and by assessing their success, the participants of the audit exercise can see the importance and usefulness of the overall audit exercise. This phase thus helps to boost the morale of the audit team as well as the higher-level management. It is important to try to demonstrate early on in a CP audit a few examples of successfully implemented CP options. This will not only gain support among hotel management and staff for the continued CP audit, but may also strengthen the morale of the audit team members.

Setting the Audit Focus

Typically, a CP audit is initiated in line with set objectives or targets or is initiated to address a specific prioritized problem such as solid waste minimization, or water conservation. In such a case, the audit focus is more or less pre-determined, however, based on the outcomes of the pre-assessment exercise in conjunction with the hotel walk-through, it becomes much easier to set the audit focus for the detailed

assessment in the next phase. This in turn defines the work to be done in the assessment phase and then a detailed assessment of the hotel activity or operations unit under consideration is made.

For instance, 'water', 'organic solid waste' or 'plastic and paper waste' may be selected as the audit focus and accordingly, a detailed assessment is undertaken in the next phase. In some instances, hotels may set the audit focus as 'kitchen and restaurants area' or 'guest rooms' and detailed assessment may be undertaken in those areas.

Step 3: Assessment — Investigating the Issues

The assessment phase is indeed the heart of the CP auditing activity. It is in this phase that a detailed, quantified assessment is made and this in turn serves as a pointer for potential CP options.

The assessment phase normally employs the 'material and energy balance technique', which is commonly used in process engineering. This involves the following steps:

a.) List Unit Operations and Construct Process Flow Diagrams

Each step or process unit in the focus area of the CP audit is connected to preceeding and following steps/units in a block diagram. Material flows relevant to the audit (e.g. water, foodstuff, energy) into and out of each step/unit are identified. It is important that the block diagram is based on real-life observations and not on drawings and construction plans. Many processes in a hotel are redesigned and changed and the original plans and drawings become irrelevant.

This step is essential for an audit program as it gives insight into the production operations/process vis-a-vis sources of waste generation and hence enables identification of avenues for better operating practices and waste reduction.

Standardized color coding may be used; raw material inputs represented by black lines, for example, wastes by red lines and a recycled stream by green lines.

b.) Determine the Material Balance: Process Inputs and Outputs

When the process diagram is properly established the material flows should be quantified by actual measurements. If the flows are not uniform over time, which is usually the case in a hotel, it is important that the changes over time be recorded in the block diagram.

A detailed account of the process inputs and outputs is made to identify where material is lost or where unexpected or unnaturally large amounts of material are spent. With this information it is possible to identify the problem areas and thus the need for improvement. Material balance is important for any Cleaner Production project since it makes it possible to identify and quantify previously unknown losses or emissions. Material balance is also useful for monitoring the advances made in an on-going CP program by estimating the costs of additional installations and/or modifications.

A material balance may be defined as a quantitative account of the inputs and outputs of the production process. Inputs to a process or a unit operation may include raw materials, chemicals, water, air and energy. Outputs include primary products, by-products, rejects, wastewater, gaseous wastes, liquid and solid wastes which need to be stored and/or sent off-site for disposal and reusable or recyclable wastes. The material balance includes both materials entering and leaving a production process. In its simplest form, a material balance is drawn up according to the mass conservation principle:

Mass in - Mass out + Generation - Consumption = Accumulation

If no chemical reactions occur and the process progresses in a steady state, the material balance gets simplified to :

Mass in = Mass out

Determining Inputs

Inputs for a hotel activity or operation (audit focus) may primarily include raw materials, water, and energy. The inputs to each unit operation need to be quantified to the extent possible. As a first step towards quantifying raw material usage, purchasing records should be examined; this readily gives an idea of the quantities involved.

The energy input to a unit operation should be considered at this stage, however, energy use deserves a full audit in its own right. For CP auditing purposes a note of the energy source and whether CP options could reduce energy costs should be made. Input data should be recorded on the process flow diagram or in tabular form.

Water is one of the most heavily consumed resources in hotel operations. Thus, water usage needs to be accurately quantified. It is very rare that detailed and accurate data on water consumption by individual guest room or kitchen or banquet hall is readily available and hence a monitoring program may be required to assess the use of water in each activity. The measurements in such a case must cover a sufficient period of time to ensure that all actions are monitored. If it is not possible to install water

meters at all points, measurements for low flow rates can be carried out using a bucket and stopwatch or by measuring water level difference in the tank (provided there is no other discharge).

It is highly desirable to carry out a water balance for all water inputs and outputs to and from hotel operations because water imbalances may indicate underlying problems such as leaks or spills. Once the material balance for each unit operation is completed it might be worthwhile repeating the procedure with respect to other contaminants of concern. The individual material balances can be summed up to give a balance for the whole hotel operation.

Quantifying Outputs

To calculate the second half of the material balance, the outputs from individual hotel operations under consideration and the hotel as a whole need to be quantified. Outputs may, depending on the focus of the audit, include wastewater, gaseous emissions, solid wastes and reusable or recyclable wastes. It is important to identify appropriate units of measurement.

In hotels, significant quantities of both clean and contaminated water are discharged to sewers or to a watercourse. In many cases, this wastewater has environmental implications and incurs treatment costs. Therefore, it is important to know how much wastewater is going down the drain and what the wastewater contains. The wastewater flow from each hotel operation as well as from the entire hotel needs to be quantified, sampled and analyzed.

Here are some suggestions on how to carry out a thorough survey of wastewater flow.

- The effluent discharge points should be identified; that is, where does wastewater from various sources (guest rooms, kitchens, laundry, swimming pool filter backwash etc.) leave the hotel? Wastewater may go to an effluent treatment plant or directly to a public sewer or watercourse. One factor that is often overlooked is the use of several discharge points — it is important to identify the location, type and size of all discharge flows.
- The contribution from different unit operations or process areas to the overall flow should be identified. In this way, it is possible to piece together a picture of the drainage network, which can lead to discoveries of what flows where.
- Once the drainage system is understood it is possible to design an appropriate sampling and flow measurement program to monitor the wastewater flow and characteristics of each unit operation.
- For small or batch wastewater flows it may be physically possible to collect all the flow for measurement using a bucket and stopwatch. Larger or continuous wastewater flow can be assessed using flow measurement techniques like simple triangular notch (V-notch) or flowmeter.

- The sum of the wastewater generated from various unit operations/departments should be approximately 80% of the hotel's total water input.
- The wastewater should be analyzed to determine the concentration of contaminants. The normal pollution parameters analyzed in wastewater are pH, chemical oxygen demand (COD), biochemical oxygen demand (BOD), suspended solids and grease and oil.
- Composite samples should be taken for continuously running wastewater. For example, a small volume (100 ml) may be collected every hour through a period of ten hours to gain a one-liter composite sample. The composite sample represents the average wastewater conditions over that time. Where significant flow variations occur during the discharge period, consideration should be given to varying the size of individual samples in proportion to flow rate in order to ensure that a representative composite sample is obtained.
- The job of analyzing the samples can be given to a laboratory if facilities are not available in the hotel.

Gaseous Emissions

Gaseous emissions are generally more difficult to quantify. To arrive at an accurate material balance some quantification of gaseous emissions associated with the process is necessary. In many instances, gaseous emissions carry some amount of hazardous materials (like VOCs) and these should be accurately attended to. External assistance from experts can be made use of to arrive at the material/product lost through gaseous emissions.

c.) Prepare a Material Balance

Preparing a material balance is essential to gain better understanding of the inputs and outputs in individual operations, especially waste management, so that inaccurate or missing information can be identified. Imbalances require further investigation. The initial balance should be considered a rough assessment which has to be further refined and improved.

The units of measurement should be standardized (liter, tonne or kilogram) on a per day, per year or per batch basis. The measured values in standard units should be summarized by reference to the process flow diagram. It may be necessary to modify the process flow diagram following in-depth study of hotel operations.

d.) Evaluate and Refine Material Balance

The individual and sum totals making up the material balance should be reviewed to determine information inaccuracies. Ideally, the input should equal the outputs but in practice this will rarely be the case and some judgement will be required to determine what level of accuracy is acceptable. If there is a significant material imbalance then further investigation is needed. For example, if outputs are less than inputs some potential losses or waste discharges (such as evaporation) might not have been considered. Outputs may appear to be greater than inputs if large measurement or estimating errors are made or some inputs overlooked.

Several factors have to be taken into consideration when constructing material balances in order to avoid errors that could overstate or understate waste streams. Precision in analytical data and flow measurements is crucial when constructing an accurate material balance. The time span is also important when constructing a material balance. Material balances constructed over a shorter time span require more accurate and more frequent stream monitoring in order to reasonably close the balance. Material balances performed over the duration of a complete production run are typically the easiest to construct and are reasonably accurate.

Thus, sometimes all or at least a few steps of the material balance exercise may need to be repeated in order to refine the material balance. Further research may include quantification of input or output streams or even a search for material flows that might have been totally missed in the initial stage. Additional field sampling and analysis may also be required in certain cases and thus the data collected should again be organized and represented so as to establish an accurate material balance. At best an accuracy level of $\pm 10\%$ can be expected for this kind of material balance.

Step 4: Identifying Cleaner Production Options

The material balance will help you identify areas in the hotel/resort where large or unexpected losses of material occur. The fact that a large amount of material (e.g. water or energy), is consumed or lost does not automatically imply that there is scope for improvement in that area but it does imply that a closer investigation of the cause for the loss/consumption in that area should be made.

Example of Generation of CP Options

The Happy Hotel (situated in a tropical country) has identified the guest room air conditioning as a major energy consumer. A closer investigation reveals the following facts:

- The rooms are individually air conditioned by separate air conditioning aggregates.
- All aggregates are normally tuned to 18 degrees C.
- The aggregates are controlled by a remote control. However these have tended to 'disappear' and only housekeeping has access to the remaining remote controls.

The obvious CP options identified by the CP teams include:

1. Turn off air conditioning when rooms are not occupied.
2. Increase the standard temperature to 22 degrees.
3. Provide wall-mounted temperature controls in each room, making it easier for hotel guests to choose their temperature of preference.

The brainstorming session generated the additional CP options:

4. Provide remote controls to the guests as they check in and ask them to return the remote controls upon check-out.
5. Inform guests about how to control the temperature and make them aware of the need to turn off the air conditioning when they are not in the room.
6. Ask the housekeeping department to check that air conditioning aggregates are turned off when the guests have left the rooms.
7. Organize a contest between housekeeping teams on different floors to see who can achieve the best improvement in energy consumption by controlling the room temperature on each floor.
8. Provide separate temperature controls for the main room and the bathroom in each unit (as the comfortable temperature is usually a few degrees higher in the bathroom than in the main room).
9. Replace the existing air conditioning aggregates with new more energy-efficient aggregates.
10. Improve insulation of windows to reduce the leakage of cold air.
11. Add venetian blinds outside the windows to screen out heat from direct sunlight.

When the causes for the loss/consumption are known it is usually obvious what kind of remedial actions (CP options) could reduce the loss/consumption. But in addition to the obvious options there might also be a range of other less direct or less obvious actions that could help improve the situation. Such options are best identified by 'brainstorming' sessions, where members of the audit team sit together and try to think of any factors that may affect the loss/consumption in a certain area and come up with ideas about how to address these factors.

At this stage all ideas are listed and none are rejected, as the selection of ideas to be implemented will undergo screening in the following step of the CP audit. The spirit of this part of the CP audit could be summarized as "*the only bad idea is lack of ideas*". One way of producing ideas is to decide that the team will not leave the room until 20 options have been identified for each area.

It might be helpful to keep in mind that CP options are not only technical or managerial in nature but are typically found in all of the following eight categories:

- Recovery and re-use of waste:
e.g. recycling of water, re-fill of shampoo bottles.
- Creation of useful by-products:
e.g. sell, as second-hand, products that are not used any more (towels, hygienic articles).
- Modification of products or services offered:
e.g. clean the hotel beach, minimize packaging of bathroom articles.
- Input material change:
e.g. use liquid soap that can be refilled, instead of soap bars that are changed every day.
- Better process control:
e.g. improve stock-keeping records to avoid purchasing more food stuffs or other "raw materials" than is consumed, improve control of air conditioning or heating.
- Equipment modification:
e.g. install automatic valves on water taps, optimize positioning of lights and air-con exhausts.
- Technology change:
e.g. change air conditioning aggregates, use alternative energy sources such as solar energy.
- Improved 'housekeeping' (i.e. day-to-day management of operations):
e.g. cleaning staff to turn off lights in unoccupied rooms, change wash towels when requested by guest, use check-lists for daily waste minimization activities.

It should be noted that 'housekeeping' in the above list does not refer to the housekeeping department of a hotel but rather to the day-to-day management and operation of routine work that is carried out in all parts of a hotel by all staff. Much can be done to conserve energy and water through good housekeeping. This approach does not require major capital investment and specialist knowledge, but significant reductions in energy and water consumption, and thereby operational costs, can be obtained. Up to 10% reduction in energy and water consumption is achievable.

Good housekeeping means reducing use of water and energy when they are not required, or where they are oversupplied. For example, lights and air conditioning should be switched off when a room is not in use, water taps in kitchens turned on only when needed, equipment such as coffee machines turned off when not in use. The key to successful good housekeeping is engendering self-motivation in the staff responsible for operating and maintaining equipment in the laundry, kitchens, guest floors and other areas.

Senior management should try its best to encourage and educate staff about the merits of saving energy and water through individual good housekeeping. The ultimate aim is that every staff member in the hotel becomes aware of the importance of energy and water conservation and is an active participant in the hotel's efforts. The message that energy and water saving through good housekeeping is everyone's responsibility should be clearly communicated to all hotel staff.

Good Housekeeping Checklist

This checklist is intended for all staff working in a hotel to guide them in their routine work in good housekeeping practices which minimise energy and water wastage.

Main Entrance:

- Ensure that the main entrance door is closed as much as possible to avoid air filtration.

Guestrooms:

- When a room is not occupied, ensure that drapes and/or blinds are closed.
- Housekeeping supervisors, in consultation with engineering staff, should ensure that temperature and fan speed settings for room thermostats are correctly adjusted.
- Report any leaking taps, running toilets and similar faults and ensure all room windows are closed.
- For guest rooms without automatic access control systems, ensure that all power and lighting is off in unoccupied rooms as soon as guests have checked out.

Kitchens:

- Turn off or turn down kitchen equipment, in particular gas cookers, when not in use.
- Minimise opening of doors of cold storage and freezers.
- Turn on water taps only when needed and never let water run continuously.
- Adjust water flow rate and water temperature to suit different kitchen usages and for cleaning.
- Turn off ventilation and lights when no one is in the kitchen, or turn off local ventilation and lighting if the area is not in use.
- Operate dish washers at or near their full load to minimise the number of operations.
- Keep kitchens clean at all times to reduce the amount of water used.
- Clean daily and check frequently all kitchen equipment for highest possible efficiency.
- Follow the operating instructions of kitchen equipment manufacturers.
- Kitchen doors adjacent to dining areas should normally be kept closed to prevent excessive kitchen exhaust make-up air drawn from the dining areas, (this needs to be done in consultation with the engineering department to check whether the exhaust make-up is via dining area).

Laundry:

- Turn off lights and ventilation or air conditioning when the laundry is not in use.
- Run full loads in washing machines to minimise number of operations. Weigh loads if necessary.
- Ensure that water temperature and amount of water are in accordance with the specifications of the washing machine manufacturer.

Step 5: Technical, Economic and Environmental Evaluation of Cleaner Production Options

After all the CP options are identified it is time to evaluate them in terms of their economic, technical and environmental features. Some CP options may be unrealistic for various reasons (very expensive, very technically complicated or with obvious negative environmental effects) and can be deleted from the list immediately. There may also be some options that can be easily implemented without any substantial costs (in addition to those identified at the initial walk-through). These may be implemented without any further delays. For the remaining options, however, it is necessary to analyze them in more detail to determine their technical, economic and environmental consequences.

a.) Technical Evaluation

The technical analysis comprises an evaluation of availability of technology/new equipment required for the implementation of the CP option, compatibility of the technology with existing installations in the hotel/resort, competence of staff to maintain the technology, availability of spare parts, etc. Many CP options are not technical in nature and for those options the technical evaluation may be omitted. The engineering staff at a resort/hotel can normally perform the technical evaluation but may also use advice from technology providers or other outside expertise if required.

b.) Economic Evaluation

The economic evaluation is carried out using standard measures of profitability, such as payback period, return on investment, and net present value (or net present worth). In performing the economic evaluation, various costs and savings must be considered. As in any project, the cost elements of a CP project can be broken down into capital costs and operating costs.

Capital Costs Include not only the fixed capital costs for designing, purchasing, and installing equipment, but also costs for working capital, permits, training, start-up, and financing charges.

Operating Costs and Savings: The basic economic goal of any CP project is to reduce (or eliminate) waste disposal costs and to reduce input material/operating costs. However, a variety of other operating costs (and savings) should also be considered. When making an economic evaluation, it is convenient to compare the difference between the estimated operating costs of the CP options versus the operating costs of the existing system.

Reducing resource costs and/or avoiding present and future operating costs associated with waste treatment, storage, and disposal are major elements of a CP project economic evaluation. In many countries these costs are still quite low and hotels may tend to ignore them. However, recent regulatory requirements imposed on generators and waste management facilities have caused the cost of waste management to increase to the point where it is becoming a significant factor in a company's overall cost structure.

Profitability Analysis: A project's profitability is measured using the estimated net cash flow (cash income minus cash outlay) for each year of the project's life.

If the project has no significant capital costs, the project's profitability can be judged by whether an operating cost savings occurs or not. If such a project reduces overall operating costs, it should be implemented as soon as practical.

For projects with significant capital costs, a more detailed profitability analysis is necessary. The three standard profitability measures are:

1. Payback period
2. Internal Rate of Return (IRR)
3. Net Present Worth/Value

1. Payback Period

The payback period for a project is the amount of time it takes to recover the initial cash outlay on the project. The formula for calculating the payback period on a pretax basis is the following:

$$\text{Payback period (in years)} = \frac{\text{Capital investment}}{\text{Annual operating cost savings}}$$

Payback periods are typically measured in years. However, a particularly attractive project may have payback period measured in months. Payback periods in the range of three to four years are usually considered acceptable for low-risk investments. This method is recommended for quick assessments of profitability. If large capital expenditures are involved, it is usually followed by more detailed analysis.

2. Net Present Worth and Internal Rate of Return

The internal rate of return (IRR) and the net present value (NPV) are both discounted cash flow techniques for determining profitability. Many companies use these methods for ranking capital projects that are competing for funds. Capital funding for a project may well hinge on the ability of the project to generate positive cash flows beyond the payback period to realize acceptable return on investment. Both the NPV and IRR recognize the time value of money by discounting the projected future net cash flows to the present.

Present Value: The term 'Present Value' is simply a numerical representation of the time value of money. In a situation where money is gathering interest, the longer ago it was invested, the more it is worth today. A rupee received 2 years ago would have earned a rupee's worth of interest if earning at a 35% interest rate. The present-value factor **compounds** rupees received or dispersed before zero time from their face value to a larger value which they have at zero time, as either receipts or expenditures, because of the time value of money.

Discounting: 'Discounting' or 'deducting' interest by present-value factors is a numerical expression of the time value of money received or dispersed in the future. The farther off in the future that money is spent, the better. Similarly, 'devaluation' or 'discounting' applies to money that one will receive in the future. The longer the time in the future before the money is received, the less it is worth today.

Rate of Return on Investment: The ratio relating profit to investment in some manner is known as rate of return on investment. By definition IRR is that discount rate at which Present Worth equals zero, as found by trial and error. For investments with a low level or risk, an after tax IRR of 12 to 15 percent is typically acceptable.

3. Calculation of Present Worth

The present worth method selects the project with the largest present worth (PW) of the discounted algebraic sum of benefits minus costs over its life.

$$PW = \sum \{1/(1+i)^n\} \{B_t - C_t\}$$

where, B_t are the benefits and C_t the costs in the subscripted year, n is the period of analysis in years and i is the discount rate.

The following points need to be considered while carrying out Present Worth analysis.

1. Figure all the present worths to the same time base.
2. Figure all the present worths using the same discount rate.
3. Base all the present worth's on the same period of analysis.
4. All the alternatives with positive present worth are acceptable, those with negative present worth must be rejected.
5. Present worth method can not be used to rank projects in the order of economic desirability unless all require equal investment.

c.) Environmental Evaluation

The environmental evaluation is often difficult to carry out in the same quantitative way as the economic analysis, as the environmental consequences may be more difficult to quantify. However, it is possible to rate effects, such as “reduced water consumption” or “reduced generation of hazardous waste” or “reduced risk for accidents” in terms of none/small/medium/substantial impact. A CP audit may be undertaken for various reasons, and one environmental aspect may be of more concern to the hotel than others (e.g. water consumption) and then CP options with a substantial water saving potential may receive a higher priority than others.

Having evaluated the technical, economic and environmental aspects of each option they have to be compared to each other. This can be done by assigning the feasibility or attractiveness of each aspect a certain value, ranging from 1 (for very difficult implementation or unattractive features) to 5 (for very easy implementation or very attractive features). Furthermore, if a certain aspect, (e.g. water conservation) is of special importance, this priority status may be added as a feature to evaluate in addition to the technical, economic and environmental evaluation. The alternative(s) that receive the highest points would then be selected for implementation.

Step 6: Implementing CP Options and Maintaining the CP Process

When the evaluation of CP options is done it is time to implement the CP options. This is normally done along the same routines as any other project or activity would have been implemented in the hotel, even if it was not identified through the process of a CP audit. It is, however, important that the actual impacts of implemented CP options are monitored. This will give the CP team opportunity to learn from unexpected advantages or drawbacks of specific CP options, and may even prove helpful in generating ideas about other CP options that may be used to improve the operations in the hotel.

It is also important that the CP effort is not abandoned as soon as the first round of an audit is completed. The CP audit is an on-going process that requires a continuous commitment by the hotel to avoid loss of gained benefits in the long run.

Example of Profitability Analysis

The Happy Hotel is undertaking a CP audit to assess how the hotel's energy consumption can be reduced. The audit has revealed that the guest room air conditioning is a major energy consumer and the CP team has come up with a number of CP options:

- A. Raise room default temperature
- B. Replace air conditioning aggregates
- C. Provide temperature control units to guests
- D. Install venetian blinds outside windows
- E. Insulate windows and doors

These alternatives are now evaluated from technical, economic and environmental perspectives

	A	B	C	D	E
Technical feasibility	Very easy (5 points)	Difficult (2 point)	Medium (4 points)	Very difficult (1 point)	Difficult (2 points)
Economic pay-back period	Immediate (5 points)	12 months (2 points)	6 months (3 points)	4 months (4 points)	18 months (1 point)
Environmental benefit/ Energy saving	Medium (3 points)	High (4 points)	Low (2 points)	Medium (3 points)	Low (2 points)
TOTAL	13	8	9	8	5
Ranking	1	3/4	2	3/4	5

From the above comparison it appears that CP option A (raise room default temperature) and C (provide temperature control units) are the two most beneficial CP options to implement. Of course, the hotel management may also choose to implement more or all of the CP options.

CLEANER PRODUCTION TECHNIQUES FOR HOTELS AND RESORTS

The opportunities for environmental improvement or CP options in hotels can be grouped under the following categories and practiced in the given areas within the hotel:

I Water Management (including conservation and treatment)

- Toilets and baths
- Swimming pools
- Laundry
- Kitchen
- Gardens and lawns
- Indoor plants
- Cooling plants

II Solid waste management (including reduction, reuse, recycling and treatment)

- Guest rooms
- Kitchen
- Management and secretarial offices
- Restaurants

III Energy Conservation

- Guest rooms
- Other indoors such as lobby, restaurants, etc.
- Kitchens
- Laundry

Management-wise these can be achieved by:

- Good housekeeping
- Green purchasing
- Awareness, commitment and training

I Water Conservation

Water conservation is an effective way to save money and improve the environment, and it can be done without sacrificing the quality of service. Thus quality and commitment are key to the success of such a program in any hotel.

Water conservation is becoming increasingly important because it can reduce not only the total cost for water consumption, but also the cost of wastewater treatment. Furthermore, water saving can also lead to energy saving because water storage and transportation consumes energy, and a reduction in hot water consumption means a direct boiler fuel saving. In the context of water conservation in a hotel, major water consumers should be identified by undertaking a preliminary audit on water consumption. This can facilitate any further actions for water conservation. For many existing local hotel buildings, appropriate metering equipment for water consumption in various parts in a hotel is not available, making it impossible for an audit on water consumption to be carried out. Therefore, installation of appropriate water flow meters in various water-consuming areas such as kitchens and laundry is a prerequisite for undertaking a valid water conservation program in a hotel building. However, in many existing hotels, installing water flow meters may be difficult due to a shortage of space.

The major water users in hotels are kitchens, laundry and guest floors. Water consumption on guest floors is difficult to predict but is to some extent related to hotel occupancy. Even under similar occupancy rates, water consumption on guest floors might fluctuate because of factors such as guest's personal preferences and habits. However, it is extremely important that care be taken in implementing water-saving measures on guest floors in order not to cause any inconvenience to guests. On the other hand, a water conservation program for laundry and kitchens can be implemented without risk of complaints from guests.

Water Conservation Checklist

Kitchens

There is usually more than one kitchen in a hotel, and water consumption in different kitchens depends largely on the nature of the kitchen, for example, a French style kitchen would use less water than a Chinese style kitchen. Water conservation should be accomplished mainly by good housekeeping. Water discharged from a kitchen is normally greasy and it is not economical to reuse it.

Laundry

Water consumption in a laundry may account for up to 30 % of total water consumption in a hotel, therefore the saving potential is large if appropriate measures are taken. Apart from good housekeeping practices mentioned earlier, there are a number of measures worth considering:

- Recycling rinse water for next prewash if space for building an additional recycling water tank is available.
- In consultation with the supplier of washing detergent and with the washing machine manufacturer, select the most suitable detergent and determine the most economic washing cycle.
- Washing machines that spin along the horizontal axis use 95 - 113 liters per load, while vertical axis use 132 - 208. Rinse water from industrial clothes washers can be collected and reused in the next cycle's wash, cutting water use by 60%.

Guest Floors

Water (both hot and cold) is consumed primarily for showers or baths. Consider installing a calibrated water control system. This system uses a compact valve which is inserted into the hydraulic system and controls the pressure in a water system and regulates the flow in every shower or tap outlet.

The quality of service provided to hotel guests should not be reduced in order to save water. Guests will not accept devices with weak water pressure. Therefore it is extremely important to choose high quality technology when investing in water efficiency. A wide variety of technological products is available in Thailand. Consider the following basic technologies and water-saving practices:

- Showers:** Most showerheads use more water than they need - in fact, the water droplets are so big that they often bounce off the body without rinsing. Efficient showerheads use 10 liters per minute instead of 20, while delivering the same or better quality and service.
- Toilets:** A normal toilet uses 20 liters per flush and wastes water by sloshing it around the bowl. An efficient toilet uses only 6 liters and directs a powerful pulse of water into the bowl to wash it out effectively. Replacing toilets could save a household 83,000 liters/year. Another way to save water is to fix toilet leaks, which can save up to 100 m³/yr.
- Faucets:** Faucet aerators work better (splash less), and save water. An open, unrestricted faucet uses approximately 12 - 30 liters per minute and most of the water splashes off the user. An aerator decreases the droplet size, splashes less and restricts the flow to 6 - 10 liters per minute. Many faucets leak, usually because of a worn washer. Fixing a faucet that leaks two drops a second can save 20 m³/day.
- Gardens and Lawns**
Use recycled water

Reuse / Recycling Wastewater

After proper treatment, hotel wastewater can often be recycled for use in gardens, and many hotels are already doing so. It is also possible to reuse the treated wastewater for flushing in toilets; this option can be implemented in new hotels as the necessary piping can be made in the design phase itself.

Rainwater Harvesting

Rainwater harvesting (collecting and using the rainwater) is an attractive option in areas where heavy rainfall predominates, and treated water from other sources is not easily available or is expensive. Typically, isolated resorts on islands find this option attractive as rain water is very clean. This technique calls for a rainwater collection and storage system and this can best be implemented during the design phase of the hotel.

II Solid Waste Reduction and Recycling

There are many opportunities to reduce, reuse and recycle solid waste. Both organic and inorganic solid waste can be handled with techniques that correspond to CP principals.

Reducing Waste

Reducing waste means not producing it in the first place. By reducing the amount of waste generated, the handling, disposal and recycling costs can be saved. Here are a few easy, simple ways to reduce waste:

- ❑ Use both sides of the paper when making copies.
- ❑ Substitute reusable items for disposable ones.
- ❑ Make discarded paper into scratch pads.
- ❑ Equip guest rooms with a bulk dispensing system to replace individual plastic soap and shampoo bottles.
- ❑ Use two-way shipping containers (ones that can be returned and refilled).
- ❑ Reuse manila envelopes.
- ❑ Order products in concentrated form or in bulk.
- ❑ Install cloth roll towels or hand dryers in public restrooms.
- ❑ Have fax machine and laser printer cartridges recharged.
- ❑ Use worn towels and linens as cleaning rags.
- ❑ Reuse foam packaging pellets or bubble wrap.
- ❑ Install reusable furnace and air conditioner filters.
- ❑ Choose a low-maintenance landscape design that uses few chemicals and little water.

Reusing Waste Materials

Many items that are thrown away can be reused. Worn-out or out-of-style items that are still usable can be donated to service organizations, homeless shelters, or group homes. Usable goods may include blankets, mattresses, china and glassware, food, sheets, towels, soap pieces, furniture, lamps, draperies, uniforms, and lost-and-found items.

Recycling Waste Materials

Materials that can be recycled include:

- Cardboard boxes
- Newspapers
- Aluminum cans
- Office paper
- Glass bottles
- Plastic containers
- Steel cans
- Yard debris
- Food waste
- Telephone books
- Magazines
- Kitchen fats and oils
- Laser printer cartridges
- Construction and demolition debris.

A Typical Hotel's Solid Waste Composition

<i>Waste,</i>	<i>% based on volume</i>
Food & Non-recyclables	46.2%
Paper	25.3%
Cardboard	11.7%
Plastics	6.7%
Glass	5.6%
Metal	4.5%

Cardboard

Corrugated cardboard probably makes up the greatest volume of a hotel's solid waste stream. In fact, hotels may be able to make money from selling the cardboard. Medium-sized and large hotels may purchase balers or compactors to manage their waste cardboard and get a better price for it. Other lodging facilities can reserve a separate dumpster for recyclable cardboard.

Guest Rooms

The recyclable materials typically collected from guest rooms are newspapers, aluminum cans, and glass and plastic bottles. There are several ways to encourage guests to separate their recyclable wastes: (1) ask them to leave recyclable materials in a specified location in the room, (2) supply a bin for recyclable wastes in each room, (3) set a recycling container near the elevators in each hallway or in another convenient location. Duffle or plastic bags can be added to housekeeping carts to collect recyclable materials.

Offices

Office workers can place recyclable paper in centralized bins. These bins should be placed in areas where large amounts of waste paper are generated, next to copy machines, for example. Each employee can keep a small box or container alongside the desk and empty it periodically into a centralized bin.

Restaurants and Lounges

Bins can be provided in the kitchen and behind the bar for glass, aluminum, and plastic containers. Food wastes from the kitchen can be composted or offered to hog farmers. Grease and oil can possibly be picked up by a recycling service.

Solid Waste Segregation

Solid waste segregation, though at times not classified as a CP option, is a very important part of a hotel's environmental improvement program. In order to facilitate solid waste reuse or recycle, a systematic solid waste reduction program becomes a pre-requisite. Also, composting of organic solid waste is being increasingly promoted worldwide, and separating organic solid waste becomes very necessary. A companion composting manual to this CP manual is available from the Canadian Universities Consortium (CUC); the manual highlights the details on initiating and maintaining an organic solid waste composting program in hotels and resorts.

III Energy Conservation

Air-conditioning System

Air conditioning and ventilation systems combine to provide a thermally comfortable environment and good indoor air quality. There is a trade-off between energy use and indoor environmental quality. Sufficient cooling and fresh air must be provided to meet the occupants' needs. However, it is not unlikely that the equipment will be oversized or improperly controlled. Proper sensors and controls are essential to good operation. In many hotels this key feature is the one most often neglected. Improvements can be made by simply putting equipment into the best operating mode possible. This may involve better on/off control, or finer tuning of controllers. However, in the absence of measuring equipment this is almost impossible. Expert advice and equipment will be needed if significant performance gains are to be achieved.

The total energy for air conditioning can be divided into two major components:

1. *The energy input to the main chiller plant including auxiliary pumps etc. the 'water' side).*
2. *The energy used to move the air inside a building (the 'air' side).*

The efficiency of the chiller plant is defined in terms of the cooling energy delivered in relation to the electrical energy supplied. Electrical energy is relatively easy to measure, but cooling energy measurement requires more costly equipment.

Chillers (Water Side)

It is expected that the electricity consumed by the central chiller plant will account for around half of the total electricity used for air conditioning. Therefore, the central chiller plant deserves more attention than any other part of an air conditioning system.

- ❑ Ensure that all chillers are in good working order through regular maintenance, including annual machine overhaul and cleaning of heat exchange surfaces.
- ❑ Check for any leakage of refrigerant and water (chillers and pumps).
- ❑ Check the accuracy of built-in instruments, and take corrective measures if there are problems.
- ❑ Record all operating parameters and ensure that plant operators understand their interpretation in terms of safe and efficient operation for the plant.
- ❑ Ensure that chilled water flow rate through each chiller is as specified by the chiller manufacturer, because lower water flow rate could result in a poorer operating efficiency. Improper setting of a butterfly valve in the chilled water exit may lower efficiency.
- ❑ A water flow meter is required to measure water flow rate; if water flow meter is not present or is malfunctioning, flow rate can be estimated using the water pump pressure head and characteristic curves of the pump.
- ❑ Ensure that chilled water bypass valves are fully closed when pressure difference does not exceed the preset value.
- ❑ The chilled water supply temperature should not be set too low. A supply temperature of 7 degrees C with a temperature rise of 5 degrees is the normal practice. However, if it can be set higher, set it higher — this is particularly useful when chillers are operated in mild seasons when the cooling load for a hotel building is reduced.
- ❑ Delay the starting of a chiller if it is feasible and consider installing extra cooling distribution equipment to avoid running more chillers than necessary.

- ❑ For a plant with multiple chillers and without automatic chiller sequencing control, always ensure that an additional chiller is only turned on when the capacity of operating chiller(s) is not sufficient. Endeavour to avoid chillers operating under light load conditions.
- ❑ Stop all associated water pumps when a chiller is shut off (except for the safe operation of a chiller, i.e. to remove residual cooling from an evaporator to avoid freezing of heat exchange tubes).
- ❑ For a direct sea water cooled chiller plant where sea water pumps are designed for at least two chillers, consider retrofit to two-speed sea water pumps.
- ❑ For a plant still operated with CFCs, due consideration should be given to the time frame for CFC phaseout set by the government. CFC retrofit provides a good opportunity for a plant with major design problems to be replaced.

Air Side

While there are many opportunities to substantially reduce the electricity consumption on the water side, there are opportunities for energy conservation on the air side as well:

- ❑ Never over-cool a hotel building to an unnecessarily low level, bearing in mind that for summer air conditioning, the recommended comfort temperature and humidity are 24 degrees C and 50% respectively.
- ❑ For public areas in a hotel such as the main lobby, restaurants, ballroom, etc., air temperature should be closely monitored by engineering staff and necessary actions taken to avoid too low a temperature; original design specifications (temperatures and humidities) should be checked and complied with.
- ❑ Endeavour to ensure that the hotel building maintains positive internal pressure relative to atmospheric pressure in order to minimise infiltration of untreated outdoor air. If positive pressure is seldom maintained, make sure that air exhaust volume is less than the fresh air volume, (in particular the air supplied to and exhausted from kitchens).
- ❑ Pay special attention to the fresh air supply to a hotel building. The ASHRAE Standard recommends for hotel buildings 15 L/s/room for guest rooms and 10 L/s/person for public areas. Check PAUs on guest floors to ensure that the right amount of fresh air is supplied to each room and check also the fresh air dampers for these PAUs. If missing or malfunctioning, install new dampers or replace.
- ❑ The fresh air supply for a ballroom in a hotel is normally designed based on maximum occupancy, but for most of the function time the ballroom occupancy is often significantly lower, therefore, fresh air supply can also be reduced.
- ❑ Fine tuning of pneumatic control for all AHUs and PAUs can ensure proper distribution of cooling requirements.
- ❑ Carefully examine the cooling distribution within a hotel as an unbalanced distribution of cooling calls for early start of additional chillers. In particular areas with heat generating machines (e.g. a cafe with coffee makers) or with unfavourable orientation (east, north-west) are more prone to such problems. Installing additional cooling distributing apparatus might be necessary to satisfy local cooling requirements.
- ❑ When permitted by local weather conditions (air temperature is sufficiently low) and by duct system design (with appropriate filtration), use as much outdoor air as possible to maximise free cooling effect.
- ❑ Work in conjunction with other departments; consider closing an entire guest floor during low occupancy periods, so the air conditioning system (as well as other energy consuming systems on that floor), can be shut off.

Boiler Plant

Boilers are used to generate steam for use in laundries, to supply hot water (stored in calorifiers), and to heat space in cold seasons. The oil used in a hotel might account for 40% of total energy consumption, however because it is cheap, its share in the total cost is less significant. Nonetheless, efforts can be made to improve efficiency.

Boiler efficiency can be in general represented by two values: combustion efficiency and operating efficiency. The combustion efficiency accounts for the energy loss due to incomplete combustion, and loss to flue gas. It is measured by using a commercially available combustion gas analyser; the percentage of oxygen (O₂) and carbon monoxide (CO) concentration of flue gas are important indexes for combustion efficiency and are obtainable using a gas analyser.

The operating efficiency is defined as percentage of heat provided by fuel which is transferred to generate steam or hot water. It can be indirectly calculated if fuel consumption, steam consumption and pressure, and feed water temperature are all measured. The CO concentration is a good indicator of combustion. Although there is no regulation on the optimum level of CO, it is generally thought that a level below 400 ppm is acceptable.

- ❑ To achieve optimum combustion, the air/fuel ratio has to be adjusted accordingly, which can be done by adjusting air damper openings or fuel flow rate while the CO concentration level in flue gas is continuously monitored by an analyser. If there is a sudden significant change in CO concentration level, then the optimum combustion has been reached, and this air/fuel ratio is the best obtainable. To allow a safety margin, the damper could be slightly opened further or fuel flow rate be slightly reduced.
- ❑ The air/fuel ratio should be adjusted at least twice a year, once in winter and once in summer, as an optimum air/fuel ratio is strongly affected by ambient temperature.
- ❑ The temperature difference between flue gas and steam temperature should be as small as possible; the smaller the temperature difference, the better the heat transfer.
- ❑ Whenever possible, a boiler should be operated at a percentage load of over 30%. Otherwise, boiler operating efficiency decreases significantly. For an oversized boiler plant the load might be 30 to 50% of capacity.
- ❑ In order to obtain operating efficiency of reasonable accuracy, it is necessary to have appropriate steam meters installed and regularly calibrated.
- ❑ All heat transfer surfaces in a boiler should be regularly checked and cleaned.
- ❑ Check daily and record the normal operation of a boiler including operating pressure and temperature, consumption of fuel, amount of steam generated, ambient air temperature and feed water temperature, combustion and operating efficiencies.
- ❑ Maintain the most appropriate chemical treatment for feed water for a boiler; the instructions of the boiler manufacturer should be strictly followed.
- ❑ Consider applying an Economiser to recover waste heat in hot flue gas by preheating feed water before entering a boiler as a 3% increase in boiler efficiency can be expected.
- ❑ Manufacturer's instructions on boiler maintenance procedures should also be fully followed to ensure the highest possible safety and reliability.

Lighting Systems

Lighting typically accounts for 30 % of total electricity consumption. A reduction of electricity consumption in lighting is significant in terms of not only electricity saving but also for the reduction of the cooling load of the air conditioning system.

Savings on lighting energy come from two adjustments: conservation from switching off unnecessary lights, and efficiency gained from more energy-efficient lamps and controls.

The measurement for lighting is a watt. A watt is not a measure of brightness, but a measure of energy. For example, every 40W bulb uses 40 watts of electricity, but the amount of light given out can vary considerably depending on the type of bulb.

The lumen is the measure of light output. A 40 W incandescent bulb produces about 450 lumens, while a 40 W fluorescent tube produces about 2150 lumens - nearly five times as much the light with the same electricity consumption.

- ❑ When replacing lights, use high-energy efficiency fluorescent lamps/ tubes wherever possible as they require no more than one-third of the electricity used by incandescent lamps to achieve the same illumination level.
- ❑ Reduce excess wattage to ensure that illumination level is not higher than necessary for guests' visual comfort. Lights in public areas such as restaurants and coffee shop should have flexible switching arrangements so that part of the lighting system can be turned off if there is sufficient daylight available near windows or if there are no people using the area.
- ❑ Use of electronic ballasts for fluorescent light fittings should be preferred because not only are they more energy efficient than the common magnetic type but also they do not generate heat which contributes to the space cooling load.
- ❑ Cleaning of all light fittings in hotel buildings should be carried out on a regular basis.
- ❑ Key-tag room control to switch off power and guest room lighting is an effective way to ensure that energy is not wasted in guest floors when they are not occupied.

Other Engineering Systems

Lifts and Escalators

The typical percentage of electricity consumption by lifts and escalators is significant enough for attention in any hotel. However, outside of ensuring proper maintenance by lift contractors, the main CP measure is to control elevators and escalators according to traffic demand.

Building Envelope

In summer, heat flows through the envelope into the hotel building by conduction, solar radiation and filtration, and in winter heat is lost through the envelope. The objective is to minimise heat gain in summer and heat loss in winter to reduce both cooling demand in summer and heating demand in winter.

- ❑ Curtain wall structure is popular in many hotels, which allows for more heat gain in summer, in particular from solar heat penetration, resulting in a large cooling load. In cases of unfavourable orientation, large solar heat gains may call for earlier start and/or later shut-down of additional chillers. Applying anti-solar reflective film in glass may be useful in reducing solar heat gain.
- ❑ Use of internal venetian blinds can also have a significant effect on reducing solar gain through glazing.
- ❑ Eliminate all possible paths of uncontrolled infiltration including gaps of external doors and windows, cracks and unnecessary openings on external wall. Dampers for fresh air intake should be in position and functioning.

MANAGEMENT TOOLS

Cleaner Production is achieved by applying the CP Audit Methodology outlined above. There are, however, a number of additional tools or approaches to environmental management that may support or complement the CP Audit process, thereby further facilitating hotel environmental management. These include Environmental Management Systems, green purchasing, eco-labeling, good housekeeping, and training and education. These may be applied one by one, in combination, or all together.

Environmental Management Systems: Integrating CP into Business Operations

An organized approach to managing environmental issues in a company or organization is called an Environmental Management System (EMS). An EMS may be very extensive, fully integrated, and cover the whole range of operations with a forward-looking perspective, or it may be very simple and address the most urgent concerns on a case-by-case basis. Most Environmental Management Systems are operated somewhere in between these two extremes. Over the last decade businesses all over the world have realized the need to adopt EMS as part of their business strategy. This is not only in order to be able to address environmental issues per se, but also because the environmental profile of companies is becoming a competitive advantage when selling products or services to customers.

An EMS may be certified according to a certification scheme, such as EMAS or ISO 14000. The certification is by many companies seen as a way of earning an environmental seal on their operations, products and services. Like other organizations, more and more hotels and resorts are applying for ISO 14000 certification of their EMS. This interest is most pronounced among hotels catering to western tourists, but is slowly catching up amongst the smaller local hotels as well.

The CP approach to environmental management does not in itself constitute an EMS, as it does not include certain elements essential to an EMS, such as environmental policy or a review of conditions and licenses for operations. The CP approach, however, does comprise an excellent backbone to an EMS, as it provides the methodology to address many of the environmental issues in a company. Many companies have started with CP audits that later have developed into fully fledged EMSs some of which have been ISO 14000 certified.

One important benefit of implementing EMS as a follow-up of a CP project is that it ensures a continual CP activity in the hotel and sustainability of CP practices. With this advantage, some form of formal EMS implementation is strongly recommended as a logical follow-up to the CP program.

Green Purchasing

Green purchasing means that products purchased by, and used in, a hotel or resort, such as food, detergents, towels, fuel etc. are eco-labeled or otherwise certified as environmentally preferable products. Green purchasing is attracting attention from the industry and business community as a tool to promote and practise sustainable development. Green purchasing can greatly boost the efforts of any hotel to “go green”. While this could be directly helpful in reducing the environmental impact of the hotel operations, it can also create awareness amongst the employees as well as hotel guests about the hotel’s efforts to improve their environmental performance.

There are a number of opportunities to change over to more environmentally-friendly items to be used in the daily operations. The following items can directly contribute to environmental improvements in a hotel:

- ❑ Detergents and laundry chemicals.
- ❑ Soaps and shampoos.
- ❑ Cleaning chemicals and solvents.
- ❑ Non-CFC sprays.
- ❑ Energy saving electrical appliances.
- ❑ Water-saving sanitary fixtures.

To ensure success, the changeover to green purchasing should come as a top management policy. This should be followed by the training of purchasing staff. It is a good idea to involve the existing suppliers in such a program and seek their help to meet the new hotel policy.

There are eco-label programs in many countries to provide labels for environmentally-friendly products. For instance, a number of products relevant to the hotel industry have been awarded Green Label in Thailand, including paper, energy efficient electrical appliances, water economizing sanitary fixtures, etc. Such programs can lead to the success of green purchasing programs in any hotel.

Environmental Labeling for Hotels

Eco-labels or environmental labels are used as indicators of environmentally-friendly hotels. They are awarded to environmentally friendly hotels both to attract customers to the hotels and to allow the guests to make a choice about the environmental characteristics of the hotel they stay at. There are different eco-labeling schemes in operation in most countries, but they all have in common that they are only awarded to hotels or resorts that meet a set of specified environmental criteria. Several eco-labeling schemes charge a fee to hotels that apply for the eco-label, but will in return offer advice and technical assistance to the hotel to help it achieve the criteria of the labeling scheme. An important feature of most eco-labels is that they are only awarded for a limited period of time (typically for one or two years) and require the hotel to measure and report its environmental performance in order to be allowed to keep the label for a longer period. Eco-labels benefits the tourism industry on the whole as they encourage environmentally-friendly and sustainable behaviour, but they are also beneficial to individual hotels or resorts by supporting and recognizing hotels that pursue a better environment.

Good Housekeeping

Much can be done to conserve energy and water through good housekeeping. This approach does not require major capital investment and specialist knowledge, but significant reductions in energy and water consumption, and thereby operational costs, can be obtained. Up to 10% reduction in energy and water consumption is achievable.

Good housekeeping means reducing use of water and energy when they are not required, or where they are oversupplied. For example, lights and air conditioning should be switched off when a room is not in use, water taps in kitchens turned on only when needed, equipment such as coffee machines turned off when not in use. The key to successful good housekeeping is engendering self-motivation in the staff responsible for operating and maintaining equipment in the laundry, kitchens, guest floors and other areas.

Senior management should try its best to encourage and educate staff about the merits of saving energy and water through individual good housekeeping. The ultimate aim is that every staff member in the hotel becomes aware of the importance of energy and water conservation and is an active participant in the hotel's efforts. The message that energy and water saving through good housekeeping is everyone's responsibility should be clearly communicated to all hotel staff.

Awareness, Commitment and Training

Awareness and training are essential elements to help the hotel implement the CP techniques mentioned above. To successfully implement CP commitment from top management is essential. To implement CP the hotel must bring about an attitudinal change among its staff, for which training is essential. On-the-job training and short workshops and demonstrations are the most effective forms of staff training. On-the-job training includes posters, displays, etc. in the work area to remind staff to perform the activity in a particular manner; during demonstrations the expected behaviour is demonstrated by others. In the TTTP CUC UEM Project the construction of a composting pile was demonstrated to the gardeners of the five member hotels on the premises of one hotel. This helped the gardeners to understand the process and replicate it in their respective hotels.

CP Toolbox

1. Pre-assessment Questionnaire
2. Benchmarks / Key Figures for CP Audit in Hotels
3. Information Resources and References

ANNEX 1: QUESTIONNAIRE FOR PRE-ASSESSMENT IN HOTELS

*Questionnaire designed by Thailand Environment Institute and Prof. Dr. Thamrongrat Mungcharoen, Kasetsart University, Bangkok, Thailand
Email: fengtrm@nontri.ku.ac.th for CUC TTTP Project.*

A. General Information

1. Name of Hotel:

2. Address:

3. Contact Person: 1.
2.

4. Telephone:

Fax:

Email:

5. Registered Capital:

6. Year of Establishment:

7. Expansion / Other Modifications after establishment:

8. Management:

Division	No. of Staff	
	Management Level	Operator Level
1. Management		
2. F&B		
3. Front Office		
4. Housekeeping		
5. Engineering		
6. HR / Personnel		
7.		
8.		
9.		
10.		
Total		

9. Types of Accommodation:

Type	Capacity of Room	Total no. of Rooms
• Single	one	
• Double		
• Suit		
• Others (specify e.g. <i>Family room, Cottage, Bungalow</i>)		
1)		
2)		
Total		

13. Engineering Data:

Item	Size	Nos.	Remarks
1.0 Electricity			
1.1	KVA	Units	
1.2	KVA	Units	
1.3	KVA	Units	
2.0 Steam Boiler /Hot Water Bolier			
2.1	BHP	Units	
2.2	BHP	Units	
2.3	BHP	Units	
3.0 Chiller			
3.1	BTU	Units	
3.2	BTU	Units	
3.3	BTU	Units	
4.0 Cooling Tower			
4.1			
4.2			
4.3			
5.0 Air Ventilation System			
5.1			
5.2			
5.3			
6.0 Lifts / Escalators			
6.1			
6.2			
6.3			
7.0 Laundry Washing Machines			
7.1			
7.2			
7.3			
8.0 Wastewater Treatment Plant			
8.1			
8.2			
8.3			

9.0 Air Pollution Control Equipment 9.1 9.2 9.3			
10.0 Utilities			
10.1 Generator			
10.2 Transformer 10.3			
11.0 Water Pumps (Swimming Pool) 11.1 11.2			
12.0 Other 12.1 Walk-in Refrigerators 12.2			

B. Input-Output Information

Please provide the timeframe used as the baseline for the information in this section.

- From Month _____ Year _____ Up to Month _____ Year _____
- Total _____ Months
- Average / Monthly Occupancy During this period: _____ % or No. of Guests _____

B.1 Input Side

1.0 Energy Consumption

1.1 HVAC

- Lighting _____ % of total (estimated)
- Air Conditioning _____ % of total (estimated)
- Others _____ % of total (estimated)

1.2 Management of Electric Consumption

- Participate in EGAT's energy conservation programs
 - Key tag system for automatic lights switch-off
 - Other (Specify) _____
- Have policy for purchaing energy saving appliances
- Other (Specify)

1.3 Details of Electricity Consumption

	Month	Consumption KWh/Month	Peak Load (KVAR)	Cost (Baht / Month)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
Total				

2.0 Fuel

2.1 Type of Fuel

- Fuel Oil _____
- Diesel
- Sawdust / Chipped Wood
- Solar Energy
- Other (Specify) _____

2.2 Management of Fuel

- Have a trained and responsible person certified by EGAT.
- Have safety management for fuels
- Other (Specify)

1.4 Fuel Consumption Details

	Month	Quantity Used (Lit/Month)	Cost (Baht/Month)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
Total			

Remark: In case of more than one fuel, provide separate details for each type.

3.0 Water

3.1 Source

- Municipal
- Open well
- Groundwater
- Other (Specify) _____

3.2 Water Management

- Details about Pre-treatment (if any)
 - Filter System
 - UV treatment
 - De-Ionization
 - Other (Specify) _____
- Have water conservation policy
- Other (Specify)

3.3 Water Consumption Details

	Month	Quantity (c.u.m./Month)	Cost (Baht/Month)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
Total			

Remark: In case your hotel uses more than one source of water, please provide details separately for each category.

4.0 Utilities / Auxiliaries

4.1 Type/ Quantity / Cost

Material Type	Quantity	Cost
Used in Office		
1. Paper		
2.		
3.		
4.		
Used in Guest Rooms		
1. Tissue		
2. Soap		
3. Shampoo		
4. Shower Cap		
5.		
6.		
7.		

4.2 Materials Management

- Have a policy for purchasing environmentally-friendly products
- Have a policy for reduced packaging
- Other (specify)

5.0 Chemical Consumption

5.1 Type of Chemical/Amount/Cost

Area of Use	Type of Chemical	Amount (Unit/year)	Cost (Baht/Year)
Swimming Pool	1.		
	2.		
Boiler	1.		
	2.		
Laundry	1.		
	2.		
Air conditioning	1.		
	2.		
Garden	1.		
	2.		
Toilets	1.		
	2.		
Cleaning (Floors/air spray)	1.		
	2.		
Others	1.		
	2.		
	3.		

5.2 Chemical Management

- Have a policy to purchase environmentally-friendly chemicals

Others

B.2 Output Side

1.0 Wastewater

1.1 Source of Wastewater

Estimated break-up (%) of the various sources of wastewater

- From guest rooms / toilets / office _____% of total (estimated)
- From swimming pool _____% of total (estimated)
- Laundry _____% of total (estimated)
- Kitchen _____% of total (estimated)
- Others (Specify) _____

1.2 Wastewater Management

- Have wastewater recycling program
- Have a screen / grease trap for removing oil and grease from kitchen waste
- Have wastewater treatment plant in hotel
- Monitor / test wastewater before discharging outside the hotel premises
- Type of wastewater discharged without treatment
 - Guest Rooms / Toilets
 - Swimming Pool
 - Floor Cleaning
 - Other (Specify) _____
- Wastewater leaving the hotel after treatment
 - From Laundry _____% of total (estimated)
 - From Kitchen _____% of total (estimated)
 - Other (Specify) _____
- Details on wastewater management / treatment
 - Add chemicals _____ Cl₂ _____ Other (Specify) _____
 - Aeration of wastewater
 - Activated Sludge Process

Other (Specify) _____

1.3 Details of wastewater generation / discharge

	Month	Total Volume (m ³ /Month)	Cost for Treatment (Baht/Month)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

2.0 Solid Waste / Garbage

2.1 Type of solid waste

Estimated composition

- Food Waste _____% of total (estimated)
- Plastics / Packaging _____% of total (estimated)
- Paper _____% of total (estimated)
- Clear Glass _____% of total (estimated)
- Colored Glass _____% of total (estimated)
- Aluminum cans _____% of total (estimated)
- Other Metal _____% of total (estimated)
- Garden Waste _____% of total (estimated)
- Hazardous Waste (Battery / bulbs etc) _____% of total (estimated)
- Other (Specify)

2.2 Management of solid waste and utilities material

- Reuse back side of paper
- Anaerobic digestion of solid waste for generating methane (biogas)
- Solid waste segregation
 - Segregate wet waste from dry waste
 - Segregate hazardous waste from other solid waste
- Have separate garbage area
Area _____m² Storage Capacity _____m³
- Solid waste management practice
 - Incinerator on site
 - Send to municipal landfill
- Other (Specify)

2.3 Solid Waste Generation Data

Wet Waste

	Month	Total Quantity (m ³ /day)	Cost for disposal (Baht/Month)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Dry Waste

	Month	Total Quantity (m ³ /day)	Cost for disposal (Baht/Month)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

3.0 Air Emissions

3.1 Source

- Boiler
- Parking
- Other (Specify)

3.2 Air emission control

- Use low sulfur/special fuel oil for reduced emissions
- Have air emissions monitoring and control program
 - Other (Specify)

C Supporting Documentation *(Attach if available)*

Documents	Have	Don't have	Have but N/A	Remarks
<p>1.0 General</p> <p>1.1 Layout Plan</p> <p>1.2 Floor Plan</p> <p>1.3 Utilities</p> <ul style="list-style-type: none"> • HVAC (Heating&Ventilation&Air Conditioning • Domestic Hot Water System • Steam System • Chiller Water System • Machines Layout + Machine List for eng./workshop <p>1.4 Electrical</p> <ul style="list-style-type: none"> • Lighting Systems • Electricity for other appliances <p>2.0 Management</p> <p>2.1 Policy</p> <ul style="list-style-type: none"> • Mission Statement • Policy • Environmental Policy <p>2.2 Organizational</p> <ul style="list-style-type: none"> • Organization Structure/Chart <p>2.3 Ongoing Programs</p> <ul style="list-style-type: none"> • Good Housekeeping • Preventative Maintenance • Training • Operational Health & Safety • Inventory Control • Purchasing Policy <p>3.0 History / Background information about hotel</p> <p>4.0 Applicable laws and regulations <i>(w/w, boiler, transformer etc.)</i></p>				

List of Resources

Publications:

Ecolabels in Tourism Industry. UNEP-IE, 1998.

How the Hotel and Tourism Industry can protect The Ozone Layer. UNEP TIE, 1998.

Environmental Good practices in Hotels: Case Studies from the international Hotel and restaurant Association Environmental Award, UNEP IE/IHRA publication, 1997.

Environmental Action Pack for Hotels. UNEP-IE/IHRA/IHEI, 1995.

A Manual for Composting Organic Waste in Hotels. CUC UEM, 2000